European competitiveness report 2003

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Executive summary

This is the seventh edition of the Commission's Report on European competitiveness since the 1994 Industry Council Resolution that established the basis for the Competitiveness Report. Competitiveness is understood to mean high and rising standards of living of a nation with the lowest possible level of involuntary unemployment on a sustainable basis. The present Report continues the analysis of productivity developments initiated with the 2001 edition. It presents a comparison and a decomposition of productivity growth in Europe relative to the US. The use of hourly data on labour productivity, in addition to data on productivity by employed person, represents a novelty in comparison to previous editions.

Recent evidence suggests that the combination of organisational improvements with other types of enterprise modernisation measures, such as new ICT equipment, constitutes an essential characteristic of those firms that have experienced robust productivity growth. The Report reviews the theoretical basis for this and provides new empirical evidence from establishment level data from Germany. The Report also uses a new set of regional data to identify those factors, principally R&D– and knowledge–related ones, that appear to determine the performance of regions in terms of labour productivity growth (or regional competitiveness) in a sample of over 200 NUTS–2 EU regions.

Europe's industrial landscape is likely to change after the forthcoming EU enlargement. The Report examines the competitiveness of the acceding countries using indicators of productivity, labour costs and market shares, and discusses the likely impact of the enlargement on economic structures in a wider European Union.

Growth, productivity and employment

Economic growth in the EU slowed markedly in the aftermath of the Lisbon European Council of March 2000. More recently, growth in several Member States has slowed to a standstill. Compared to other slow growth periods, employment first remained more resilient with over 2.5 million jobs having been added in 2001 and 2002, but in 2003 employment stopped growing and unemployment began to rise. Many of the new jobs are part-time, leading to a decrease in average hours per worker. In an accounting sense, sustaining job creation (or preventing job destruction) during a slow growth period implies weak productivity growth. Indeed, in the past two years productivity per person employed increased by less than half a percentage point and per hour productivity by 0.9 % annually.

On average, growth rates in 2001-2002 were not dissimilar in the EU and in the US. However, labour productivity growth in the US remained resilient during this period of slow growth and into 2003. In the US, productivity per person employed and productivity per hour worked both rose by 1.6 % per year in 2001-2002. In the EU, productivity growth has been modest since the mid-1990s when productivity developments in the EU and in the US started to diverge. The cumulative US–EU difference in real GDP growth over the period 1996-2002 amounts to around 8 percentage points, while the cumulative difference in productivity growth amounts to 9 percentage points when measured per person employed and 4.5 percentage points when measured in terms of hours worked. Thus, the superior productivity performance of the US compared to the EU since the mid-1990s is not restricted to measures per person employed but also holds, albeit less markedly, for productivity measures based on hours worked.

In terms of the standards of living, measured by GDP per capita, growth rates in the US and in the EU have been comparable, both advancing cumulatively by some 14 percentage points during the

period 1996–2002. This reflects principally the higher population growth in the US compared to the EU during this period (almost 10 % in the US and around 2 % in the EU), which eroded the advantage of the higher real GDP growth in the US. Similar growth rates of GDP per capita implied that the gap between the EU and the US remained unchanged: in 2002, average GDP per capita in the Union was nearly 30 percent below that in the US.

Among the EU Member States, Ireland, Greece and Spain recorded real GDP growth rates significantly above the EU average in the most recent years. In contrast, growth was particularly slow in Germany. In the second half of the 1990s, growth accelerated to 2.7 % in the EU. While all the Member States except Germany registered an acceleration of growth, only Ireland, Finland and Luxembourg had growth rates higher than the US. Ireland, Greece, Finland, Austria, Belgium, and Luxembourg outperformed the US also in terms of productivity (per hour) gains in the period from 1996 to 2002.

Earlier editions of the Report have suggested that the deviation of the EU standards of living (measured by GDP per capita) from the US can be attributed principally to the lower employment rate in the EU and also to the lower EU labour productivity. The new data used in the present edition of the Competitiveness Report allow a finer disaggregation using the – in many ways superior – measure of hourly labour productivity. Data for 2002 show the EU/US gap in the standards of living amounting to around 30 percentage points (i.e. the EU at 70 percent of the US level). According to the Commission's Structural Indicators compiled by Eurostat, 13 percentage points can be attributed to higher hourly productivity in the US, 4 percentage points to lower average hours worked in the EU, and 12 percentage points to the lower employment rate in the EU.

Though other data sources point to different values for the contribution of the various elements used to decompose the EU/US gap in GDP per capita, the fact remains that independently of the source, the same variables – employment rate, hours worked and hourly labour productivity – account, not surprisingly, for the largest part, leaving virtually no role to the demographic factor. All three factors – average working time, the employment rate and the efficiency of work – are essential ingredients of policies to raise the standards of living.

The previous two editions of the Competitiveness Report suggested that investment and diffusion of information and communication technologies (ICT) have played an important role in the productivity revival in the US and that similar gains are still to be realised in the EU. The present Report re-examines the relevant data, looking in particular at the contribution of ICT capital to hourly labour productivity growth in the EU, the Member States and the US.

While the EU recorded annual hourly productivity growth more than 1 percentage point above the US growth rate during the period 1990–1995, the situation was reversed in the period 1996–2001 when average annual growth in the US exceeded that in the EU by some one third of a percentage point. The superior US performance in terms of hourly productivity growth was due to larger contributions from both capital deepening and total factor productivity growth; in the early 1990s, the EU had performed better than the US in both areas. Within capital deepening, the EU however recorded a higher contribution from non-ICT capital throughout the 1990s.

The contribution of ICT capital to the growth of hourly labour productivity was higher in the US than in the EU during both the first and the second half of the 1990s. In the first half of the 1990s, ICT capital contributed 0.2 percentage points to hourly productivity growth in the EU and 0.32 percentage points in the US. In 1996–2001, ICT contributed 0.34 points in the EU and 0.57 points in the US. Thus, the ICT contribution to productivity growth was not only higher in the US than in the EU, but it also increased by a larger amount after 1995. Among the EU Member States, the contribution of ICT investment to the acceleration of labour productivity between the periods 1990–1995 and 1995–2001 was largest in Ireland, Finland and Sweden and smallest in Portugal, Spain and Germany.

Until 1995, the EU converged rapidly towards the US level of hourly labour productivity. Subsequently, due to the superior US performance in the late 1990s, the gap widened again. In 2002, average labour productivity per hour in the EU was 13 percent below that in the US. In Luxembourg, Belgium and France, hourly labour productivity is higher than in the US while Ireland, the Netherlands and Italy have productivity levels comparable to the US.

Performance across EU nations differed in the 1990s. The only country that increased both productivity and employment faster than the US was Ireland. During the 1990s, Ireland surpassed the EU average in terms of GDP per head and in terms of productivity per hour (while it still remains below the EU average in terms of Net National Product and in wages per head). Of the catching-up countries, Greece and Portugal recorded above-average growth rates.

Among the countries with medium or high income, the performance of Sweden, Finland, the Netherlands and Denmark can be considered as particularly successful, allowing a combination of high wages and comprehensive welfare systems. The strategy of these countries – in addition to fiscal prudence and institutional reforms - has been to enforce education[1], research and the diffusion of new technologies, which are the main elements of the Lisbon strategy.

Among the larger countries, ICT played a large role in productivity growth only in the UK. In the UK, the level of hourly productivity remains low compared to the EU average, but employment has risen markedly in recent years. France spread employment by reducing working hours; it has a high level of productivity, while per capita income is slightly above the EU average. Germany is beginning to address more thoroughly the rigidities that have inhibited productivity and output growth and to implement the necessary structural reforms in order to restore the economy's ability to grow and generate jobs.

There are persistent differences in productivity, income, and working hours between the EU and US on the one hand and across the Member States on the other. The differences partly reflect different choices between income and leisure or are the result of different policy choices. Facilitating part-time work has successfully been used to increase the flexibility of labour markets and to raise the employment rate. For some workers, part-time work is preferred to full-time work, for others it is involuntary and limits earnings and upward mobility. Reducing the cost of low skilled labour, or limiting wage increases are other strategies to increase employment and the employment content of growth. Higher incomes can be achieved only by measures that increase the long-term growth potential of an economy. Removing growth barriers and investing in the future, i.e. in innovation, education and diffusion of new technologies, contribute to this. Each European country is facing a unique combination of structural constraints; some countries seem to be on track to increase productivity and employment. The Lisbon strategy provides a core set of policies to raise potential growth through research, education and the diffusion of new technologies. A precondition for this approach – as demonstrated by some of the smaller countries in the European Union – is to foster innovation, thus retaining flexibility for policies in a changing environment.

[1] References to investments in education should be interpreted in the wider sense of lifelong learning, embracing all aspects of education, including notably initial and continuing vocational training.

In the second half of the 1990s the EU underperformed the US both in labour productivity and in standards of living. The period 2001-2002 saw a partial reversal in these patterns. Standards of living in EU grew faster than in the US but the resilience of the US productivity performance contrasted with a halving of the EU's productivity growth leading to an increased productivity gap relative to the US. The counterpart of the EU's productivity deceleration was a rather resilient employment situation with job creation, in contrast with a decline in employment in the US.

The EU gap in standards of living relative to the US amounts to 30 percentage points of which 25 points can be attributed, in almost equal parts, to a lower employment rate and to a lower hourly productivity in the EU. This suggests that, to bridge the difference in standards of living between the two regions, the EU will have to rely on an improvement in both employment performance and in the efficiency with which labour is used in the production process.

The natural limits to long run increases in employment rates together with the increased weight of less skilled/lower productivity workers inherent to increases in the overall employment rate (at least in the short run), bring labour productivity developments to the centre stage of a sustainable long-term improvement in living standards. Despite the modest narrowing of the EU gap in standards of living in the period 2001-2002, the fact remains that sustainable long-term increase in living standards and convergence towards US levels will require a strong improvement in the productivity performance of the EU.

Structural reforms leading to more flexible labour and product markets, investments in innovation and education, further diffusion of new technologies are all crucial elements in reversing the present trends and bring productivity and employment to levels compatible with the competitiveness goals embedded in the Lisbon agenda.

Enterprise reorganisation and productivity growth

A growing body of literature and empirical evidence point to complementarities between information and communication technologies (ICT) on the one

hand and organisational capital (such as enterprise modernisation or new working methods) on the other. In order to exploit fully the potential of the new information and communication technologies, changes are needed in the way enterprises operate. Investments in organisational change may have been insufficient as enterprises may not have fully recognised their importance, or because of the high costs of organisational reform, often significantly exceeding the costs of acquiring ICT capital goods. Of the different types of organisational reforms, the Report looks at e-business applications and their effect on productivity growth.

Most large firms in the EU use some e-business applications such as enterprise resource planning or online procurement. Data from the *e-business watch* of the European Commission for four EU Member States (Germany, France, Italy and the UK) indicate that industries with a higher skill intensity or with a higher information technology intensity tend to use certain e-business applications – in particular knowledge management solution systems and customer relationship management systems – more frequently. The adoption of e-business applications is often accompanied by additional investments in hardware, software and training. The organisational changes which accompany the adoption of e-business applications can be substantial and may have an impact on virtually every business process or function within the organisation: applications such as enterprise resource planning require changes in the organisation chart, job descriptions, responsibilities, internal power structures, and in the organisation's culture.

Empirical analysis based on data from the *e-business watch* suggests that the frequency of the use of enterprise resource planning and online procurement across industries is positively correlated with labour productivity growth. On the other hand, no correlation was found between productivity growth by industry and the implementation of other types of e-business applications, such as supply chain management or customer relationship management.

Case studies and academic research also document cases where the implementation of enterprise resource planning failed. The failures were due to reasons such as inadequate complementary organisational reforms, poor project management, insufficient training or an underestimation of the time needed for the implementation.

An empirical analysis of firm–level data for Germany does not identify a unique reorganisation measure or bundle of measures that is available in the majority of establishments. Large establishments with training and ICT investments and modern equipment introduce organisational changes that increase the participation of employees. In addition, expected qualification gaps and anticipated increases in training efforts also have a positive impact on the propensity to change the organisation structure.

The analysis of German firm-level data looked at three types of organisational reform which increase the participation of employees: shift in responsibility to lower levels of hierarchy, introduction of teamwork and the establishment of autonomous work groups. The results indicate that the three measures complement each other and establishments that introduced all these measures have an additional productivity advantage. The simultaneous introduction of all three measures in the years 1996 or 1997 increased the average productivity of a representative sample of German establishments by 8 % in the period 1997-2000.

Finally, data from the Community Innovation Survey for Finland show a significant positive relationship between labour productivity growth by industry on the one hand, and the frequency of new or significantly changed organisational structures on the other. In other words, industries with an above-average growth rate of labour productivity, such as telecommunication services and electrical machinery, have a higher share of firms with new or significantly changed organisational structures. However, for the other EU Member States covered by the data (Germany, Austria and Sweden) this relationship is not statistically significant.

Evidence from the Community Innovation Survey also points to the complementary nature of different organisational changes. For all the four EU Member States covered by the data, there was a strong correlation between the frequency, across industries, of the implementation of advanced management techniques (which may include e-business applications such as enterprise resource planning or supply chain management) on the one hand, and the frequency of significant changes in organisational structures on the other.

Despite the widespread availability of different e-business applications, their adoption remains limited in particular in small enterprises. The European Commission has put forward policy recommendations to improve the managerial understanding of and the skills needed for e-business in SMEs, to promote the availability of

SME friendly e-business solutions, and to facilitate the effective participation of SMEs in electronic marketplaces and business networks.

Managers and system users need to acquire the skills required for a successful integration of e-business applications into the overall company operation. Enterprises can facilitate the adoption of e-business applications by providing training that gives attention to issues such as organisation culture and work organisation. Given the positive externalities associated with human capital, governments also have a role – in particular in the areas of tertiary education, worker training and lifelong learning. Some Member States, notably the UK, have already established SME business support networks, which typically aim at providing targeted knowledge and practical assistance to SMEs i.e. in their efforts to adopt e-business applications.

The key role of ICT in organisational change suggests a role for governments in the provision of a high quality ICT infrastructure. At the EU level, the e-Europe Action Plan has defined a roadmap to facilitate the transition to an information society throughout the Union and all the Member States. Governments can also disseminate information on the benefits and costs of ICT–enabled organisational change. This is particularly important for small and medium sized firms, as well as for firms in low skill intensive industries such as food and beverages; textiles; leather and clothing, which appear to be late adopters of e-business practices.

Regional aspects of competitiveness

The EU is characterised by substantial regional diversity in wealth, and competitiveness conditions differ substantially across regions. While a process of convergence has taken place, assisted by the contribution of the Structural Funds, this process has been slow and, therefore, fostering regional cohesion remains a critical policy challenge. The Report reviews some central issues about regional competitiveness in the EU. Regional competitiveness is understood as strong productivity performance, measured by regional GDP per hour worked.

Data constraints limit the number of available indicators, both across regions and across time, with which to undertake empirical analysis. However, a sufficient number of indicators were available to measure productivity in 15 sectors across the NUTS-2 regions over 1980-2000. Similarly, proxies were identified to measure the importance of knowledge in the regional economy.

Data analysis suggested a positive correlation of productivity with R&D intensity, specialisation in high-tech activities, and the number of students in tertiary education. Decomposition of regional productivity data showed that in the majority of successful regions, market services accounted for a large part of the recorded productivity gains.

The results also suggest that high productivity in one region is positively related to similar results in the neighbouring areas. Nevertheless, this does not mean that peripheral areas always exhibit low productivity and low competitiveness – in favourable circumstances, 'pockets of success' can exist in any location.

A negative relationship was found between productivity growth and its starting level, providing support for the hypothesis of (unconditional) regional convergence. In other words, regions which start off with lower productivity levels register higher productivity growth and gradually move closer to the productivity levels of the better performers. Econometric results support the hypothesis of productivity convergence across the EU NUTS-2 regions, both with a simple model structure (explaining growth only by catch-up effects) and a more complex formulation (allowing for other knowledge-based factors such as R&D expenditure and workforce skills). Nevertheless, the pace of convergence is very slow and substantial disparities still remain across the regions.

Additional case study work was performed on five successful regions: Oberbayern and Darmstadt in Germany, Sterea Ellada in Greece, Île de France in France and Niederösterreich in Austria. These regions were selected since their productivity performance was stronger than one would expect on the basis of their levels of R&D expenditure and other knowledge-based indicators, and after accounting for possible catch-up effects. Analysis of the regions revealed characteristics which were not captured in the empirical work but were likely to have contributed to a strong productivity performance. These included:

— Good connections to all major forms of transport, in particular access to an international airport, and a modern telecommunications network;

— A strong entrepreneurial culture that provided a bridge between research undertaken in universities and innovation activity in business;

— The presence of high-tech clusters in areas such as bio-technology;

— An active public authority which provided links between the academic and business communities and promoted the region in the face of forthcoming challenges;

— Spillover effects from networking, and a common vision among regional stakeholders.

The fastest growing regions host enterprises that have successfully integrated into the international competitive system. The role of public policy has been subtle but critical in the successful regions, providing an infrastructure which supports business innovation. The evidence of the Report points to a role for the EU and the Member States in continuing to remove barriers to trade and to open up regions to competition across the Internal Market.

The evidence on the importance of human knowledge in raising regional competitiveness is varied, often difficult to tie down but ultimately compelling. The fastest growing regions are those with enterprises which are better at harnessing human knowledge. This is supported both by the cross–regional statistical analysis and by the case studies. The success of clustering in the high technology and especially in biotechnology industries also points to the importance of human knowledge factors. Clusters not only confer advantages through common access to human knowledge resources, such as the science and research base of higher education, or indeed capital resources, but also facilitate inter-firm communication and entrepreneurial activity.

Public support for improved competitiveness can come from concerted programmes operating at different levels, ranging from pan-European to regional, and covering associated physical and non-physical infrastructure requirements. Such support should aim at better transport and communications infrastructure and at fostering a regional entrepreneurial culture that allows businesses to build close links with well-funded and well-organised networks of, especially science-based, higher education institutions. Policy support at regional level appears critical in the better-performing regions. Support at regional level is instrumental in making regional stakeholders subscribe to a common vision and public-private partnerships help taking this vision forward.

Though productivity levels across regions have converged at least since the 1980s, the differences are still very significant and invite a reflection on the possible factors of success for regional competitiveness. A positive association between productivity and a number of variables measuring the potential in terms of knowledge-based activities – such as R&D intensity, human capital and specialisation in high-tech activities – indicate the importance of a knowledge base for regional competitiveness. The analysis also suggests the presence of spillover effects across adjacent regions showing that proximity matters.

The study of particularly successful regions identifies a number of common features likely to have played a crucial role in their productivity developments. Again, knowledge is given a pivotal role, as is the ability to establish links between academic work and innovation at the firm level – both through active public support and by means of a strong entrepreneurial culture. The common thread appears to be the potential to connect the different economic actors – both in the physical sense through good transport and communication networks and in a more intangible way through a common vision among regional stakeholders as well as through collaboration between the academic and the business world.

These findings suggest a number of policy areas where action would help addressing the still significant competitiveness differentials. The identification of knowledge factors as engines of success makes the development of policies supporting innovation and knowledge-base activities, as well as those ensuring that human capital is available to exploit the innovation potential, instrumental in speeding up the process of regional convergence. To enlarge the positive effects of these knowledge-supporting policies, clustering of knowledge-based and innovative activities should be encouraged to take advantage of spillover effects. Equally important is to make sure that the Internal Market functions well across all regions and that they are effectively open up to competition.

Enlargement and competitiveness of manufacturing

While the process of integration across the candidate countries and the present EU members has already advanced significantly, the forthcoming EU enlargement will imply further changes in Europe's industrial landscape. The Report reviews the likely

implications of the accession of eight Central and East European countries for the manufacturing industry in an enlarged Europe.

The acceding countries underwent a pronounced process of systemic change and structural adjustments during the 1990s. The strengthening of their trade and production links with Western Europe played a major role in this process. Major shifts of resources between the main sectors of the economy have brought the broad economic structures of the acceding countries closer to those in EU-15.

Closer integration of the acceding countries following their entry into the EU will contribute to raising productivity and competitiveness in the Union as a whole. Although the overall production and trade volumes of the acceding countries are too small to have large aggregate effects on prices, employment and production in the EU, specific regions and sectors are likely to be affected. The acceding countries are likely to become more attractive as investment locations and can increasingly exploit their cost advantages. Enlargement could lead to some production re-location to the acceding countries – not necessarily only from the present EU Member States – and to more pronounced patterns of specialisation according to comparative advantage. Industries within the enlarged EU are likely to expand where internal or external economies of scale are important.

Since 1995, economic growth in the acceding countries has exceeded that in the EU, marking the start of a catch-up process. Productivity growth (GDP per employed person) in the acceding countries accelerated strongly during the 1990s, but this was to a large extent linked to declining employment. Low employment growth, as well as low employment levels in some acceding countries, constitute a major policy challenge. Although productivity catch-up has taken place, with particularly strong gains in the manufacturing industry of the acceding countries, average labour productivity in these countries is still only half that in EU-15. Prospects for further catch-up remain uneven across countries and industries.

For the manufacturing sector as a whole, complying with the existing stock of EU legislation, the *'acquis communautaire*', will not be easy and will require additional investments. While foreign direct investment has contributed to modernisation and has brought new management skills into the acceding countries, the ability of many domestically owned enterprises to cope with increased competition in the Single Market remains weak.

Some of the acceding countries have dramatically reduced – or even completely lost – their specialisation into labour–intensive, low-skill branches and made some inroads into technology–driven and skill–intensive branches, while others have been 'locked in' in labour–intensive, low–skill sectors. The present industrial structure in the majority of the acceding countries is between that of the industrially less advanced southern EU (Greece, Portugal and Spain) and that of the more advanced large Member States (Germany, France, Italy and the UK).

The ten Central and East European acceding and candidate countries – the eight countries acceding in May 2004 together with Bulgaria and Romania – account for 21 % of all manufacturing jobs in an 'enlarged EU' comprising themselves and the present 15 EU members. Excluding Bulgaria and Romania, their employment share is 15 %. The largest employers are the food and beverages industry, textiles, basic metals and fabricated metals, as well as mechanical engineering.

The ten Central and East European acceding and candidate countries account for about 11 % of total manufacturing production (using purchasing power parities) in an area comprising themselves and the present EU-15. However, their share is larger in industries such as wood products and furniture, non-metallic minerals, as well as food and beverages. In contrast, paper and printing, chemicals, machinery and equipment, as well as electrical and optical equipment have a smaller weight in total manufacturing than they have in EU-15.

Productivity growth in manufacturing in recent years has outpaced that of EU-15 by more than 6 percentage points per year and the process of productivity convergence is bound to continue. But in contrast to EU-15, where manufacturing employment has remained stable, productivity catch-up in the acceding countries has been associated with persistent job losses. Among the individual industries, the best productivity performance was recorded in the electrical and optical equipment industry, followed by transport equipment and furniture. Weaker productivity growth was registered in food and beverages, textiles, leather, wood products, paper and printing and chemicals. In general, industries which are technologically more sophisticated have strongly improved their productivity performance, while traditional sectors using standard techniques and low-skilled labour have been falling behind.

Overall labour costs in the ten Central and Eastern European acceding and candidate countries are so

low that the cost advantage more than compensates for their lower productivity relative to the present EU-15. Unit labour costs vary between 17 % (Bulgaria) and 72 % (Slovenia) of the EU-15 average. If the current productivity catch-up continues and if wage increases remain moderate, the acceding countries can further improve their unit labour cost competitiveness. Such competitiveness gains have already been registered in sectors which have successfully been restructured. Enterprises with foreign participation have posted particularly strong performance in terms of productivity growth and related cost advantages. Nevertheless, appreciation of the currently undervalued currencies of some acceding countries could partly or wholly offset the gains in terms of unit labour costs.

During the 1990s, trade integration between the EU and the acceding and candidate countries in Central and Eastern Europe progressed swiftly. In most sub–sectors of manufacturing, trade with EU-15 already accounts for a very high share of the total. Manufacturing trade of the Central and East European acceding and candidate countries with EU-15 has become increasingly focused on a few key industries: textiles and textile products, basic metals and fabricated metal products, electrical and optical equipment and transport equipment. Over the 1995-2001 period, these countries gained market shares in a wide spectrum of industries, largely at the expense of France, Germany, Sweden, Belgium and Denmark (Austria, Spain, Ireland and Portugal also increased their market shares in total EU trade). There is ample evidence of growing intra-industry trade, especially between the more advanced acceding countries and EU-15, and of product and quality upgrading of the exports of the more advanced acceding countries.

Following major economic transformations after the early 1990s, the economic structures of the acceding countries in Central and Eastern Europe are now much more similar to those in the EU-15 than they were ten years earlier. The previously small services sector has grown in importance; the most advanced acceding countries have shifted their production towards more sophisticated technology-intensive industries and upgraded their exports' product quality. Despite these encouraging developments some challenges remain.

In the Central and East European acceding and candidate countries, the export-oriented industries – often dominated by large enterprises and where largest FDI flows have gone – are relatively well prepared for the EU acceding. In contrast, there are still major challenges in many domestically oriented industries and, in general, small businesses are still not well aware of the changes which EU membership will require.

The low level of unit labour costs gives a competitive advantage to the Central and East European acceding countries. Major currency realignments, or wage convergence towards EU-15 levels over and above a productivity catch-up, may risk undermining the cost advantage.

In terms of overall manufacturing competitiveness, the ten Central and East European acceding and candidate countries fall into two groups. Countries in the first group, with higher labour productivity and higher wages, are increasingly shifting their production specialisation towards technology-driven high-skill industries. The second group - the Baltic States, Bulgaria and Romania - displays lower productivity levels and competes essentially on the basis of lower labour costs. There is a danger that the countries in the second group might be locked in labour-intensive or natural resource-intensive patterns of production.

The impact of enlargement on enterprises in the present EU-15 is likely to be largest in the areas bordering the acceding countries, in particular Germany and Austria. In the long run, the relatively high human capital endowments of the acceding countries should allow them to compete in principal with the industries located essentially in the Northern EU-15 members. Analysis of recent trade flows however points to a relative specialisation of the acceding countries in capital- and labour-intensive production; in the latter industries they would compete in particular with Greece and Portugal.

Introduction

This is the seventh edition of the Commission's Report on European competitiveness since the 1994 Industry Council Resolution that established its basis. As in previous editions, competitiveness is understood to mean high and rising standards of living of a nation with the lowest possible level of involuntary unemployment on a sustainable basis. The present Report continues the analysis of productivity developments initiated with the 2001 edition and continued in the 2002 Report.

The present edition consists of five topics. First, there is a comparison and decomposition of productivity growth in Europe and the US. Secondly, recent evidence suggests that the combination of organisational capital with other types of enterprise modernisation measures constitute an essential characteristic of those firms that have experienced robust productivity growth. The Report reviews the theoretical basis for this and provides new empirical evidence from sectoral and establishment level data from Germany. Third, the Report also examines empirically, on the basis of a new set of data, some hypotheses derived from recent developments in economic geography. The purpose here is to identify those factors, principally R&D intensity and knowledge–related ones, that appear to determine the above–average performance of regional labour productivity growth (or regional competitiveness) in a sample of over 200 NUTS–2 EU regions. Fourth, as Europe's industrial landscape is likely to change, perhaps radically, after enlargement, the Report examines various aspects of the enlargement process and discusses the likely impact of the enlargement on economic structures in a wider Europe.

The Competitiveness Report is one of several Commission instruments directed at analysing competitiveness developments in the EU. The importance of competitiveness has been explicitly recognised in the EU's growth strategy, the Lisbon strategy. The ultimate goal of the Lisbon strategy is for the EU to become, by the end of the present decade, the most competitive and dynamic knowledge–based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion. Achieving this goal clearly requires durable and strong productivity growth sustained over a number of years.

The emphasis of the Lisbon strategy on structural reform and renewal, and on competitiveness that is based on science and on knowledge, provides a new direction for the EU. It clearly recognises that the old structures and the old ways of thinking about economic growth have become less relevant for the EU of the 21st century. Indeed, for an advanced industrial economy such as ours the sources of economic growth and of prosperity must be found in our intangible resources – knowledge, science, entrepreneurship and risk taking – on which we need to build to enable us to achieve our ambitious social and environmental objectives. The need for reform is clearly all–encompassing, extending beyond the economic and into the social and environmental fields.

The forthcoming enlargement, while presenting us with many opportunities, also adds to the challenges that the EU is confronting almost midway into the Lisbon strategy. The strategy, of course, remains very relevant for the acceding nations where the needs for reform and modernisation are perhaps most marked. Attaining the objectives of the original Lisbon vision has now become urgent, and decisive progress must be made, especially in the present EU Member States, if the goals are to remain attainable.

In the period since the Lisbon European Council of March 2000 economic developments in the EU have

been disappointing. The Lisbon European Council saw at the time that "the Union (was) experiencing its best macro-economic outlook for a generation". The reality has been far from this assessment. The EU has since been under–performing without much of secure evidence that the outlook will improve decisively in coming quarters. Even more worrying has been the substantial slowdown in productivity growth that has been registered in several Member States including the larger ones. Clearly, without a reversal of these trends, the ambitions of the EU will not be realised and the challenges ahead will be difficult to surmount.

Previous editions of the Competitiveness Report have discussed the issue of the slowdown of productivity growth in the EU using data on output per person employed across the EU and in the Member States and notably in comparison with the US. The present Report continues this reflection, examining different aspects of the productivity performance of the EU.

Chapter 1 discusses EU/US and Member States productivity comparisons and presents an empirical analysis. Using data for 2002 from the Groningen Growth and Development Centre and from the Structural Indicators, the EU/US gap in the standards of living amounts to around 30 percentage points (the EU variable was around 70 percent of the US variable). Between 8 (Groningen) and 13 (Structural Indicators) percentage points can be attributed to higher hourly productivity in the US, between 15 (Groningen) and 4 (Structural Indicators) points to lower average hours worked in the EU, and between 6 (Groningen) and 12 (Structural Indicators) points to the lower employment rate in the EU. Similar remarks can be made for each of the Member States.

This chapter also discusses the apparent conundrum of "having to choose" between employment and productivity growth and uses examples from the Member States to highlight some policy choices. There might, however, be some temporary trade-off in that with the growing share of low-skills services sector in GDP the inevitable might be that productivity growth in the EU would remain weak. Raising the standards of living through an increase in the employment rate is a key aspiration of the Lisbon strategy but it is important to recognise that there are limits to the extent this can be sustained over the medium term. After all, there is a finite volume of labour input (employment and hours worked) that can be mobilised out of a given labour force, thus leaving productivity growth as the single most important determinant of the growth in the standards of living over the medium term.

Chapter 2 reviews the literature and provides evidence on the complementarity of ICT applications and enterprise re-organisation. The key idea is that ICT–type innovations will not yield their full productivity benefits unless they are accompanied by investment in organisation capital. Enterprises that invest in ICT applications must also invest in complementary organisational changes to make effective use of the potential of new technologies.

The Report examines the specific role of e-business applications in promoting productivity growth. Most large EU firms use e-business applications often accompanied by complementary investments in hardware, software and training. Sectoral data for Germany, France, Italy and the UK suggests that there is positive correlation between the use of some types of organisational initiatives and labour productivity growth, and that certain e-business applications are positively correlated with either sectoral skill intensity or information technology intensity. Also, industry data from Finland show that there is a positive relation between labour productivity growth and the percentage of enterprises with new or significantly changed organisational structures, but this relationship is not supported in data from other EU Member States.

The key role of ICT in organisational change suggests that governments must ensure the provision of an efficient infrastructure, especially a high quality ICT infrastructure, in view of the externalities involved. Finally, firm–level data from Germany indicate that the simultaneous introduction of three organisational measures – teamwork, autonomous work groups and the reduction of hierarchies – in the years 1996 or 1997 increased the average productivity of a representative sample of German establishments by 8 % in the period 1997-2000.

Chapter 3 of the Report examines regional aspects of competitiveness. Regional competitiveness is understood to mean productivity, that is, regional GDP per hour worked. The scope of the analysis is limited by the availability of indicators, although indicators were available to measure productivity of 15 sectors across the NUTS-2 regions over 1980-2000, and to identify a selection of knowledge-based proxies such as R&D expenditure, and students enrolled in higher education.

Decomposition of the regional productivity data shows that the majority of successful regions (those with higher than average productivity growth) were supported by large contributions from market services – in particular other market services and financial intermediation. Correlations suggest that productivity

growth is positively related to R&D intensity, specialisation in high-tech activities, and the proportion of students in tertiary education. Productivity growth is negatively related to its starting level, indicating that a process of regional convergence is underway. Furthermore, the data indicate that spillover effects are likely to be present and that high productivity in one region is positively related to similar results in neighbouring areas. This does not mean that peripheral areas always exhibit low productivity and low competitiveness, as pockets of success can always emerge if the conditions are right. Evidence from more detailed analysis of five "outlying" regions reveals that a range of factors have likely contributed to a superior productivity performance.

The evidence also reinforces the key role of the EU and the Member States to continue to remove barriers to trade and open up regions to competition across the Single Market. Problems of peripheral regions need to be specifically addressed through improved transport and communications, especially telecommunications, and policy everywhere needs to address human capital requirements.

Chapter 4 examines the implications of the forthcoming enlargement and, in particular, its likely implications for the manufacturing industry in an enlarged Europe. The EU enlargement could cause production re-location to the acceding countries and an improved resource allocation. Industries within the enlarged EU are likely to expand where internal or external economies of scale are important, while the acceding countries could become more attractive as investment locations and will increasingly exploit their cost advantages. An even closer integration of the acceding countries following their entry into the Union will help to raise productivity and competitiveness in the EU as a whole.

In recent years, significant sectoral shifts have taken place in the acceding countries bringing their structures closer to the broad economic structures in the EU. The productivity catch-up has been especially pronounced in manufacturing industry even though levels of labour productivity are still less than half of the EU average. The majority of the acceding countries have an industrial structure that is positioned somewhere between the industrially less advanced southern EU countries (Greece, Portugal and Spain) and the more advanced northern Member States (Germany, France, Italy and the UK).

Productivity growth in manufacturing in recent years, closely linked to employment losses, has outpaced that of the EU by more than 6 percentage points per year and the process of productivity convergence is bound to continue. Labour cost gaps in acceding countries relative to the EU are much larger than gaps in productivity, implying substantial cost advantages in terms of unit labour costs. Productivity growth and related cost advantages have been particularly high in enterprises with foreign investment participation.

During the 1990s, trade integration between the EU and the acceding and candidate countries in Central and Eastern Europe progressed swiftly. Over the period 1995-2001, the latter group of countries has gained market shares in a wide spectrum of industries, gains that occurred largely at the expense of market shares of France, Germany, Sweden, Belgium and Denmark.

Some of the Central and Eastern European acceding or candidate countries have dramatically reduced (or even reversed) their specialisation in labour–intensive, low-skill branches and made some inroads into technology–driven and skill–intensive branches. Others, however, show specialisation structures that are 'locked in' in the labour–intensive, low–skill sectors. While accession will not bring about additional dramatic changes for industry, owing to the already high degree of integration, there will be some sectors and regions that might be adversely affected.

Chapter 1: Growth, Productivity and Employment

1.0 Introduction

The European economy is currently in the midst of a slow growth period, with some countries in recession. Overall growth in the European Union was about 1.3 % in each of the past two years while, according to the Commission's Spring 2003 Economic Forecasts, growth in 2003 is estimated at around 1 %. Compared to other slow growth periods, employment proved to be rather robust, increasing at about 0.9 % per year and creating 2.6 million jobs in two years. However, there has been low growth in labour productivity.

Economic growth continues to be higher in the United States. Real economic growth was lower in 2001 but in 2002 and in 2003 US growth will again be higher than in the European Union. In contrast to Europe, US growth was determined primarily by an increase in productivity, while employment was stagnant. This reflects both substantial layoffs in the formerly booming ICT sector and the high utilisation of labour. Employment increased by 20 million or 16.7 % in the 1990s, and the employment rate increased from 73.5 % to 75.1 %.

This chapter discusses comparisons of productivity and employment growth in Europe and the US in recent years and investigates country differences across these variables within the EU. Comprehensive studies on the EU-US comparisons and on determinants of growth differences are available in previous Competitiveness Reports[2] and in the literature, as shown in Box 1.1. This chapter provides new evidence based on new data. In particular, it provides a comparison of EU performance against that of the US in per capita income, productivity per person employed and per hour worked. Conflicting data have been presented in the past on these important indicators of the standards of living. Moreover, the chapter reviews the determinants of productivity growth over the past decade in the EU, in the Member States and in the US and, in particular, the role played by information and communication technology (ICT) in these differences.

A widely accepted definition of competitiveness is the ability of an economy to provide its population with high and rising standards of living and a high level of employment for all those willing to work on a sustainable basis. The central ingredient of competitiveness is productivity growth. Raising productivity growth in a sustainable manner and increasing the rate of employment over the medium term constitute crucial (albeit not the only ones) objectives of the Lisbon strategy.

The present chapter is organised as follows: Section 1.1 reviews some recent evidence over the period 2001 – 2002 on developments in productivity and uses data on productivity per hour worked for the EU and the US for this purpose. Section 1.2 discusses developments in 2002 in output per capita, output per person employed and output per hour worked and it also takes a longer term perspective over the past quarter century on the growth rate of these variables as well as on employment trends. Reviewing data spanning a longer term period is important since many impressions about productivity developments and a widening of differences between the EU and the US have been based on data for the second half of the 1990s. This section also reviews more detailed evidence by Member State and considers the question of convergence between the EU and the US.

Section 1.3 examines the role of information and communications technology (ICT) in productivity growth and provides a comparison, in greater detail than in previous editions of the Competitiveness

2 See in particular European Commission (2000a, 2001 and 2002a).

Box 1.1: Recent studies on cross-country differences in economic growth

Author/Institution	Title	Scope	Additional features
Aiginger, K., European Forum at Stanford University, Working Paper 2/2002	The New European Model of the Reformed Welfare State	Analysing performance differences in Europe & determinants	Excellent performance of reformed welfare states with specific innovation policy
Aiginger, K., Landesmann, M., WIFO Working Papers 179/2002	Competitive Economic Performance: The European View	Productivity comparison EU vs. US: determinants on prospect	Impact of differences in industry structure
Ark Van et al., GGCG, 2003	ICT Investments and Growth Accounts for the European Union 1980-2000	Contribution of ICT or growth in EU and US	Structural impact in product and labour markets may limit growth
European Commission, 2003a	Choosing to grow: Knowledge, innovation and jobs in a cohesive society	Progress of Lisbon Strategy	Role of knowledge, innovation and jobs
European Commission, European Economy 6, 2002b	European Economy	Structural reforms in labour and product markets	Impact of reforms on GDP and employment growth
European Commission, European Economy 6, 2002b	The EU Economy 2002 Review	Macroeconomic Development	Convergence of Accession countries
European Commission, European Economy 71, 2000b	The EU Economy 2000 Review	Is there a new pattern of growth emerging?	Prospects and challenges for Europe
European Commission, 2002a	European Competitiveness Report 2002	Productivity growth in services	Human capital, environmental performance
European Commission, 2001	European Competitiveness Report 2001	Productivity and innovation	Increasing gap to US; industry study on biotechnology
European Commission, 2000a	European Competitiveness Report 2000	Competition in quality	Industry study on service inputs, pharmaceuticals
Gordon, R.J., Northwestern University, 2002	Two Centuries of Economic Growth: Europe Chasing the American Frontier	Performance Europe vs. US in the long and short run	Specific differences in per capita and per hour performance
McMorrow, K., Roeger, W., European Commission, Economic papers no 150, 2001	Potential Output: Measurement Methods	New Economy effect on potential growth	Growth scenarios for the EU and the US
OECD, 2003	The Sources of Economic Growth in OECD Countries	Econometric evidence and growth determinants	Impact of regulation and public sector human capital
OECD, 2001	The New Economy: beyond the hype, Final report on the OECD Growth Project	Explaining differences in growth performance of OECD countries	Policy conclusions
Pichelmann, K., Roeger, W., Review of International Economics, 2003 (forthcoming)	The EU Growth Strategy and the Impact of Ageing	Impact of ageing on growth and stability pact	Changes in work incentives needed

Report, of the performances in the EU, the Member States and the US. A novel aspect of this work is a decomposition of hourly productivity acceleration in the second half of the 1990s compared with the first half of the decade into the contribution of ICT capital, non-ICT capital and total factor productivity growth. While the overall characteristics of EU productivity growth in recent years, as reported in the 2001 and 2002 editions of the Competitiveness Report, are confirmed once more the analysis provides some new and interesting insights.

One key reason for the lower level of GDP per capita in the EU is that work time is shorter than in the US. This is both a policy and a choice variable. Given the importance of this factor, section 1.4 considers policy choices and strategies about the employment rate and the labour content of growth, and discusses the policy efficiency of measures implemented to facilitate the employment of women or of low wage workers. Finally, section 1.5 summarises and concludes.

1.1 Evidence from 2001-2002: EU, US and the Member States

EU and US

There has been considerable debate among growth economists over the reality of a lasting rebound in global productivity growth in the US since 1995 and the so-called emergence of a "new economy" based on production and diffusion of information and communication technologies (ICT). In parallel, there are significant questions about the apparent inability of the EU to profit from the possibilities offered by IC technology[3].

Critics of the "new economy" paradigm believe that the period of 1995 to 2000 is exceptional (see debates in Gordon, 2000, Oliner and Sichel, 2000). Yet, despite scepticism, and notwithstanding the stock market bubble associated with "new economy" exuberant expectations, the evidence from US data confirms that there has been a substantial productivity renaissance in the US since the mid-1990s.

Data for 2001 and 2002 show that labour productivity growth in the US has remained strong[4]. Yet, this period is very different from the high growth period of 1995-2000. In 2001-2002 real GDP growth in the US was 1.3 % after a 4 % increase per annum in the second half of the 1990s (see Table 1.1). Population increased by 0.9 %, thus limiting GDP per capita growth to 0.3 %.

GDP per employee on the contrary rose by 1.6 % reflecting principally a substantial decline in employment. With stable hours worked per employee, output per hour worked in the US rose also by 1.6 %. These developments contrast with long-term trends, where growth in income is higher than productivity growth (see Table 1.1 and Section 1.4), with employment increasing faster than population. On the basis of the conventional productivity cycle one would have predicted a decrease in productivity at the beginning of a recession (2001), but it appears that US firms have reacted quickly by laying off workers in this cycle. At the same time, it is clear that with fewer workers in employment, output per person employed and per hour increased relatively fast as compared to the slow growth of output. This suggests that previous organisational and technological investments on the part of US enterprises are ultimately paying off in the form of continuous and robust productivity growth during the downturn.

Economic growth in the EU was higher than in the US in 2001 but lower in 2002, averaging around 1.3 % during this two-year period in either of the two regions. With stagnant EU population growth (0.3 %), GDP per capita growth was 1 %. EU employment growth was 0.9 % and GDP per person employed increased by 0.4 %, that is, substantially less than the growth recorded in the US. While the shortfall of EU productivity growth relative to the US was somewhat less in terms of hours worked (0.9 % against 1.6 %) the cumulative growth of US hourly productivity over the period 1995-2002 surpassed the corresponding EU growth by nearly 4.5 percentage points.

Graph 1.2 shows trends in EU and US productivity per hour worked since the mid-1980s to 2002 that confirm that the EU convergence towards the level of US productivity, which advanced rapidly until 1995, has come to an end and a divergence is now characterising the data. Indeed, during 2001-2002 a more marked divergence in productivity developments has emerged (1995 has been selected as the base year in Graph 1.2 to reflect the beginning of this divergence).

3 The impact of ICT is discussed in Section 1.3 of this chapter and in Chapter 2; Ark van (2000), European Commission (2001), Aiginger and Landesmann (2002) and OECD (2001), among others, credit ICT with an important role in the acceleration of productivity growth.

4 According to the Bureau of Labor Statistics' estimate (6 March 2003) US hourly labour productivity in the business sector rebounded in 2002 to 4.8 %, a record surpassing all of the past records since the end of WWII (except 6.9 % in 1950) after a 1.1 % increase in 2001, which was a recession year. This increase for 2002 results from a 2.7 % increase in output and a strong decline in hours worked (2.1 %).

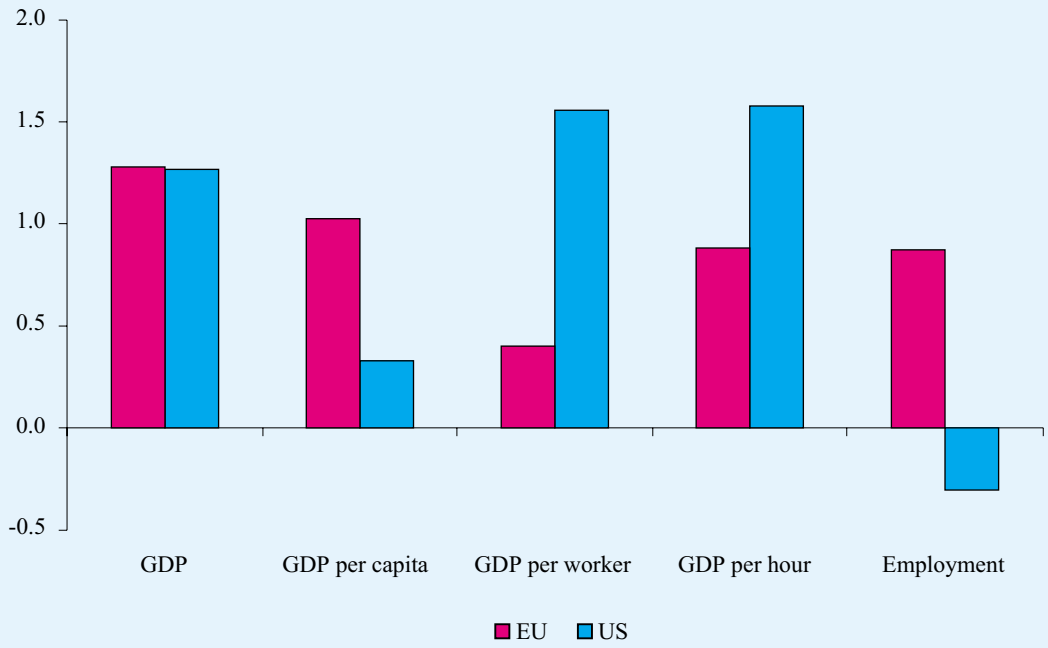
Table 1.1: Trends in GDP employment and productivity growth: US and EU

	Growth of									
	Real GDP		GDP per capita		Productivity per worker		Employment		Productivity per hour	
	EU	US	EU	US	EU	US	EU	US	EU	US
1990	3.03	1.75	2.43	0.67	1.83	0.50	1.19	1.24	2.06	1.08
1991	1.89	-0.50	1.21	-1.54	2.36	0.41	-0.47	-0.90	3.57	1.04
1992	1.20	3.06	0.98	1.96	2.09	2.39	-0.87	0.66	2.30	2.89
1993	-0.35	2.67	-0.81	1.59	1.20	1.16	-1.53	1.49	1.70	0.29
1994	2.79	4.08	2.44	3.07	2.94	1.71	-0.14	2.33	2.86	1.10
1995	2.46	2.70	2.16	1.75	1.71	1.19	0.74	1.50	1.86	0.39
Growth p.a. 1990-1995	1.59	2.39	1.19	1.35	2.06	1.37	-0.46	1.01	2.46	1.14
1996	1.67	3.61	1.39	2.66	0.97	2.13	0.69	1.45	1.02	2.21
1997	2.59	4.43	2.21	1.58	1.79	2.13	0.78	2.25	1.86	1.58
1998	2.91	4.28	2.68	3.07	0.88	2.77	2.02	1.47	0.94	1.92
1999	2.66	4.11	2.41	2.93	0.89	2.54	1.76	1.54	1.29	2.09
2000	3.45	3.75	3.17	2.63	1.61	2.43	1.81	1.29	2.03	2.05
Growth p.a. 1995-2000	2.66	4.04	2.37	2.57	1.23	2.40	1.41	1.60	1.43	1.97
2001	1.63	0.25	1.36	-0.69	0.29	0.35	1.33	-0.10	1.29	0.38
2002	0.95	2.30	0.71	1.36	0.52	2.81	0.43	-0.50	0.47	2.81
Growth p.a. 2001-2002	1.29	1.27	1.03	0.33	0.40	1.58	0.88	-0.30	0.88	1.59
Accumulated growth 1995-2002	16.95	25.00	14.74	14.30	7.15	16.16	9.15	7.60	9.23	13.78
Growth p.a. 1995-2002	2.26	3.24	1.98	1.93	0.99	2.16	1.26	1.05	1.27	1.86

Source: WIFO and CEPII calculations using data from Groningen Growth and Development Centre (GGDC web site at http://www.eco.rug.nl/ggdc/homeggdc.html).

Graph 1.1: Growth of real output and productivity, EU and US

(Average annual increase in percent, 2001-2002)



Source: WIFO calculations using data from the Groningen Growth and Development Centre.

Box 1.2: Convergence paths of EU to US performance: Some illustrative scenarios

In order to make the data presented in Table 1.1 more concrete and to understand their implications for the possibility of convergence of the EU towards the US variables, three hypothetical questions can be asked. The answer to each question is based on the data used in the chapter.

A word of caution is in order here. The answers to these hypothetical questions (in particular questions I and III) should in no way be seen as describing a real situation and have by no means any forecasting merit. These are illustrative scenarios based on mechanical extrapolation of current trends. However, they are enlightening because they show (in perhaps a dramatic manner) the extent of some challenges if the present trends are not reversed. Another important caveat is that these exercises have been run for the EU–15. Should the EU–25 level be considered, two aspects would have to be factored in. First, given the significantly lower standards of living (and productivity) levels in the acceding nations, the enlarged EU average is lower and therefore the answers to the questions would have to be revised accordingly. Specifically, the catching–up process with the US will be harder, or will take longer, for the enlarged and on average poorer EU–25. On the other hand, this lower starting level of the new Member States is likely, by the convergence hypothesis, to be associated with a faster growth rate of these countries relative to the incumbents and therefore it is reasonable to expect higher growth rates for the enlarged EU.

The questions

I — Time required to double the standards of living (GDP per capita)

On the assumption that GDP per capita in the EU will grow on average at the same pace as during the period 1996-2000, how long will it take until the standards of living in the EU double?

Table I: How long will it take to double the standards of living

Growth during	GDP per capita (%) (annual growth rate)		Years before doubling	
	EU	US	EU	US
2002	0.71	1.36	98	51
2001-2002	1.03	0.33	68	210
1996-2000	2.36	2.57	30	27
1996-2002	1.98	1.93	35	36

Table I answers this question for the EU and the US using growth rates over different periods[4]. Between 1966 and 2000 the US has enjoyed a doubling of its standards of living as have most EU Member States during the same period (GDP per capita in the US rose from USD 15 900 in 1966 to USD 31 700 in 2000. Data for the EU are not easily available, but for each Member States they do exist).

Depending on the growth rate used, the time it would take for the standards of living to double again in the EU varies between almost a century – if growth proceeds at the 2002 pace – and a mere 30 years if the situation during the period 1996-2000 can be replicated in the future. The US would have to wait as much as over two centuries to double it standards of living if the sluggish pace of the period 2001-2002 (due to a negative performance in 2001) persists into the future. If, on the contrary, the good performance of the period 1996-2000 materialises in the future, 27 years would be enough for the US to have twice its present GDP per capita.

II — Additional growth required for catch up

Given the present divergence in the standards of living between the EU and the US by how much should the EU outperform the US in order to catch up 20 years from now? Similarly, by how much should the EU outperform the US in order

[5] The number of years before doubling (n) is computed as $n = \ln 2 / \ln (1+r)$ where r is the growth rate used.

to reach the same level in productivity per worker (GDP per person employed) and in productivity per hour (GDP per hour worked)?

Table II: By how much should the EU outperform the USA

For catch up within:	Standards of living (%)	Productivity per worker (%)	Productivity per hour (%)
20 years	1.62	1.2	0.34
50 years	0.65	0.48	0.14

In 2002, GDP per capita in the EU was 71.7 % of the corresponding level in the US. For the standards of living in the EU to catch up with those in the US within the coming 20 years, the EU would have to experience, on average, an annual growth rate in GDP per capita 1.7 percentage points higher than the US growth rate. An equalisation of standards of living in a longer horizon of 50 years would require an over-performance of the order of 0.7 percentage points[6].

Reflecting the fact that the EU gap relative to the US is narrower in terms of labour productivity than in standards of living, the extra EU productivity growth required to catch up within 20 (50) years is 1.3 (0.5) percentage points for per worker productivity and 0.5 (0.2) for hourly productivity. This is suggestive of the difficult task of outperforming US productivity performance on the basis of current trends.

III — What would the gap be in the future?

What will be the difference in the US–EU standards of living 10 years from now if the growth differential for this variable (GDP per capita) remains the same as for the period 1996–2000? Similarly, how much will the level of productivity differential be, per worker and per hour, against the US if trends over a given period do prevail over the next 10 and 20 years? The results are presented in Table III[7] where the data represent the percentage difference between the EU and the US variable in question measured against the US.

Table III: Judging from the past, what will the gap be in the future?

	Standard of living		Productivity per worker		Productivity per hour	
	Percentage difference in 10 years	Percentage difference in 20 years	Percentage difference in 10 years	Percentage difference in 20 years	Percentage difference in 10 years	Percentage difference in 20 years
2002	32	36	37	50	26	41
2001-2002	22	17	30	38	13	19
1996-2000	29	30	30	37	11	16
1996-2002	27	27	30	38	12	17

In 2002, the gap in standards of living between the EU and the US was of the order of 28 %. If the relative growth performance between the two regions witnessed during the period 2001–2002 were to prevail into the future, the gap would decrease to 23 % 10 years from now and to 18 % 20 years into the future. This suggests that the EU would be converging to the US standards of living. If, on the contrary, the relative performance in the years to come is similar to that experienced in the period since 1996, the next 10 or 20 years will not see much of a change in this gap.

The projection of past relative performances in terms of productivity growth into the future depicts a less encouraging situation. If the EU performance in productivity per worker of the last two years, and those since 1996, were repeated over the next 10 years this would imply an increase of 8 percentage points in the productivity gap (from 23 % in 2002) and up to an extra 16 points 20 years from now. For hourly productivity, the results go in the same direction though to a lesser extent. The gap in hourly productivity, which was 8.5 % in 2002, would increase by around 6 percentage points within 10 years and by around 10 percentage points in 20 years.

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[6] The differential in growth rates (d) required for the EU to catch up with the US in the coming N years is computed as $d = (US/EU)^{1/N} - 1$, where *EU* and *US* are the variable's level for each region in 2002.

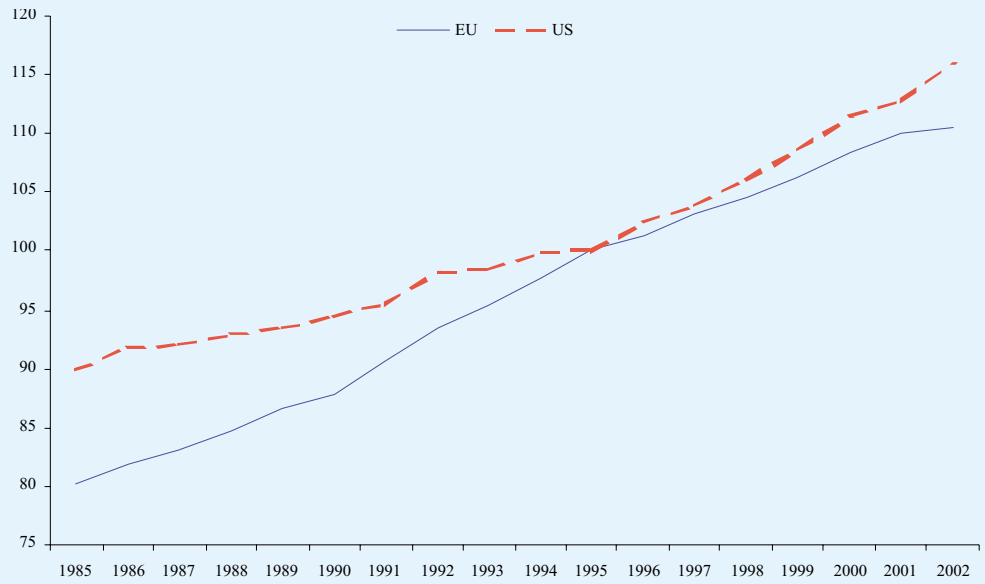
[7] The gap (g) N years from t is computed as $g = 1 - (EU/US)_t ((1+r_{EU})/(1+r_{US}))^N$ where $(EU/US)_t$ stands for the relative level of the variable at time t (2002 in this exercise) while r_{EU} and r_{US} stand for the growth rate of the EU and the US variables respectively.

This exercise should not conceal the fact that productivity developments and the associated improvements in living standards are driven (or hindered) by a multitude of factors such as the human capital content of the labour force, levels and quality of capital stock, regulatory environment and macroeconomic conditions. Therefore, judging whether the maintenance in the future of the recent past performance is realistic, or whether the growth rate necessary to fulfil a certain objective is likely to materialise, would require an assessment of the likely future developments in these factors. Nevertheless, this simple exercise stresses two important, though not surprising, messages:

— Becoming the most competitive economy in the world, if understood as catching up with the economic performance of a benchmark such as the US, will require a significantly superior performance relative to the US through the coming years. This is particularly true for standards of living and for productivity per worker. Current trends are clearly at variance with such a possibility and they do not support such a conjecture.

— Though the EU gap relative to the US is narrower in terms of productivity than in standards of living, if the relative performance of the two regions in recent years (since 1996) does not change substantially, the productivity differential will increase further in the future. This implies that convergence towards the US standards of living would have to depend, *ceteris paribus*, on an important improvement in EU participation and/or employment rates relative to the US.

Graph 1.2: Productivity (GDP per hour) in the EU and US (1995=100)



Source: WIFO calculations using data from the Groningen Growth and Development Centre.

The Member States

The performance of the individual Member States during this period has also been quite diverse. Only three countries recorded average GDP growth above 2 % in 2001-2002: Ireland, Greece and Spain. All three are considered to be catching up countries, although Ireland enjoys well above average growth after surpassing the EU productivity level (see Table 1.2). The UK, Sweden and France registered an average growth of about 1.5 % while Germany had the lowest growth rate followed by the Netherlands, Belgium, Austria, Portugal and Italy with GDP growth rates near or below 1 %.

Seven countries created more employment than the average (0.9 % in the EU on average): Ireland, Italy, Portugal, Spain, the Netherlands, Sweden and Luxembourg. As a consequence, their measured productivity performance is much lower than their growth performance. All other countries recorded an improvement in productivity performance through adjustment in total hours of work. Consequently, Denmark, Germany, Greece, France, the Netherlands and Finland had a higher increase in productivity per hour than in GDP. Compared to the US, on current trends the EU is experiencing a widening of its divergence in terms of productivity per hour worked by an average 0.7 % per year. This, of course, is a substantial worsening of the EU performance compared to the US. With the exception of Ireland, Greece, France, and Denmark, all EU countries had a lower increase in hourly productivity than the US during the period 2001-2002.

Graph 1.3 plots the average per worker productivity growth in 2001-2002 against the average employment growth in the EU, in the Member States and in the US. A minority of nations registered either employment declines but positive productivity growth – Germany and Greece – or (sometimes strong) employment growth coupled with negative productivity growth –the Netherlands, Italy and Spain. Clearly, the case of Ireland stands out with substantial productivity and employment growth during this period. The majority of the Member States cluster in the region of slow productivity growth and modest (around or less than 1 %) employment growth.

1.2 Labour productivity: Long-term trends and comparative levels

This section considers levels and trends in labour productivity in the EU, in the US and in the individual

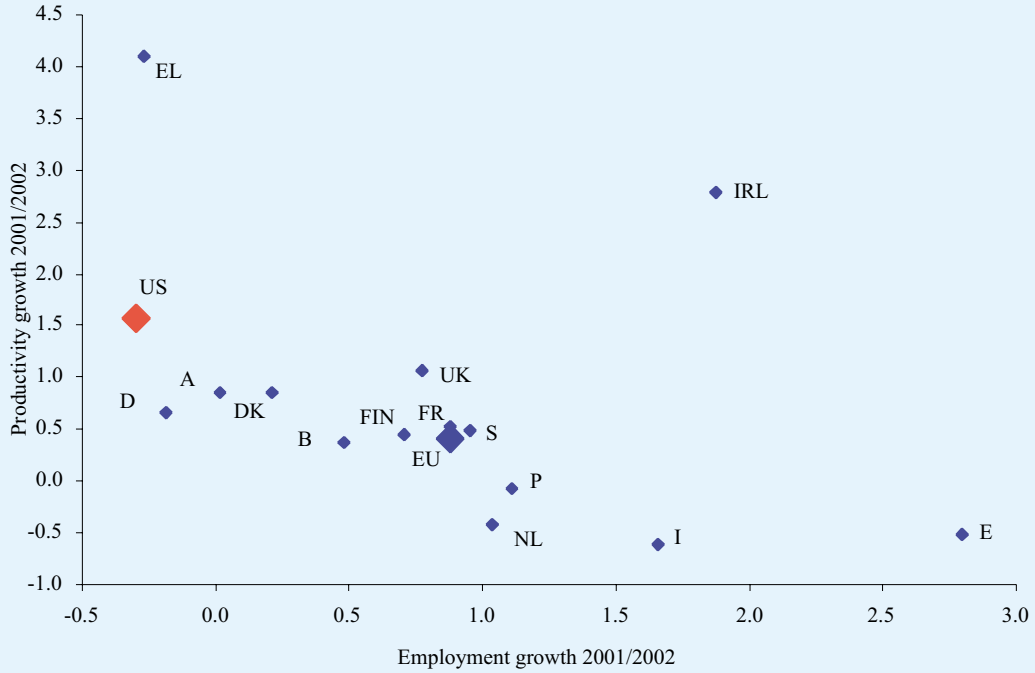
Table 1.2: GDP, GDP per capita and productivity (Average annual increase in percent, 2001-2002)

	Growth of					
	Real GDP	GDP per capita	Productivity per worker	Productivity per hour	Real GDP	
	2001/2002				1991/1995	1996/2000
Belgium	0.85	0.68	0.36	0.43	1.60	2.81
Denmark	1.07	0.76	0.86	1.60	1.97	2.66
Germany	0.48	0.38	0.67	1.18	2.05	1.79
Greece	3.82	3.61	4.10	4.10	1.25	3.42
Spain	2.28	2.10	-0.51	-0.56	1.51	3.80
France	1.42	0.96	0.53	2.41	1.06	2.68
Ireland	4.72	3.55	2.79	3.28	4.70	9.89
Italy	1.04	0.85	-0.62	-0.12	1.27	1.87
Luxembourg	0.99	0.33	-2.02	-1.96	3.93	6.76
Netherlands	0.61	0.06	-0.42	0.87	2.13	3.68
Austria	0.87	0.63	0.85	0.85	2.05	2.57
Portugal	1.03	0.84	-0.08	-0.08	1.70	3.81
Finland	1.16	1.00	0.45	1.25	-0.67	5.05
Sweden	1.45	1.43	0.49	1.18	0.59	2.96
UK	1.85	1.52	1.07	0.98	1.76	2.83
EU	1.29	1.03	0.40	0.88	1.59	2.66
US	1.27	0.33	1.58	1.59	2.39	4.04

Note: GGDC does not include Luxembourg so OECD data are used for this country.

Source: WIFO calculations using data from Groningen Growth and Development Centre.

Graph 1.3: Productivity per worker and employment growth in the EU, in the Member States and in the US, 2001-2002



Source: WIFO calculations using data from Groningen Growth and Development Centre.

Member States against the aggregate EU performance. Two measures of labour productivity are used, GDP per person employed and GDP per hour worked. Both are contrasted with performance in GDP per capita. The purpose of this material is to present an encompassing picture of the determinants of the standards of living and especially the message of different measures of productivity. First, the level of EU productivity is discussed relative to the US and a preferred estimate for 2002 is contrasted with alternative estimates. Secondly, relative EU/US GDP per capita level is presented with the focus on the relative importance of labour force participation and the labour leisure trade-off. Finally, growth across time and issues of convergence of productivity in the EU towards the US level complete this section.

1.2.1 The level of EU and US productivity in 2002

A comparison of estimates

Table 1.3 presents estimates of the level of GDP per capita and labour productivity in the EU relative to the US, based on three alternative estimates: OECD data, estimates from the University of Groningen Growth and Development Centre (GGDC) which underlie the results in the Conference Board (2003) and estimates from EUROSTAT Structural Indicators (SI).

All three estimates demonstrate consistently that GDP per capita in the EU is nearly 30 % lower than in the US.

Discrepancies appear when examining the two estimates for labour productivity. First, all three sources suggest again a large US lead in GDP per person employed, but the lead implicit in the SI is significantly below that in either OECD or GGDC data. In contrast, both OECD and GGDC indicate a lower US lead over the EU in output per hour than does the SI estimate.

Understanding these differences requires further examination of the components that make up the underlying estimates – these are shown in the second panel of Table 1.3. The OECD estimates suggest a marginally lower level of GDP in the US relative to the EU than the remaining two measures. All three estimates employ essentially the same population numbers, but there are variations in the two labour input components. Thus, in contrast to the other two estimates, SI implies that the level of EU employment relative to the US in 2002 was only

Table 1.3: EU/US comparisons: Alternative estimates for 2002 (US = 100)

	OECD data	GGDC	Structural Indicators
GDP per capita	72.4	71.7	71.2
GDP per person employed	79.0	77.1	82.6
GDP per hour worked	90.0	91.5	86.8
Components:			
GDP	95.2	94.4	93.7
Population	131.5	131.7	131.5
Persons employed	120.6	122.4	113.4
Annual average hours worked	87.7	84.2	95.2
Total hours worked	105.7	103.2	107.9

Notes: OECD estimates have been computed based on data received from OECD – in particular OECD does not publish a total EU estimate. GGDC does not include Luxembourg in its estimate for the total EU – for completeness OECD data are used for Luxembourg The components for the Structural Indicators were derived implicitly by comparing relative levels of GDP per capita, per person engaged, per hour worked and population.

Sources: **OECD:** GDP in 2001 USD and population from National Accounts, vol.1, 2002, OECD, persons employed from Labour Force Surveys, 1981-2001, OECD, Annual average hours worked from Employment Outlook, 2002, OECD; **GGDC:** GDP in 1999 USD employing Purchasing Power Parities and Real Expenditures 1999 Benchmark year, Edition 2002, OECD, updated to 2001 using growth in constant price GDP from National Accounts, vol.1, 2002, OECD, persons employed from Labour Force Statistics, 2002, OECD, annual average hours worked, various sources including Employment Outlook, 2002, OECD, national statistical offices web-sites e.g. US Bureau of Labor Statistics (BLS), for most EU countries levels were extrapolated from Angus Maddison (1995), Monitoring the World Economy, 1820-1992, OECD – see GGDC web site http://www.eco.rug.nl/ggdc/homeggdc.html for more detail; **SI:** Eurostat Structural Indicators for relative levels of GDP per capita, per person employed and per hour worked, http://europa.eu.int/comm/eurostat.

15 % higher compared to more than 20 % in GGDC and OECD. This is more than compensated by the fact that the SI estimates imply annual average working hours only about 5 % lower in the EU than the US, in contrast to about 15 % lower EU average hours in both GGDC and OECD.

There are four variables that are key in arriving at estimates of the level of productivity, namely the purchasing power parities (PPP) employed to convert output in national currency units into a common currency; the definition of employment; the methods used to calculate hours worked; and methods to adjust for the informal economy. Details for all four are outlined in Box 1.3. Since the three sets of estimates use consistent, albeit different, methods and data sources it is difficult to choose between them. The remainder of this section uses GGDC data as these are the estimates where both comparative numbers and the component series are most readily available and cover the longest possible period. The same data has also been used subsequently in several Graphs in other sections for the same reason.[8]

Productivity levels in the EU and the US in 2002

Table 1.4 presents, relative to the US, levels of GDP per capita, GDP per person employed and GDP per hour for the EU and the Member States in 2002.

With the exception of Luxembourg, all Member States had levels of GDP per capita significantly below that of the US in 2002. However, within the EU there is much variation so that the countries with the highest levels (Ireland, Denmark, and the Netherlands) enjoy average standards of living some 70 % above those in the poorest nations (Greece, Portugal). There is less variation in levels of GDP per capita among the countries with the highest population (Germany, France, the UK and Italy clustering around 73 % of the US level) but Spain falls well behind this mark.

Data on GDP per person employed show a somewhat different picture even though, once more, the US leads all EU Member States bar Luxembourg. There remains a large gap between the highest and lowest productivity per person employed across countries, but the identification of the leaders changes. In this case the highest productivity countries include some of the larger countries, i.e. France and Italy. Finally, the GDP per hour worked data demonstrate that many Member States are reaching productivity levels above or close to the US, namely Luxembourg, Belgium, France, the Netherlands, Ireland, Italy and Germany. The Member States with the lowest per capita incomes (Greece, Portugal and Spain) remain those with the lowest levels of per hour and per employee labour productivity.

Underlying the divergence in labour productivity are marked cross-country differences in the sectoral distribution of economic activity. Thus, the US continues to enjoy a significant lead over all EU Member States in manufacturing, but its lead is less

[8] Note that the GGDC data and the Structural Indicators display closely comparable growth rates, but not levels, for the variables relevant here.

Box 1.3: Relative levels of GDP and labour input: why do they differ?

There are four primary variables that are used in estimates of the level of productivity, namely the purchasing power parities (PPP) employed to convert output in national currency units into a common currency; the definition of employment; the methods used to calculate hours worked; and possibly the adjustments to account for the informal economy.

PPP: At present there are three sets of PPP that can be used to convert GDP to a common currency, the 'rolling' or 'current price' estimates of OECD/Eurostat and of the Structural Indicators for 2002 and the fixed base estimates for 1999 preferred by the GGDC. In the 'rolling' estimates, for non-European countries OECD employs national deflators through three year full PPP benchmarks, whereas EUROSTAT makes use of annual survey information. As indicated in Table 1.3 the choice of which of the three variants to use makes very little difference to the relative levels of GDP.

Employment – Jobs versus persons: There are currently two employment measures published in official statistics - number of persons and number of jobs - the difference between the two being the number of persons with two or more jobs. Multiple jobs are much more prevalent in the US (which has about 5 % second jobs) than in the EU (which has about 3 % of second jobs). The US Bureau of Economic Analysis (BEA) counts jobs, whereas Bureau of Labour Statistics (BLS) estimates refer to resident persons. For the US, EUROSTAT uses the BEA national accounts source whereas GGDC uses persons. An added complication is that, after adjusting for second jobs, BEA employment totals are about 5 % higher than BLS sources, which is largely due to BEA adjusting for under-reporting of small firms, in particular non-farm sole proprietorships and partnerships. Somewhat surprisingly, BEA also publishes data on total hours worked but these refer only to employees, so that a corresponding adjustment is not made for the hours of the self-employed. Data from the *Statistical Abstract of the USA* suggest that hours for self-employed are considerably greater than for employees. An adjustment for self-employed, using these data, was carried out by O'Mahony and DeBoer (2001). Nevertheless such adjustments tend to be crude so that there is an argument for using the published BLS persons and jobs per person estimates where such adjustments are not required. Employment in EU countries' national accounts is derived from a combination of jobs-based and headcount-based sources, whereas the labour force survey estimates refer to resident persons employed (but miss non-resident workers). A correction is applied in national accounts for cross-border workers. It is not clear a-priori, which of these two concepts is best in measuring productivity per person employed. For the US, EUROSTAT uses the BEA national accounts source whereas GGDC uses the BLS source.

Annual average hours worked: Of utmost importance is that the hours estimates be consistent with the employment concept, where hours worked are derived from the product of employment and average hours. Hours per person will by definition be higher than hours per job. Both OECD and GGDC use hours per person for the US based on data supplied by BLS. In the case of the US, the Structural Indicators use total hours worked data derived by the US BLS from both BLS and BEA underlying sources. One possible inconsistency could be introduced with the use of "direct" versus "component" methods. The "direct" method employs survey evidence on the actual number of hours worked for persons surveyed. If the survey is undertaken with high frequency, this method should yield an accurate estimate. The "component" method starts with usual weekly hours worked and deducts hours paid, but not worked due to holidays, sick leave, strikes etc. and adds any additional hours due to overtime. The "component" method frequently draws information from a large number of - possibly inconsistent - sources whereas the "direct" method is based on a single source, i.e. a survey. In practice, surveys are often carried out quarterly or on a longer delay so that they may be influenced by seasonal patterns (holidays, sickness) and ad hoc events. A further complication is that surveys may be based on persons or enterprises with the results not always consistent. In the estimates in Table 1.3 OECD hours are direct estimates based on a mixture of EU sources and on data from business and household surveys (CES and CPS) and on data from employer surveys from BLS for the US. GGDC generally employs the component method, but their US hours are from the same source as OECD. The Structural Indicators generally follow the same sources as the OECD for EU countries, allowing for the timing of new data availability. Again, it is unclear which is the better estimation method but potential improvements in the timeliness and measurement of labour force surveys, at least in the EU, may lead them to be considered the most appropriate and comparable measure of average hours worked in the future.

The informal economy: The estimates may also vary with respect to adjustments for the informal economy. Arguably, most service sector jobs, regardless of how low paid, are picked up in US official statistics. In the EU, substantial work has been undertaken to ensure that national accounts data are exhaustive. Nevertheless, while there is international agreement that the 'informal economy' should be measured, in practice national statistical offices vary in the methods they employ to deal with this problem and there are questions on how far GDP and employment adjustments are fully consistent with each other. The three estimates in Table 1.3 deal with this issue to a great extent but perhaps not entirely.

Table 1.4: Relative level of productivity in 2002 (US = 100)

	GDP per capita	GDP per person employed	GDP per hour worked
	SI (GGCD)	SI (GGCD)	SI (GGCD)
Belgium	77.3 (76.2)	99.5 (92.2)	109.0 (112.0)
Denmark	80.8 (84.9)	80.8 (78.7)	91.30 (99.8)
Germany	73.1 (75.0)	80.3 (79.2)	93.1 (101.5)
Greece	47.4 (49.3)	68.3 (62.5)	59.5 (61.1)
Spain	60.1 (60.1)	77.0 (69.8)	71.0 (72.2)
France	73.6 (72.8)	93.2 84.6)	101.9 (107.8)
Ireland	86.8 (89.5)	99.2 (94.0)	99.2 (105.5)
Italy	73.0 (73.4)	91.3 (83.1)	95.2 (97.2)
Luxembourg	133.9 (133.0)	106.8 (98.0)	110.9 (112.0)
Netherlands	80.3 (80.2)	80.1 (76.0)	99.7 (103.8)
Austria	78.6 (78.2)	81.2 (79.7)	89.1 (98.6)
Portugal	49.3 (52.2)	52.0 (49.3)	51.0 (52.7)
Finland	72.6 (74.0)	83.8 (76.0)	81.9 (88.5)
Sweden	72.4 (73.0)	76.4 (70.2)	80.9 (82.3)
UK	73.5 (72.7)	76.6 (72.0)	75.2 (81.7)
EU	71.2 (71.7)	82.6 (77.1)	86.8 (91.5)
US	100 (100.0)	100 (100.0)	100 (100.0)

Note: Using gross national product rather than GDP for Ireland would imply that that country was close to the EU average for the measures in the Table above. The difference is due to transfer pricing with the gap between NNP and GDP large and increasing over time in Ireland. Hence output is inflated by the difference between these two measures of aggregate activity; the gaps between GDP and GNP are small for remaining countries.

Source: GGCD: data from Groningen Growth and Development Centre (GGDC web site at http://www.eco.rug.nl/ggdc/homeggdc.html). GGDC does not include Luxembourg so OECD data are used for this country. SI: Structural Indicators data from Eurostat, (release 13-06-2003, http://europa.eu.int/comm/eurostat/).

pronounced in services. In 1999, the most recent year for which data are available, value added per person employed in the US manufacturing was nearly 60 % higher than in the EU, whereas the American lead in the much larger market service sector was much less, about 20 % (O'Mahony, 2002)[9].

Cross-country differences between the level of GDP per capita and GDP per person employed reflect differences in the rate of labour force participation and in the rate of employment. In turn, cross-country differences between GDP per person employed and GDP per hour worked reflect differences in the prevalence of part-time work, the length of the standard work week and days paid but not worked per year, the latter primarily due to annual holiday leave. Cross-country differences in some of these components are illustrated in Table 1.5.

The first column of Table 1.5 shows the ratios of working age (aged 16-64) to total population as reported in the Structural Indicators data set (figures within brackets use GGDC data). There is little variation across countries or between the EU and the US in this ratio. The second column shows the participation rate (ratio of the labour force to working age population), also relative to the US. It is clear that participation is much higher in the US than in the EU and higher than in most EU Member States[10]. However, Luxembourg has a higher participation rate than the US and a number of other countries (Denmark, Sweden, the UK, Portugal and the Netherlands) have rates at or near those of the US. The ratio of employment to working age population (employment rate, shown in the third column) is lower in the EU than in the US, but its variation across Member States is high. Among the countries with a large population size, France, Italy, Germany and Spain all show lower employment rates and higher unemployment rates than the US. The United Kingdom is the only large country with an employment rate similar to that achieved by the US. Luxembourg displays a higher employment rate than the US while Denmark is at par. The final column shows relative annual average hours worked. Average annual working time is longer in the US than in the EU though Greece, Spain, Portugal, Finland, the UK and Ireland have annual average working hours at or above US levels. Dutch and German workers have the shortest hours followed by Denmark, France, Belgium and Austria.

[9] Market services comprise transport, communications, distributive trades, financial and business services and private personal services.

[10] In what follows, the comments on the relative position of countries refer to the structural indicators' values.

Table 1.5: Labour and hours ratios, EU member states relative to the US, 2002 (US = 1)

	Working age in % of total population	Labour force in % of working age population	Employment to working age population	Annual average hours worked
	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)
Belgium	0.99 (0.99)	0.80 (0.85)	0.79 (0.98)	0.91 (0.82)
Denmark	1.00 (1.00)	0.98 (1.06)	1.00 (1.01)	0.89 (0.79)
Germany	1.01 (1.01)	0.93 (0.96)	0.90 (0.97)	0.86 (0.78)
Greece	1.01 (1.01)	0.71 (0.81)	0.68 (0.96)	1.15 (1.02)
Spain	1.03 (1.03)	0.81 (0.89)	0.76 (0.94)	1.08 (0.97)
France	0.98 (0.98)	0.83 (0.91)	0.81 (0.97)	0.91 (0.78)
Ireland	1.02 (1.02)	0.85 (0.92)	0.86 (1.01)	1.00 (0.89)
Italy	1.02 (1.02)	0.81 (0.90)	0.79 (0.97)	0.96 (0.85)
Luxembourg	1.00 (1.00)	1.19 (1.30)	1.23 (1.03)	0.98 (0.87)
Netherlands	1.02 (1.02)	0.95 (1.00)	0.98 (1.03)	0.80 (0.73)
Austria	1.01 (1.01)	0.94 (0.95)	0.95 (1.02)	0.91 (0.81)
Portugal	1.02 (1.02)	0.96 (1.07)	0.93 (0.96)	1.02 (0.94)
Finland	1.01 (1.01)	0.86 (0.96)	0.87 (1.01)	1.02 (0.86)
Sweden	0.97 (0.97)	0.97 (1.06)	0.97 (1.01)	0.94 (0.85)
UK	0.99 (0.99)	0.96 (1.01)	0.97 (1.01)	1.02 (0.88)
EU	1.01 (1.01)	0.88 (0.94)	0.86 (0.98)	0.95 (0.84)

Note: Working age population in 2002 was estimated using the 2001 working age to total population ratio applied to 2002 total population.

Source: Population and working age population, OECD; employment, unemployment and hours Eurostat.

Comparing the EU with the US, the single most important factor behind the 29 percentage points gap in GDP per capita[11] in 2002 is lower productivity, contributing 13 percentage points to the gap, followed by lower participation rate, accounting for 10 percentage points, see Table 1.6.

The demographic factor, the ratio of working age to total population, plays no role in the EU gap. Again there is considerable diversity across Member States in the direction and magnitude of these various contributions. In general the participation rate and the hourly productivity effects dominate followed by the effect of lower average hours worked[12].

To conclude, total working time across the EU tends to be lower than in the US either due to lower participation, to higher unemployment or to shorter hours worked on average by each worker. If it is true that this difference could partly reflect a stronger preference for leisure on the part of the EU population, it can not be excluded that the institutional environment (by constraining people's choice of working time) may also be responsible for this difference. Labour market regulations that effectively restrict part-time work, norms on holidays and on standard working week and cultural factors that constrain the participation of certain groups, e.g. married women, may all lead to a sub-optimal leisure/work pattern. These issues are discussed further in Section 1.4.

1.2.2 Productivity Growth

This section reviews data on trends in GDP per capita, in output per person employed and in

[11] The difference between country *A*'s GDP per capita and the corresponding value in country *U*, expressed as a percentage of the country *U*'s value, is decomposed into the contribution of five factors (demographic structure, participation rate, unemployment rate, average hours worked and hourly productivity) according to the following method:

$$\left(\frac{Y^A}{Y^U}\frac{P^A}{P^U}-1\right)=\left(\frac{Y^A}{Y^U}\frac{P^A}{P^U}-\frac{Y^A}{Y^U}\frac{W^A}{W^U}\right)+\left(\frac{Y^A}{Y^U}\frac{W^A}{W^U}-\frac{Y^A}{Y^U}\frac{L^A}{L^U}\right)+\left(\frac{Y^A}{Y^U}\frac{L^A}{L^U}-\frac{Y^A}{Y^U}\frac{E^A}{E^U}\right)+\left(\frac{Y^A}{Y^U}\frac{E^A}{E^U}-\frac{Y^A}{Y^U}\frac{H^A}{H^U}\right)+\left(\frac{Y^A}{Y^U}\frac{H^A}{H^U}-1\right)$$

where $Y^i, P^i, W^i, L^i, E^i, H^i$ represent respectively, GDP, population, working age population, labour force, employment and total hours worked in country *i*. Note that this decomposition method implies that the contribution from hourly productivity is given exactly by the gap in *A*'s hourly productivity relative to country *U*; this identity between contribution to GDP per capita gap and gap in the factor itself does not hold for the remaining four factors. Note further that the sum of the second and third terms (participation rate and unemployment contribution) is the contribution from the employment rate.

[12] Note that although the estimates of the EU/US difference in GDP per capita do not significantly differ in the two sources used in Table 1.6, the contribution of each factor varies substantially between the two sources reported. For instances while in the Structural Indicators differences in hourly productivity account for the largest part, the GGDC databank identifies differences in average hours worked as the main factor.

Table 1.6: Decomposition of the GDP per capita gap between EU countries and the US in 2002

	Gap in GDP per head in percentage points	Components					
		Working age population	Participation rate	Unemployment rate	Employment rate	Hours worked	Productivity per hour
	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)
Belgium	-23 (-24)	-1 (-1)	-20 (-14)	-2 (-1)	*-22 (-15)*	-10 (-20)	9 (12)
Denmark	-19 (-15)	0 (0)	-1 (5)	1 (1)	*0 (6)*	-10 (-21)	-9 (0)
Germany	-27 (-25)	1 (1)	-6 (-3)	-2 (-2)	*-8 (-5)*	-13 (-22)	-7 (1)
Greece	-53 (-51)	1 (1)	-19 (-11)	-3 (-3)	*-22 (-14)*	9 (1)	-40 (-39)
Spain	-40 (-40)	2 (2)	-14 (-7)	-4 (-4)	*-18 (-11)*	6 (-2)	-29 (-28)
France	-26 (-27)	-2 (-2)	-15 (-8)	-3 (-3)	*-18 (-11)*	-9 (-23)	2 (8)
Ireland	-13 (-11)	1 (1)	-15 (-7)	1 (1)	*-14 (-6)*	0 (-11)	-1 (5)
Italy	-27 (-27)	1 (1)	-16 (-8)	-3 (-3)	*-19 (-11)*	-4 (-14)	-5 (-3)
Luxembourg	34 (33)	1 (1)	21 (31)	3 (3)	*24 (34)*	-2 (-14)	11 (12)
Netherlands	-20 (-20)	2 (2)	-4 (0)	3 (3)	*-1 (3)*	-20 (-28)	0 (4)
Austria	-21 (-22)	1 (1)	-5 (-4)	1 (1)	*-4 (-3)*	-8 (-19)	-11 (-1)
Portugal	-51 (-48)	1 (1)	-2 (3)	-2 (-2)	*-4 (1)*	1 (-3)	-49 (-47)
Finland	-27 (-26)	1 (1)	-12 (-3)	1 (1)	*-11 (-2)*	1 (-13)	-18 (-11)
Sweden	-28 (-27)	-2 (-2)	-3 (4)	1 (1)	*-2 (5)*	-5 (-12)	-19 (-18)
UK	-26 (-27)	-1 (-1)	-3 (1)	1 (1)	*-2 (2)*	1 (-10)	-25 (-18)
EU	-29 (-28)	0 (0)	-10 (-4)	-2 (-2)	*-12 (-6)*	-4 (-15)	-13 (-8)

Note: The column 'Employment rate' corresponds to an alternative decomposition and represents the contribution of the employment rate which is identical to the combined contribution of the participation rate and the unemployment rate (sum of columns 3 and 4).

Source: See Table 1.5.

output per hour worked in the EU and in the US over a period starting in the late 1970s to 2002, but also during shorter sub-periods in the 1990s.

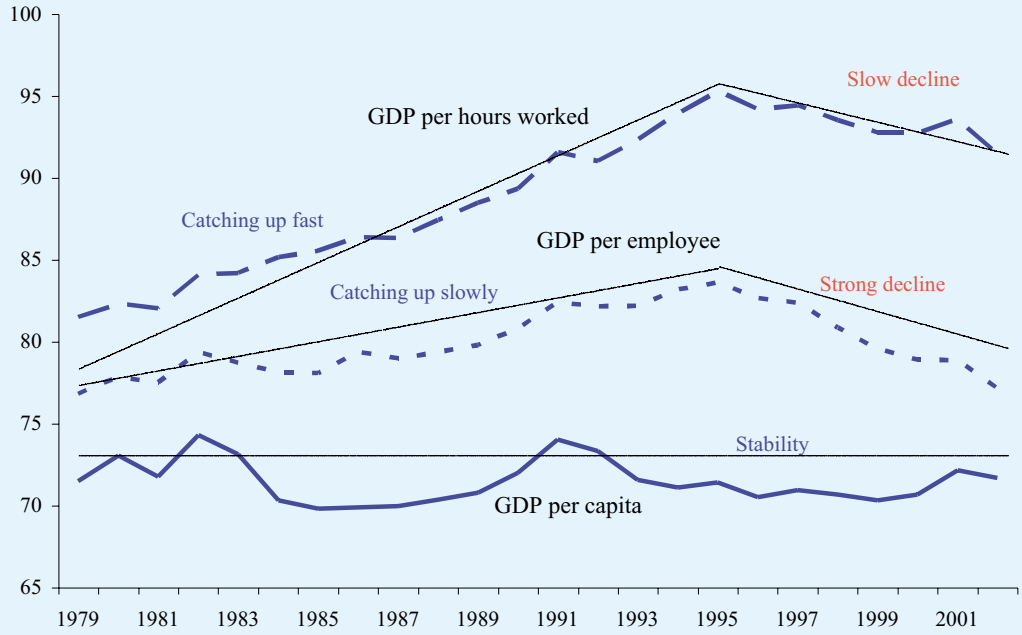
Graph 1.4 shows the path of changes in GDP per capita in the EU relative to the US for the period 1979 to 2002. In general, the ratio of EU to US GDP per capita has fluctuated around 72 %. Exceptions appear in the beginning of the 1980s and in the beginning of the 1990s. It is clear that no convergence has taken place towards the US level of this critical variable during the past quarter century.

There have, however, been significant breaks in the trend paths of the underlying components. Thus, GDP per person employed and GDP per hour worked have been growing steeply through to the mid-1990s when the decline in European productivity growth emerged. The rapid convergence towards the corresponding US level of either variable has been reversed since 1995. Convergence during the period prior to 1995 was stronger in terms of GDP per hour than GDP per person employed[13]. The period from1995 onwards has been characterised by a sharper decline in GDP per person employed than in GDP per hour worked. A prevailing view is that the US productivity renaissance of the second half of the 1990s is a reflection of the importance of ICT and of the associated technological and organisational modernisation of enterprises (see section 1.3).

Table 1.7 shows growth rates of hourly productivity (GDP per hour) for the EU, the Member States and the US during the first half of the 1990s and the period 1996-2002. The data confirm that the deceleration of EU productivity growth relative to the US during the latter period, which has been recorded in terms of productivity per person employed, has also been registered in productivity per hour worked. Graph 1.5 plots hourly productivity growth in the periods 1996-2002 and 1990-1995. It is clear, first, that hourly productivity accelerated in the US while the EU experienced a deceleration; and, secondly, a few EU Member States have also recorded acceleration of productivity growth comparable to if not better than the US in the second period (Austria, Greece and Ireland). These have been either lagging significantly behind the US (Greece) or nations with prominent high technology production (Ireland). France saw a marginal acceleration while in all remaining Member States hourly productivity decelerated.

[13] Similar stages of convergence have been analysed in Aiginger, Landesmann (2002).

Graph 1.4: Evolution of GDP per capita, productivity per person employed and productivity per hour worked in the EU relative to the US (US=100)



Source: WIFO and CEPII calculations using data from Groningen Growth and Development Centre.

Table 1.7: Growth in output per hour, 1990-1995 and 1996-2002

	1990-1995 % per annum	1996-2002 % per annum
Belgium	2.35	2.16
Denmark	2.41	1.63
Germany	3.52	1.66
Greece	0.58	3.16
Spain	2.27	-0.41
France	1.43	1.59
Ireland	3.58	5.12
Italy	2.31	0.69
Luxembourg	1.77	2.04
Netherlands	1.08	0.55
Austria	1.77	2.43
Portugal	3.52	1.72
Finland	2.79	2.58
Sweden	1.89	1.73
UK	2.65	1.48
EU	2.46	1.27
US	1.14	1.86

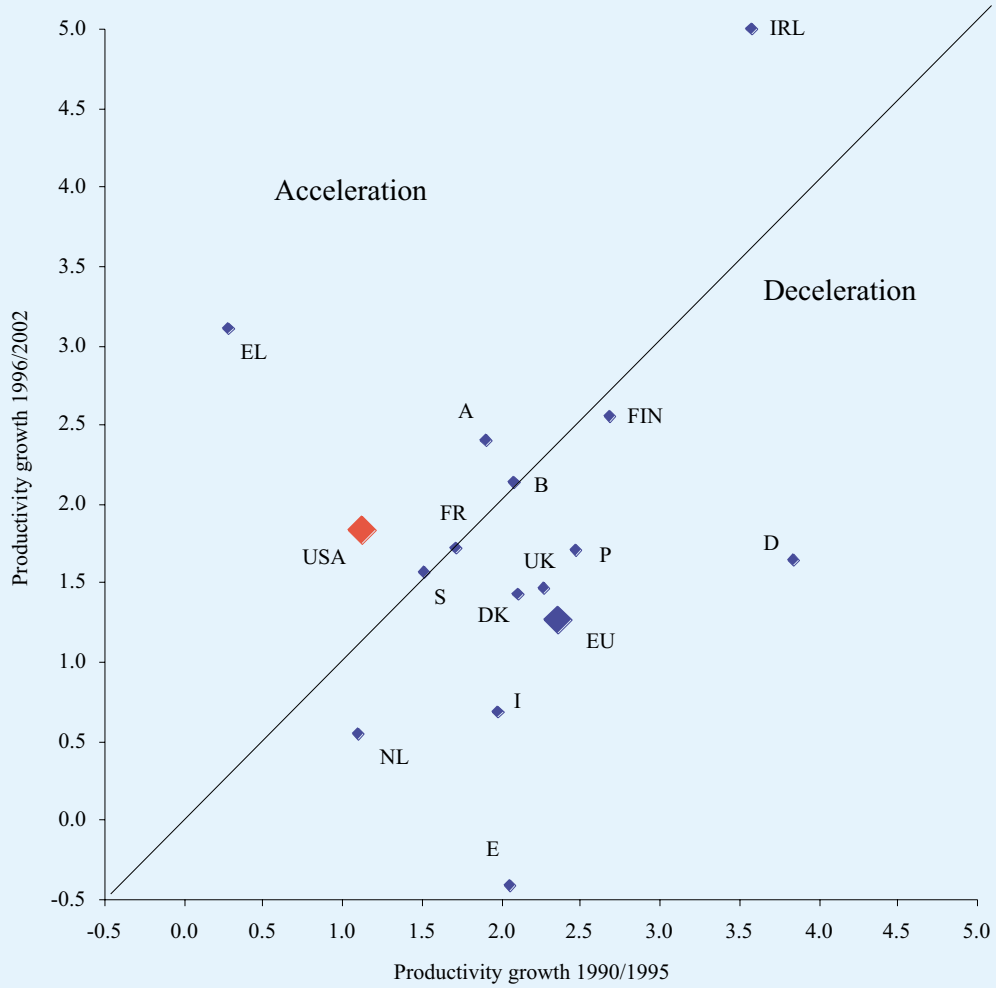
Source: GGDC: GDP in 1999 USD employing Purchasing Power Parities and Real Expenditures 1999 Benchmark year, Edition 2002, OECD, updated to 2001 using growth in constant price GDP from National Accounts, vol.1, 2002, OECD, annual average hours worked, various sources including Employment Outlook, 2002, OECD, national statistical offices web-sites e.g. US Bureau of Labor Statistics (BLS), for most EU countries levels were extrapolated from Angus Maddison (1995), Monitoring the World Economy, 1820-1992, OECD – see GGDC web site for more detail. GGDC does not include Luxembourg in its estimate for the total EU.

1.3 The contribution of ICT to productivity growth

Productivity growth from the mid-1990s to date has been higher and accelerating in the US, but low and decelerating in the EU. There are important differences across Member States, however. Some, as noted previously, have enjoyed acceleration and productivity growth similar to that of the US. In this section both the differences between the US and the EU, as well as the differences across European countries are examined using the growth accounting approach. This approach investigates which part of the productivity increase (defined here as GDP per hour) is attributable to changes in inputs (capital deepening), and which part is left unexplained and assumed to be the result of technical progress (called total factor productivity, multi-factor productivity or Solow residual). The approach is based on the Solow model of economic growth and the work of Jorgenson and Griliches (1967) who have developed the methodology. Our specific aim is to assess the impact of information and communication technology on productivity growth.[14] The data also

[14] There have been numerous studies trying to measure the "new economy", analysing the contributing factors such as ITC, but very few of these studies can make a valuable international comparison due to lack of internationally consistent data. Only the GGDC and OECD have been able to gather such information, they have broadly similar results, but as we need to use data consistent with the other sections of the report we chose to use GGDC data.

Graph 1.5: Productivity (GDP per hour) growth in the EU and US



Source: WIFO calculations using data from the Groningen Growth and Development Centre.

permit to distinguish between the impact of ICT on capital formation and on technical progress. Box 1.4 presents in more detail the methodology.

The ICT revolution, at least as it has been understood both in the EU and in the US, has had some key implications. The growth accounting approach calculates the share of investment in the new (ICT) technology and provides estimates of its impact on economic growth. Specifically, it calculates that part of capital deepening which is due to ICT investment. On the demand side, the ICT revolution has resulted in new products and new services growing at two-digit rates in the period up to the end of the last decade. Furthermore, this demand by firms and consumers has been fuelled by steep price declines that contributed to strong economic growth with low inflation. According to some early views, the "new economy" encompassed both low inflation and high productivity and output growth, and rising employment. Finally, ICT–producing sectors contributed to high and steeply rising productivity[15].

1.3.1 Comparing US and EU performance

New data based on hourly productivity and a growth accounting framework have been used here to estimate the contribution of ICT to economic growth.

Oliner and Sichel (2000) launched the debate about the resurgence of economic growth in the US associated with an acceleration of productivity gains due to the increased use of ICT. Schreyer (2001) and van Ark et al. (2003) have produced comparable results for

[15] The contribution of the ICT sectors to the increase in total factor productivity is the second element of the "ICT contribution" to the increase in labour productivity (see Table 1.8).

Box 1.4: The analytical framework

The analysis follows the standard growth accounting method which decomposes output growth into contributions from factor inputs, both quantities and qualities, and a residual, most commonly known as total factor productivity. Details of the method and an application to US growth is set out in Jorgenson et al. (1987), with additional theoretical discussion in Hulten (2000).

The growth accounting method begins with a general value added production function of the form:

$$Y_t = F(K_t, L_t, A_t) \quad (1)$$

where K_t are aggregate capital services, L_t are aggregate labour services and A_t is total factor productivity.

By differenciating (1) with respect to time, under the assumptions that all inputs are paid their marginal products and that the production function exhibits constant returns to scale, we can derive the continuous form of the output growth decomposition, with the growth in factor inputs weighted by their shares in value added. This derivation is known as the Divisia index and is invariant to the functional form chosen for the production function.

In practice data are only observed at discrete intervals so the implementation of the Divisia index requires some additional assumptions on the form of the production function. Jorgenson et al. (1987) assume a Translog production function, rather than the more usual Cobb-Douglas, to allow for substitution between factor inputs at each point in time. This then allows for a discrete approximation to the Divisia Index, the discrete-time Tornqvist index, which is an exact index number if it is applied to the Translog function (Hulten, 2000). This is given by:

$$\Delta \ln Yt = \overline{v}_{K,t} \Delta \ln K_t + \overline{v}_{L,t} \Delta \ln L_t + \Delta \ln A_t \quad (2)$$

where Δ is the first difference operator, $\overline{v}_{K,t}$ and $\overline{v}_{L,t}$ are the shares of capital and labour in value added, averaged across time periods t and t-1. Constant returns implies that

$$\overline{v}_{K,t} + \overline{v}_{L,t} = 1$$

The contribution of each factor input to output growth is given therefore by the input growth rate in volume weighted by its return share of value added. The evolution of changes in the quality of the input are incorporated in the analysis by breaking up aggregate capital and labour into a number of types, e.g. new technology and traditional assets, or types of skilled labour. By estimating aggregate inputs as share weighted growth rates of their components, the method allows for substitution of higher quality for lower quality inputs through time. Suppose there are j types of capital and l types of labour. This method of adjusting for quality, due originally to Jorgenson and Griliches (1967), replaces aggregate capital and labour in (2) by:

$$\Delta \ln K_t = \sum_j \overline{v}_{K_j,t} \Delta \ln K_{j,t} \quad (3a)$$

$$\Delta \ln L_t = \sum_l \overline{v}_{L_l,t} \Delta \ln L_{l,t} \quad (3b)$$

Departures from the assumptions underlying the growth accounting method may bias results, notably the productivity residual. In particular, by assuming that production inputs are totally compensated in the market against the services they render, this method does not allow for the presence of external effects or spillovers associated with factor inputs - such as the possible externalities due to the use of information technology equipment. Nevertheless the growth accounting method is a powerful tool of analysis in describing the sources of the growth in output.

Capital services

The implementation of the formula in (3b) for labour inputs is straightforward since we can observe wages for different types of labour in the market. The construction of capital services is more complicated and involves taking account of the efficiency of each type of asset. Data on investment at constant prices allows for differences in the performance of the

various assets whereby the price series used to deflate the investment series at current prices reflect the efficiency of assets. For some assets like computers and some parts of communications equipment, hedonic prices are used (for instance in the US and France). The asset price is regressed upon a set of related qualitative characteristics (e.g. speed of processing) in order to allow for quality change and construct a constant quality price index. The weights in equation (3a) are based on user costs of capital, composed of the rate of return plus depreciation minus capital gains, rather than the acquisition price of capital assets. Thus the relatively high contributions of information and communications technology capital to output growth, evidenced for the US in recent years (see e.g. Jorgenson and Stiroh, 2000), stems from the high growth in quality adjusted investment. But the high contribution of ICT capital is also influenced by these assets' very high depreciation rates and the fact that their owners can expect capital losses. The market return must be sufficiently high to cover the latter two effects in addition to the normal rate of return.

Decomposition of labour productivity growth

By rearranging equation (2), the contribution of factors of production to the growth in hourly labour productivity can be expressed in the form:

$$\Delta \ln y_t = \overline{v}_{K,t} \Delta \ln k_t + \overline{v}_{L,t} (\Delta \ln L_t - \Delta \ln H_t) + \Delta \ln A_t \quad (4)$$

with: $y_t = \frac{Y_t}{H_t}$; $k_t = \frac{K_t}{H_t}$

where *H* represents total hours worked.

Thus, growth in hourly labour productivity stems from:

— "Capital deepening", or substitution of capital for labour, arising from capital accumulation – this can be divided into new technology and traditional asset effects,

— Improvements in labour quality defined as the difference between the rate of growth of the weighted labour input and hours worked, and

— Growth of total factor.

the EU and confirm the role of ICT in the productivity divergence between the EU ,and US in recent years.

The results reported here cover the period 1990-2001. This, however, has three potential disadvantages. First, the data are only provisional and will undoubtedly be revised. Second, the 1995-2001 period may not be typical since it does not correspond to a consistent business cycle period (the period 1995-2000 would be preferable for this reason); this is due to the fact that 2001 is a recession year for the US and a low growth year for the EU, and productivity developments are at their most uncertain at the start of a recession. Finally, 2001 was one of the worst years in decades for the ICT industry due to the burst of the internet bubble. Nevertheless, and despite these reservations, the data suggest that the "new economy" thesis has some considerable support as does the notion of a widening gap between the US and the EU in hourly labour productivity growth discussed in the first section of this chapter.

As mentioned previously, productivity growth during the second half of the 1990s accelerated in the US but decelerated in the EU. The EU saw high growth in productivity per hour in the first half of the 1990s and was leading the US, but the pattern was reversed during the second period. As seen in Section 1.2, during the period 1996-2002 EU hourly labour productivity growth declined by more than one percentage point, and in the US it rose by somewhat more than half a percentage point, compared to the first half of the 1990s (see Table 1.7). These developments are summarised in Table 1.8 which also shows a decomposition of the contributions of capital deepening and total factor productivity to hourly labour productivity growth, in the two periods 1990-1995

Table 1.8: Contributions to hourly labour productivity growth, EU and US (in percentage points)

	1990-1995			1995-2001		
	EU	US	EU-US difference	EU	US	EU-US difference
Growth of hourly labour productivity (a)	2.42	1.13	1.29	1.39	1.69	-0.30
Contributions from:						
Capital deepening (b), of which from	1.89	1.03	0.86	1.18	1.28	-0.10
– ICT capital	0.22	0.32	-0.10	0.34	0.57	-0.23
– Office and computer equipment	0.09	0.15	-0.06	0.18	0.25	-0.07
– Communication equipment	0.05	0.05	0.00	0.09	0.14	-0.05
Software	0.06	0.12	-0.06	0.08	0.18	-0.10
Other non-residential capital	1.67	0.71	0.96	0.84	0.71	+0.13
Total factor productivity (c)	0.54	0.10	0.44	0.21	0.41	-0.21

(a) GDP per hour worked in total economy, GDP excluding imputed and actual rents
(b) Capital services per hour worked
(c) Including changes in the quality of labour

Source: Estimates based on GGDC unpublished data and CEPII calculations. EU excluding Belgium, Greece and Portugal.

and 1995-2001. For a description of the decomposition method see Box 1.4.

The deceleration of hourly productivity growth in the EU amounts to 1.03 percentage points. The contribution of capital deepening to this amounts to 0.71 percentage points while the remaining (0.33 points) reflects a decline in total factor productivity growth. Within capital deepening, however, there was a decline in the contribution of investment in non-ICT capital (0.83 percentage points in other non-residential capital) while the contribution of ICT capital was positive but amounted to a modest 0.12 points.

Moreover, the contribution of each component of ICT capital reported in Table 1.8 was greater in the second period compared to the first. Thus, it is clear that for the EU hourly productivity performance of recent years the contribution of the ICT-linked capital formation has been positive and it is rather the joint contribution of the traditional forms of capital and of total factor productivity growth that is responsible for the decline in productivity growth.

In the US, hourly productivity growth accelerated by 0.56 points between the two periods in question. This acceleration is due to ICT capital investment (0.25 percentage points) and to an acceleration in total factor productivity growth (0.31 percentage points)[16]. The contribution of other non-residential capital remained unchanged at 0.71 points between the two periods. At the same time, all three components of ICT capital (office and computer equipment, communications equipment, and software) made an increased contribution during the comparison periods. Thus, almost half of the labour productivity acceleration in the US can be attributed to an increased contribution of ICT investment.

Turning now to the comparison between the EU and the US, it is clear that while during the earlier period capital deepening accounted for the largest part of the superior hourly productivity performance of the EU (some 0.86 points), followed by total factor productivity (0.44 points), in the latter period both capital deepening and total factor productivity growth posted a worse performance than in the US. This pattern holds across all categories of ICT-linked investment but the superiority of the EU in the contribution of other non-residential investment continues to hold albeit at a much reduced rate. Overall, EU productivity growth fell short by some 0.30 percentage points relative to the US during the second period.

The empirical analysis, therefore, suggest that the larger part of the difference between the US and EU productivity growth (some 0.30 percentage points) during the 1995-2001 period is accounted for by lower contribution of ICT investment (0.23 percentage points) and by lower growth in total factor productivity (0.21 percentage points). Partly offsetting this is the superior contribution of non-ICT capital in the EU (0.13 percentage points).

[16] Estimates by van Ark et al. (2003) show that for the 1995-2000 period, a gain of 0.17 in TFP growth originates in ICT producing sectors and 0.43 in non-ICT producing sectors.

Table 1.9: Member States with accelerating TFP
Difference in growth rates, 1995-2001 minus 1990-1995

	ICT Investment	Non ICT Investment	Total factor productivity	Labour productivity
Finland	0.35	-1.23	0.83	-0.05
Ireland	0.41	0.92	0.56	1.88
Austria	0.10	-0.04	0.77	0.83
France	0.08	-0.69	0.84	0.23
Sweden	0.25	-0.48	0.08	-0.15

Source: GGCD data and CEPII calculations; see Appendix 1.2 for detailed data.

1.3.2 Member States where TFP growth has accelerated

The framework used to analyse the determinants of hourly labour productivity growth is applied to the Member States. However, for some Member States (specifically Belgium, Greece and Luxembourg) the necessary data is not available and the analysis cannot be applied to them.

The Member States can be grouped into those that saw an acceleration of total factor productivity growth during the 1995-2001, compared to the period 1990-1995, and those that saw a deceleration.

Table 1.9 shows the decomposition of labour productivity growth for the first group of Member States.

For four Member States the acceleration of TFP was greater than half percentage point, and in the group it ranges from 0.84 percentage points in France to 0.08 points in Sweden[17]. In all these countries the contribution of ICT investment has also been clearly positive, ranging from 0.08 percentage points in France to 0.41 percentage points in Ireland. But the contribution of non-ICT investment has been negative except in the case of Ireland where it amounts to 0.92 percentage points.

The data suggest that these countries had a mixed performance in terms of hourly labour productivity growth. While in Ireland and in Austria hourly labour productivity growth accelerated markedly during the second period, it did less so in the case of France and it fell in the case of Finland and Sweden.

It is clear that ICT and non-ICT investment alone could not be relied upon to raise hourly labour productivity growth. Nor could the efficiency gains made in the second half of the 1990s in these Member States, as reflected in the acceleration in total factor productivity, be sufficient to raise labour productivity growth. While this accounting analysis does not provide a formal causal view of the exact contribution of each of these factors to labour productivity growth, it at least suggests that total factor productivity growth is crucial and, in some cases (Ireland, Austria and France) combined with the contribution of ICT capital, produced gains in labour productivity growth. (For some more comprehensive evaluation of economic performance including ICT, research input and human capital, see Box 1.5).

1.3.3 Member States where TFP has decelerated

Seven Member States (the Netherlands, Denmark, the UK, Portugal, Germany, Italy and Spain) have seen a deceleration in total factor productivity in the period 1995-2001 compared to the earlier period 1990-1995. These have also seen a substantial deceleration in hourly labour productivity. The contribution of ICT capital has uniformly increased during the second period, but the contribution of non-ICT capital has uniformly decreased. Yet, one great concern ought to be the evidence associated with the weak contribution of ICT capital, except perhaps in the case of the UK. Table 1.10 provides a decomposition of the change in labour productivity growth according to these factors.

Six of the seven Member States in this group saw a decline in TFP growth of more than 0.6 percentage points, ranging from 1.30 percentage points in the case of Spain to 0.67 percentage points in Portugal. Only in the Netherlands does the data suggest that TFP growth did not change perceptibly between the two periods, but even there the decline in labour productivity growth has been substantial.

[17] However, here the contribution of ICT investment had been high for that country in the first part of the 1990s.

Table 1.10: Member States with decelerating TFP
Difference in growth rates, 1995-2001 minus 1990-1995

	ICT Investment	Non ICT Investment	Total factor productivity	Labour productivity
Netherlands	0.16	-0.52	-0.03	-0.40
Denmark	0.13	0.23	-1.07	-0.71
United Kingdom	0.23	-0.56	-0.72	-1.07
Portugal	0.01	-0.70	-0.67	-1.36
Germany	0.04	-0.85	-0.84	-1.64
Italy	0.13	-0.48	-0.90	-1.25
Spain	0.03	-1.44	-1.30	-2.71

Source: GGCD data and CEPII calculations; see Appendix 1.2 for detailed data.

Four of the largest EU Members States (Germany, Italy, the UK and Spain) registered a decline larger than 1 percentage point in hourly labour productivity growth. However, the causes for these declines are different.

— In **Germany**, the decline in non-ICT investment and in total factor productivity growth account for virtually all of the decline in labour productivity growth. During the early 1990s, Germany registered a construction boom as a consequence of German reunification. The end of the boom and the difficulties encountered in the catching-up process of the former East Germany are among the major explanations for the negative contribution of non-ICT capital investment. ICT capital investment made a modest positive contribution. At the same time, the decline in TFP growth is very worrying.

— Graph 1.6 presents data on **Germany's** GDP per capita, productivity per person employed and productivity per hour worked relative to the US over the period 1979 to 2001[18]. Germany's hourly productivity grew fast up to the early years of the 1990s but it has subsequently stagnated. Productivity per person employed has actually shown a modest diminishing trend while GDP per capita has declined markedly.

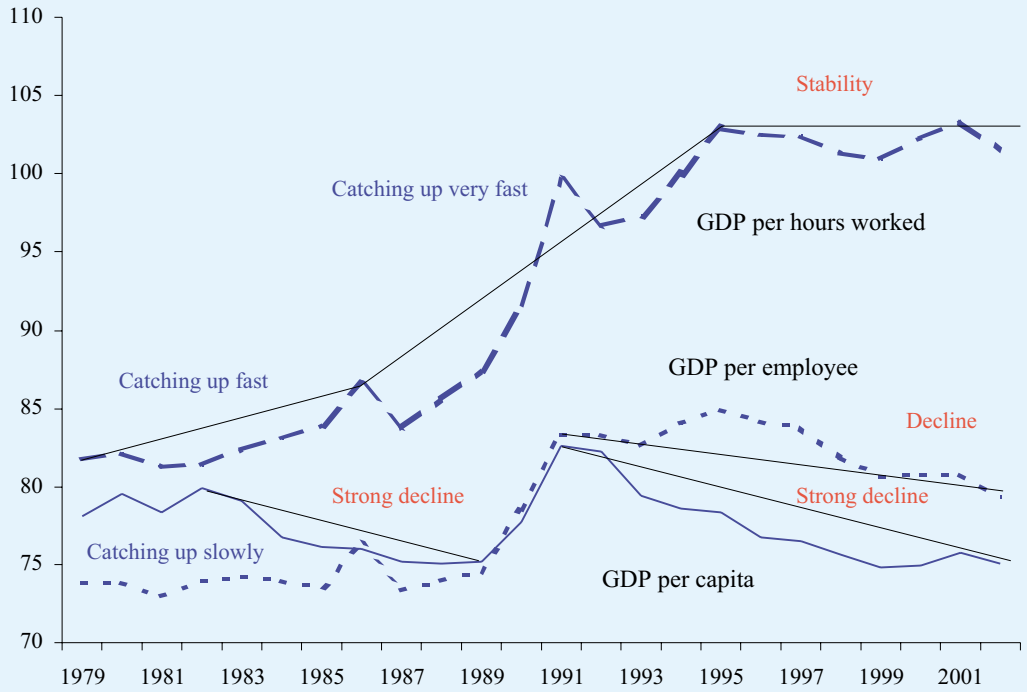
— The data on **Germany's** GDP per capita and GDP per person employed suggest that there have been two periods generally characterised by stagnation or strong decline, from 1983 to 1989 and from 1993 to 2002. In between, however, there was a marked increase. This contrasts with the persistent strong increase in hourly productivity. Taken together, these developments mean that there has been a reduction in average hours worked, without an increase in GDP per employee. Since hours worked had been longer in East Germany, unification resulted in a reduction in average hours worked associated with the application of regulations in use in West Germany. Since 1995, GDP per hour has been fairly stable as compared to the US.

— In the case of **Italy**, the major cause (about two-thirds) of the decline in labour productivity was the deceleration of TFP growth, followed by a substantial negative contribution associated with non-ICT capital spending. ICT capital has contributed positively but modestly.

— The **UK** case is to some extent a paradox. The UK invests heavily in ICT and the contribution of ICT during the 1995-2001 period (0.52 percentage points, see Appendix 1.3) is large by the standards of other countries (only Finland, Ireland and Sweden saw comparable results). The UK even saw an increased ICT contribution compared to that of the US between these two periods. Nevertheless, the growth in hourly labour productivity fell by over 1 percentage point during the second period due principally to the decline in the contribution of TFP and to the lesser, albeit still substantial, decline in non-ICT investment contribution. It is possible that these findings reflect developments in the manufacturing sector, in general, as well as, in particular, the impact of the appreciation of the sterling in the

[18] It is clear that the unification process has been a major statistical and economic problem. Statistically, before 1991 the national income accounting in the Democratic Republic was based on the concept of the measure of the net material product with administrative price valuations. Economically these were two different regions, one with a developed market economy and high efficiency notably as far as productivity is concerned, the other with very high social standards and a high employment ratio, but with very low productivity.

Graph 1.6: Germany: GDP per capita, per person employedand per hours worked (US=100)



Source: WIFO and CEPII calculations using data from the Groningen Growth and Development Centre.

mid- to late 1990s on the performance of this sector. This appreciation contributed to a reduction in the growth of the manufacturing sector through the decrease in exports and the strong increase of imports (see O'Mahony and Robinson, 2003, for a discussion of the UK manufacturing productivity slowdown).

— In **the Netherlands,** total factor productivity growth remained virtually unchanged between the two periods. The major cause of the decline in labour productivity growth is the negative contribution of non-ICT investment. The contribution of ICT spending was modest (0.16 of a point).

— In the case of **Denmark**, both ICT and non-ICT capital contributed positively (the latter more than the former) to labour productivity growth, yet there has been a significant fall in TFP growth which swamped all other effects, yielding a significant reduction in labour productivity growth.

— Finally, in the case of **Spain** and **Portugal,** ICT investment has made virtually no contribution and the decline in labour productivity growth is associated with substantial declines in the contribution of non-ICT capital and in total factor productivity growth in almost identical measure.

This review suggests that ICT investment has played a major role in the US productivity revival of recent years. It has also played an important but lesser role in those EU Member States that have seen a generally favourable productivity performance. The contribution of ICT tends to be small in the countries that have seen a decline in total factor productivity growth and, generally, insufficient ICT investment appears to be one of the reasons for the disappointing productivity performance of several EU economies.

1.4 Productivity, employment and economic growth

1.4.1 Long run trends in employment and working time

The large and persistent difference between the EU and the US in per capita income amounting to about 30 % has been strikingly stable over several

decades. Another characteristic of recent years has been the coming to an end of the productivity convergence process, which has contributed to maintaining the gap between EU GDP per capita and that of the US.

Within the EU, and excepting Ireland, productivity in the leading Member States is of the order of twice as high as that of the lagging EU Member States. This constitutes another feature of the data. While there has been some convergence of the less wealthy Member States towards the standards of living of the advanced ones, the catching up process appears to have come to a halt in the latter part of the 1990s. Employment rates differ widely across Member States as does the number of hours worked per employee.

It appears that while there are signs of slow convergence, driven by technological developments – for example, ICT – that have an impact across all economies, there remain important underlying differences in institutions and even in preferences that likely inhibit faster convergence. At the same time, such differences in institutions and preferences, as they might exist, offer opportunities for Member States to adapt their policy approaches to new challenges.

Graph 1.7 shows the trends in hourly productivity over the period 1985-2002 for each Member State relative to the EU average.

The relationship between productivity and working hours is complex. Higher productivity makes possible the production of the same volume of output with fewer hours worked and permits a reduction of either the number of workers or of the number of average hours worked or both. Over the medium term, increasing productivity lowers the relative price of products produced in high productivity sectors, raises real incomes, improves interna-

Box 1.5: In search of the best performing European countries in recent years

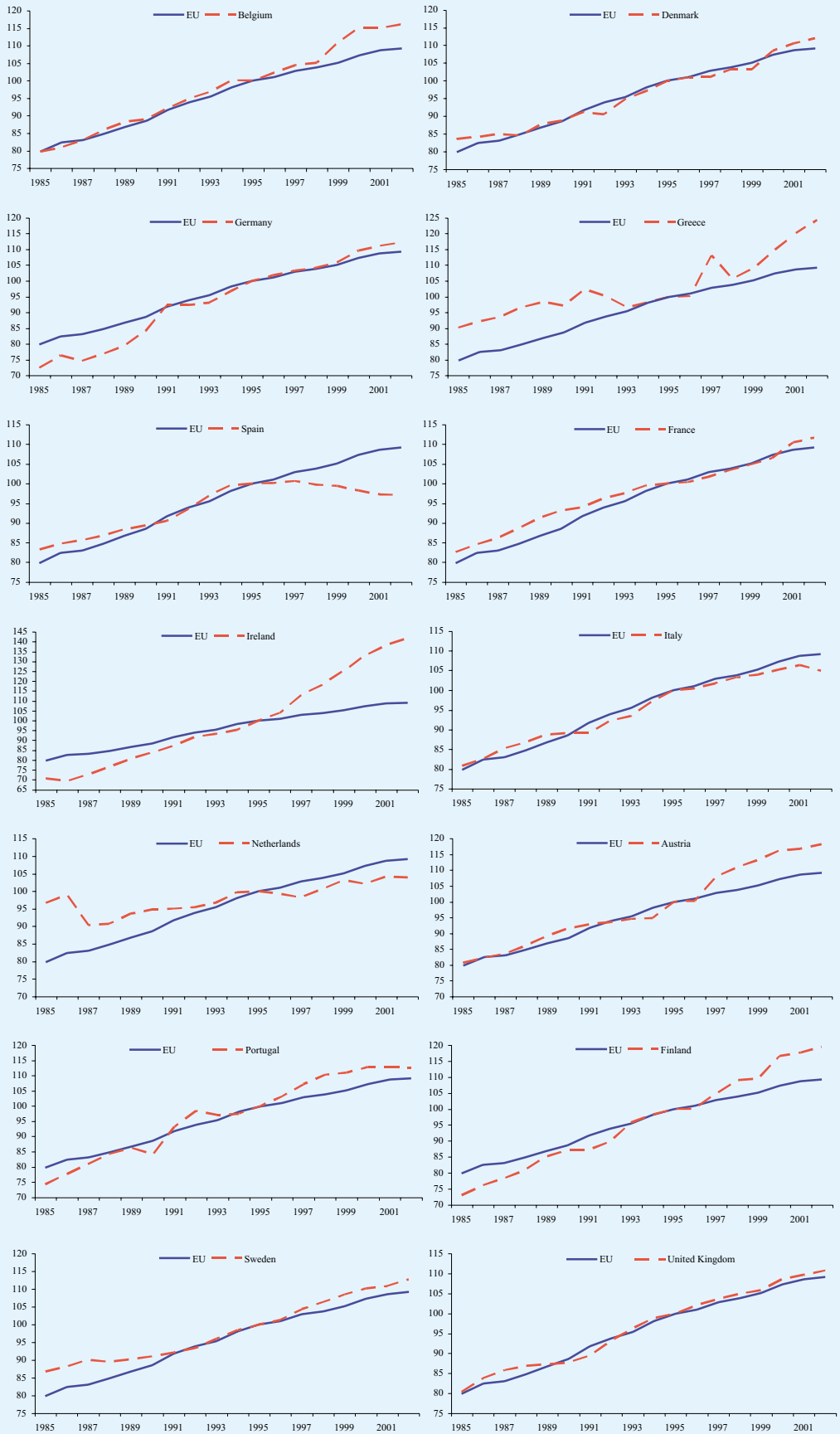
Some European countries came close to the US in terms of output growth and productivity, some in employment rates and employment growth; but none in all four dimensions. The strongest performer was **Ireland**, which experienced an extremely successful catching up process, surpassing the EU average in GDP/capita (though not in GNP/capita). Relatively successful in boosting output and productivity are **Sweden** and **Finland**, whereas the **Netherlands** increased employment partly on a part-time basis (see Section 1.4).

Even among these relatively successful countries, the performance looks rather different across indicators (Aiginger, 2002). Finland enjoyed productivity increases, specifically in the manufacturing and technology sectors but its unemployment is still rather high. Sweden also experienced high productivity growth in manufacturing, but low increases in employment and after several devaluation episodes during the past years its per capita GDP is now close to the EU average. Government expenditure shares and taxes decreased in relation to GDP but are still high. Overall performance in very recent years has been impressive as it has happened despite difficulties in some of its largest firms and the general downturn in the ICT industries.

The Netherlands has excelled in employment creation and in lowering significantly the rate of unemployment. It has encouraged part-time work, has focused on research, and has enjoyed high employment, low unemployment rates, and employment growth. But a rather large part of the employment potential has been classified as disabled and shifted into schemes meant to protect people with a disability. The Netherlands has had low increases in productivity per person employed, although starting from high levels (see Section 1.4).

Should one seek common elements among these Member States, the structural and institutional characteristics of these countries appear as a first candidate. These four countries are small open economies, belonging to the group of Northern–type welfare states with high costs and taxes. Policy–making involves tripartite–type decisions encompassing the government, trade unions and employers' representatives. All four are countries with a consistent long run consensus, rated as countries with the highest "trust" or "social capital" (see Temple, 1999).

Graph 1.7: Hourly labour productivity in the Member States (1995=100)



Source: WIFO calculations using data from the Groningen Growth and Development Centre.

There are also common elements in policy strategies that have been pursued by these Member Sates. These are the following:

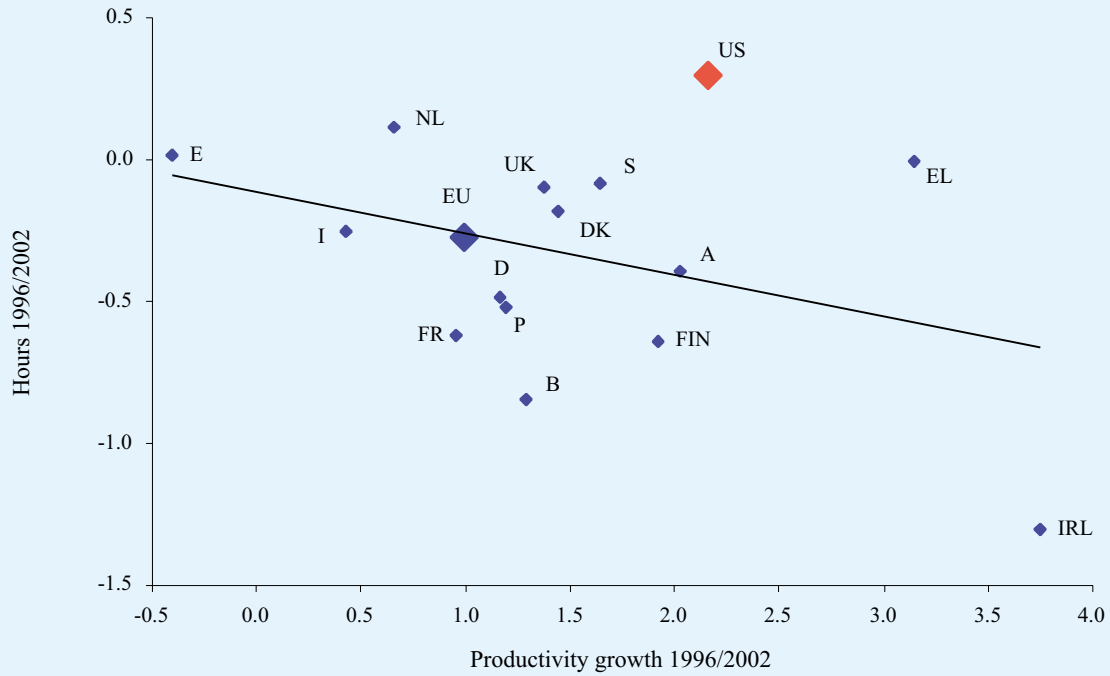
— The overriding strategy objective has been to increase the medium-term rate of economic growth. All these countries invested in research, education and in the production or diffusion of ICT. Finland and the Netherlands increased their research expenditures dramatically, even in a period when total government expenditure was reduced. Sweden reinforced the production and diffusion of telecommunications to become the leader in most ratings for the information society. On average these four countries increased R&D in relation to GDP from 1.6 % (1981) to 2.4 % (1995) and finally to 2.8 % in 2000, as compared to 1.9 % for the total EU area in the same year. Sweden and Finland are leading in expenditures on education, and Finland is leading in the PISA ranking in the quality of education. In the Netherlands the share of those in the labour force with secondary and tertiary education is above the EU average.

— The second strategy objective has been to bring costs and productivity in balance again. Additionally, all countries have reduced the corporate tax rate, which itself had been below the personal income tax rate.

— The third and crucial strategy objective has been to improve the incentive structure. Unemployed workers in these Member States have a high probability of re-employment and assistance if they look for a new job. This policy combines flexibility for firms with security for employees due to a high probability for them to find a new job.

Aiginger (2002) claims that the most important of the three objectives has been the first, namely the active investment into future growth. This is, of course, well in line with the goals of the Lisbon strategy. The other two objectives have aimed more specifically at improving competitiveness conditions and the third objective in particular was intended to strengthen the role of individuals making important economic decisions.

Graph 1.8: Productivity growth (GDP per hour) and change in labour input
(Average annual percentage change)



Source: WIFO calculations using data from the Groningen Growth and Development Centre.

tional competitiveness and contributes to raising potential output and employment. At the same time, reducing working hours may stimulate innovations and could lead to increasing productivity or, alternatively, to increasing prices, depending on the wage-price characteristics.

Graph 1.8 shows the relationship between productivity growth and the growth in average hours worked in the EU, the Member States and in the US during the period 1996-2002. The US saw an increase in hourly productivity during this period and an increase in hours per worker; the latter increased by 0.3 % per annum. In contrast, hours worked per person employed in the EU decreased by around 0.3 % per year. Ireland and Spain offer two extreme examples. Ireland was able to reduce hours worked yet achieved a high rate of hourly productivity and economic growth while in Spain hours worked remained broadly constant and hourly productivity declined.

The data in Graph 1.8 suggests that during the period in question the relationship between productivity growth and hours worked has been negative but in about half of the Member States the reduction in average hours worked has been modest. Larger reductions (greater than 0.5 %) were recorded in Belgium, Finland and France.

Graph 1.9 presents comparative data on the rate of employment, on total hours worked and on hours worked per person employed in the EU and in the US over the last decades.

Over the long term, working time has been decreasing and employment rates have been increasing. Since 1870 there has been a decrease in working hours from an annual average of 3,000 hours to less than 2,000 hours in the US and to around 1,500 for EU countries[19]. In the 1990s the reduction of working hours did decelerate, but in some countries the opposite occurred, that is, average hours worked increased (Sweden and US). In the Netherlands hours worked declined while the employment rate increased due to an increase in part-time work. Within the EU, average hours worked range from 1,376 hours per employee in the Netherlands to 1,921 hours per employee in Greece.

Historical data reveal that the ratio of employment to the total population remained surprisingly constant in Europe between 1870 and 1995, at about 44 %. In contrast the ratio of employment to population in the US exhibits an upward trend from 30 % in 1900, to 42 % in 1950 and 47 % by 1995. The share of employment in working age population in the US increased from 36.6 % in 1870 to 41.0 % in 1973 and then again to 49.1 % in 1998. A secular rise in labour participation is to be expected due to the rise in female labour participation. However, additional years spent in education, increasing life expectancy and incentives towards early retirement are working against this secular trend. Relating employment to working age population (instead of total population) underlines these trends and highlights the differences between the US and Europe.

The ratio of employment to working age (instead of total) population from 1960 to 2002 is shown in the first panel of Graph 1.9. The employment rate in Europe was 66 % in 2002, practically the same as in 1975. In the US, the employment rate increased from 63 % in 1975 to 73 % in 2002. Thus the US, which used to have a lower employment rate, surpassed Europe in 1978 and saw an increase of 12 percentage points by the end of the 1990s. The employment rate in the EU has increased in recent years from a trough of 62 % in 1994 to 66 % in 2001 and 2002.

1.4.2 Economic growth and employment

Economic growth plays a key role in the growth in employment. The ratio between the percentage change in employment and the percentage change in output is the elasticity of employment with respect to output. This elasticity is not constant over time and varies substantially with the business cycle. The estimates, presented in Table 1.11, are average elasticity estimates obtained over the peak–to–peak years 1979-1989-1996-and 2002[20].

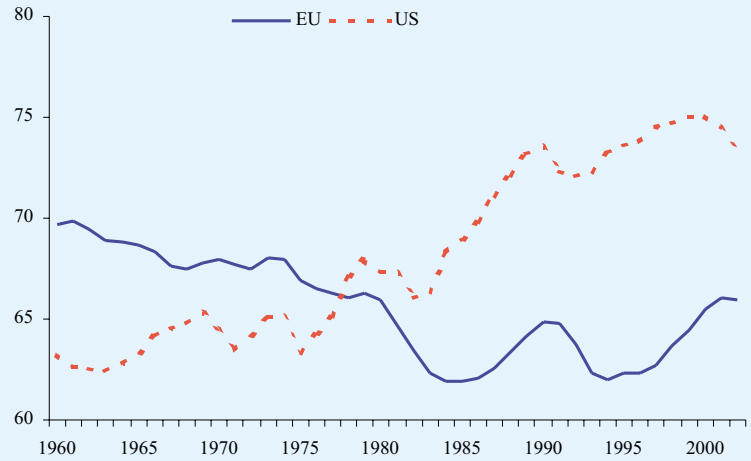
The US has generated more employment per unit of output than the EU during the two decades up to 1989. For each percentage point of GDP increase, employment increased by 0.47 percentage points in the US and by 0.27 points in Europe. However, over time the output elasticity of employment in the US has been decreasing. In the EU, the output elasticity of employment was considerably lower than in the US up to 1989 and then turned negative in the first half of the 1990s. However, in the second half of the 1990s it rose to 0.58 %, clearly surpassing the

[19] Following Maddison (2001).

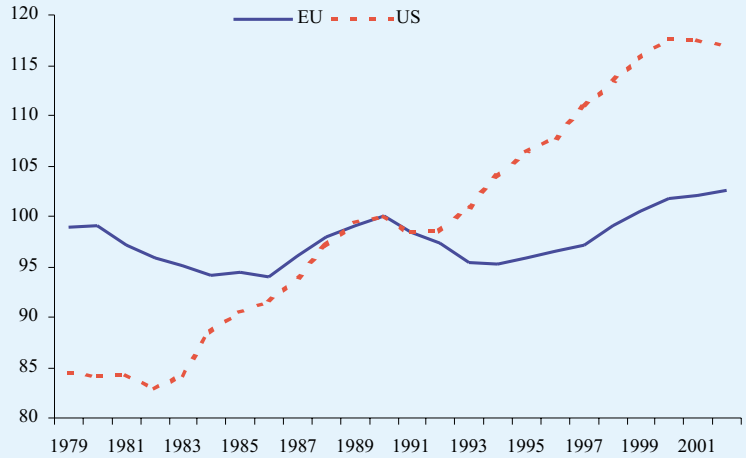
[20] The true peak was 2000 but as the data are virtually identical, the latest data available up to 2002 have been used. Employment elasticities for the 1996-2000 period are 0.53 and 0.40 for the EU and US, respectively, compared to 0.58 and 0.31 for the 1996-2002 period.

Graph 1.9: Employment and working hours in the long run

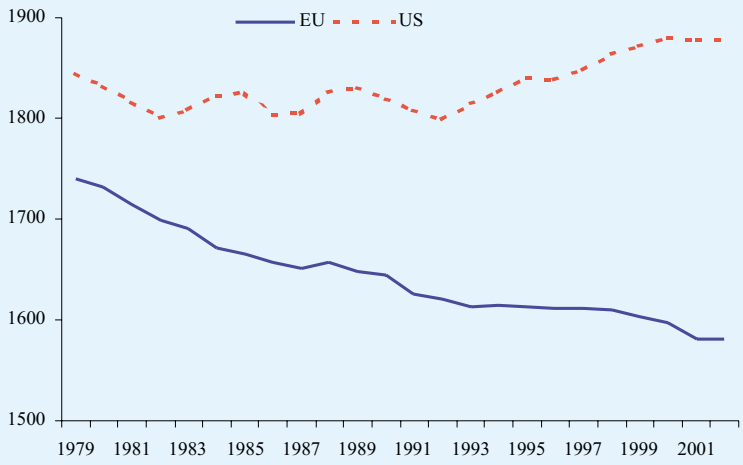
Employment rate



Total hours worked
(1990=100)



Hours worked
per person



Source: WIFO calculations using data from Groningen Growth and Development Centre.

Table 1.11: Employment elasticity with respect to GDP

	1979/2002	1979/1989	1989/1995	1995/2002	2001/2002
Belgium	0.17	0.01	-0.04	0.41	-0.29
Denmark	0.26	0.38	-0.28	0.33	0.13
Germany	0.02	0.23	-0.44	0.23	-1.26
Greece	0.35	0.58	0.45	0.06	0.06
Spain	0.47	0.13	-0.43	1.13	1.06
France	0.26	0.09	-0.11	0.60	-0.10
Ireland	0.34	-0.15	0.44	0.55	0.28
Italy	0.29	0.23	-0.44	0.75	5.63
Luxembourg	0.56	0.33	0.65	0.77	0.43
Netherlands	0.94	1.22	0.83	0.77	3.99
Austria	0.41	0.44	0.88	0.14	-0.72
Portugal	0.40	0.41	-0.66	0.62	1.50
Finland	0.08	0.25	5.23	0.47	0.00
Sweden	0.08	0.35	-3.64	0.43	0.00
UK	0.25	0.25	-0.29	0.46	0.33
EU	0.27	0.25	-0.29	0.58	0.45
US	0.47	0.57	0.42	0.31	-0.22

Source: CEPII calculations using data from the Groningen Growth and Development Centre.

US. The increase in the output elasticity of employment in the EU appears to indicate a change in the relationship between GDP and employment growth. Whether this is durable it is difficult to say at this stage. The increase is to some extent the mirror image of the deceleration in productivity growth.[21] But this is only a partial view since fast growing economies (Ireland, Finland and Sweden for example) can boost productivity and employment at the same time.

1.4.3 Recent developments in productivity and employment in France, the Netherlands and the UK

This section presents a brief discussion of the experience of France, the Netherlands and the UK on productivity and GDP per capita relative to the US since 1979. These Member States offer evidence of diverse experience based on different policy priorities. However, what is common to the three Member States is that they have emphasised employment creation but also, predominantly the UK, strengthening productivity growth. This discussion should also be seen against the urgent need to raise employment, a common feature virtually in all the Member States during recent decades.

France

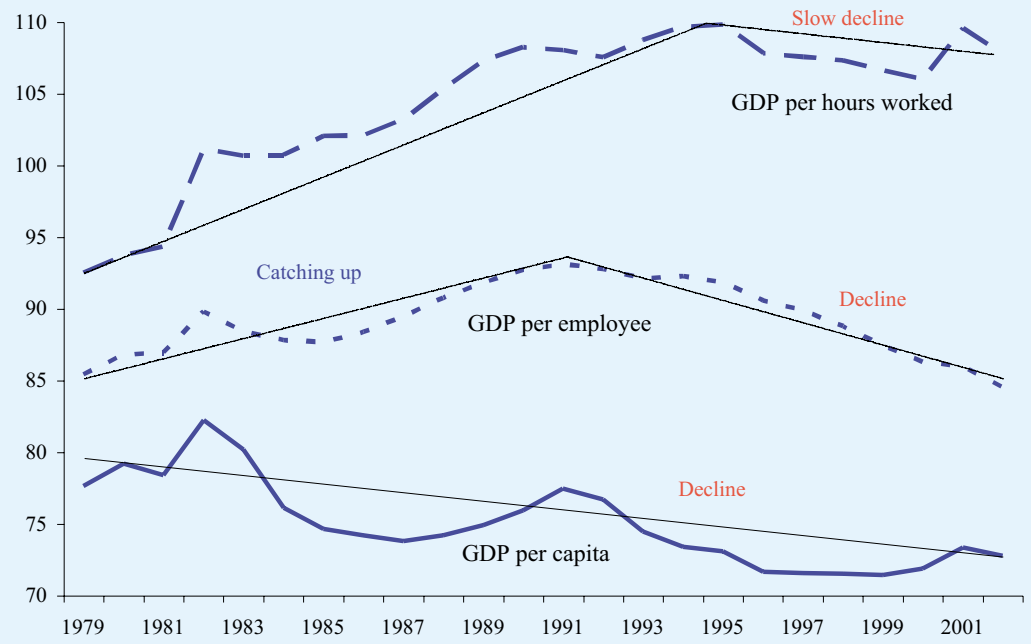
France has seen a persistent increase in unemployment from less than 3 % in the late 1960s to 12.7 % in 1996. Partly in response to high unemployment, France introduced shorter workings hours and a reduction of the cost of employing low wage earners.

Graph 1.10 presents the key data measured against the US. Productivity per person employed followed a steadily rising path up to the beginning of the 1990s when the recession brought this process to an end. Yet, hourly productivity continued to rise up to 1995, thus supporting the convergence process towards the level of US hourly productivity. What is striking, however, is that since the early 1980s GDP per capita relative to the US has been on a clear declining trend. At the background of this development are principally the low participation rates, especially those of young and less qualified people and older workers (the participation rate of those aged 15 to 24 in 2001 was 29.9 % in France, 61.1 % in the UK and 73.6 % in the Netherlands).

Clearly, high productivity of the sort experienced in France has been insufficient to support a secular rise in GDP per capita relative to the US. The secular

[21] Note that productivity growth can be written as GDP growth times the complement of the employment elasticity. Therefore an acceleration in productivity is compatible with an increase in employment elasticity provided GDP acceleration is strong enough.

Graph 1.10: France: GDP per capita, per person employed and per hours worked (US = 100)



Source: WIFO and CEPII calculations using data from the Groningen Growth and Development Centre.

decline in relative GDP per capita is a worrying development. Together with the rise in unemployment, this has posed a critical challenge to economic policy in France. In the mid-1990s the government introduced several measures aimed at reducing the duration of the workweek and at lowering the indirect cost of low-wage workers[22]. In 2001, France had a per capita GDP 2 % above the EU average and surpassed the EU average in hourly productivity and in productivity per person employed by respectively 17 % and 9 %.

The Netherlands[23]

In recent years the Netherlands has succeeded in reducing its unemployment, maintaining a rather generous welfare system and favouring part-time work. At the same time, however, hourly productivity and GDP per person employed relative to the US has seen a clear downward trend throughout the period 1979–2001 while GDP per capita has remained almost trendless during this period. These developments are shown in Graph 1.11.

In 1982 the rate of unemployment stood at close to 11 % but it declined to reach 2.1 % in 2001. Hourly productivity in the Netherlands, which was 45 % higher than the EU average in the early 1980s, has declined to just 15 % above the EU average in 2001. In the period 1996–2002, hourly productivity growth declined by 1.2 percentage points compared to the period 1989–1995 but GDP growth was around half of one percent higher. Despite the relative decline in productivity, the Netherlands maintained a steady, and modestly rising since the late 1980s, 1evel of GDP per capita relative to the US. Underlying this development has been a rising working age population (growing faster than the EU average) and a high employment rate, comparable to that of the UK. A principal contributing factor in the growth of employment has been the very rapid expansion of part-time jobs[24].

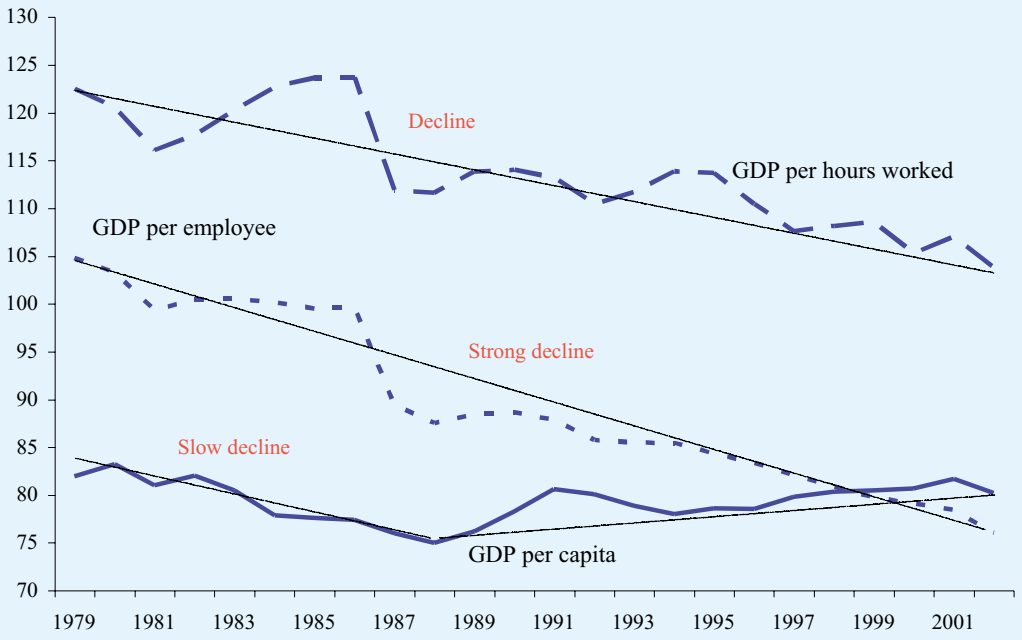
It appears, therefore, that through a mix of long term policy commitments and decentralised negotiations with social partners, including wage restraint, the Netherlands succeeded in maintain it standards of living yet at the cost of a declining level of productivity relative to the US. While there may still be some potential for pursuing such policies and make further gains in employment and output growth, the deceleration of productivity growth since 1995 suggests

[22] Various studies indicate that a 1 % decrease in the labour cost of low wage earners raises their employment by one percent, see L'Horty (2000).

[23] See Sébastien (2000).

[24] The level of part-time employment in the Netherlands is twice the average level in OECD countries.

Graph 1.11: Netherlands: GDP per capita, per person employed and per hours worked (US = 100)



Source: WIFO and CEPII calculations using data from the Groningen Growth and Development Centre.

that the limits to sustaining prosperity on the basis of such policies may be emerging.

The UK

GDP per person employed and per hour worked in the UK followed a rising trend over the period 1979 until the mid-1990s, in a manner similar to developments in other EU Member States. Indeed, the catching up process to US levels of productivity was particularly evident in the case of hourly productivity. Yet, compared to other EU Member States, the early lead in per capita income has been eroded, even though this has been partly reversed in more recent years. GDP per capita relative to the US has followed a modestly rising trend. These developments are presented in Graph 1.12.

The UK has in recent years been characterised by lower productivity than the EU average but rising employment (unemployment in the 1990s in the UK declined to levels not seen since the early 1970s). This has made possible the growth in the standards of living measured by GDP per capita[25]. Economic and technological modernisation, especially involving ICT and other modern technologies, has also contributed significantly to this advance.

1.4.4 Some evidence on the trade off between working hours and per capita income

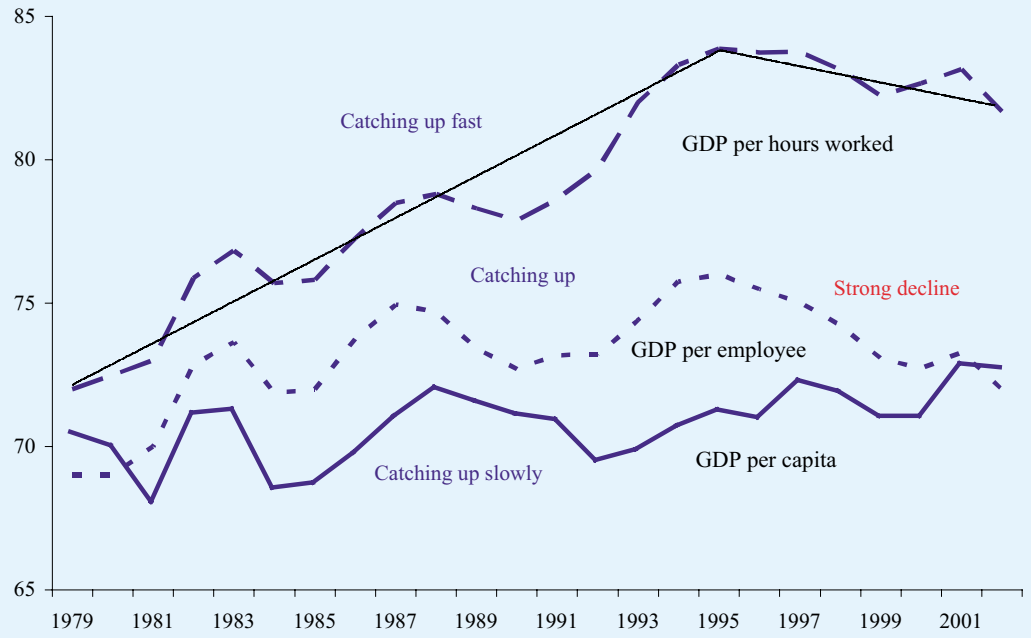
Per capita income is about 30 % lower in the EU than it is in the US, a much larger difference than the productivity difference. Section 1.2 suggested that the difference can be accounted for by the lower employment rate in the EU but primarily by lower working hours per worker. In historical perspective, these differences have evolved relatively recently since Europe has had longer working hours per person and higher employment rates than the US. Reduction in working time has been a policy goal of trade unions and has enjoyed broad support in ruling political parties in Europe. Naturally, reducing the employment rate has never been a policy goal even though it has resulted from longer time spent in education and early retirement and disability schemes[26].

Differences in labour force participation, as well as differences in working hours per year, can be

[25] Unemployment reached just over 1 million persons in 1999. Recent research suggests a wide range of factors that have contributed to this decline, including moderate wage growth in the 1990s, the decline in trade union power, more flexible labour markets and changes to the benefit administration system – see Riley and Young (2001).

[26] See OECD (2000).

1.12: UK: GDP per capita, per person employed and per hours worked (US = 100)



Source: WIFO and CEPII calculations using data from the Groningen Growth and Development Centre.

induced either on the supply or on the demand side. People may be willing to work a longer part of their life, but do not find adequate employment and stay out of the labour market (discouraged workers). Or, people working fewer hours may either voluntarily choose greater leisure for reasons of family responsibilities and cultural interests or accept part-time work as a substitute for insufficient full-time employment opportunities. The institutional settings of labour relations and working arrangements together with the cultural background and traditions, as well as the educational system, the steepness of wage schemes with experience and tenure, and the institutions for child rearing all play a critical role in these choices.

The reduction in statutory working time in Europe relates to negotiated contracts or laws, which have introduced maximum working hours and longer holidays for full-time workers. In the more recent years, average working time has declined as a consequence of an increase in part-time work, and flexible work contracts. A further reduction of working time in Japan and France reflects legal decisions, while reduction in working time in Germany and the Netherlands has been the result of intensive discussions with the trade unions. In Sweden, working time has increased due to increasing working hours for part-time workers, while in the US the increase was due to increasing overtime hours. However, historically, the reduction in working time in all EU Member States has reflected the rise in the standards of living associated with rapid productivity growth. Indeed, this has been the crucial factor that has made possible not only the rise in real incomes but also the reduction in working time and the increase in leisure time during the past decades.

Part-time work has become the main source of the increase in labour participation and job creation in Europe. Part-time jobs are nevertheless often considered as low–quality jobs: wages are lower[27], as are the possibilities to benefit from professional retraining, and it is often difficult to change from part-time work to full-time work. These factors indicate that part-time work is not always voluntary[28].

Table 1.12 shows that a large majority of workers would choose to work more, if possible. Note,

[27] Evidence on the effects of part-time work on *hourly* wages in the EU countries is mixed: estimates presented in European Commission (2003b, p. 129) suggest that in six of the twelve Member States for which data were available, part-time work appears to be associated with positive wage premia, while in the other six, hourly wages (adjusted for job and worker characteristics) are lower for part-time workers.

[28] For a discussion of labour developments in recent years and the importance of part–time work, see European Central Bank (2002).

Table 1.12: Effective working hours and leisure/income trade off in the EU, 1985 and 1994

	% employees who prefer						Average annual hours worked by employees		
	Work more			Work less			1985	1994	Ratio 1994/1985
	1985	1994	Ratio 1994/1985	1985	1994	Ratio 1994/1985			
Belgium	58	48	0.83	36	40	1.11	1 643	1 603	0.98
Denmark	38	32	0.84	51	66	1.29	1 586	1 568	0.99
Germany	56	54	0.96	30	34	1.13	1 674	1 590	0.95
Greece	68	84	1.24	26	14	0.54	1 803	1 803	1.00
Spain	64	70	1.09	31	24	0.77	…	1 741	…
France	62	53	0.85	34	40	1.18	1 696	1 670	0.99
Ireland	78	59	0.76	19	37	1.95	1 815	1 747	0.96
Italy	55	54	0.98	39	39	1.00	1 710	1 682	0.98
Netherlands	46	43	0.93	47	52	1.11	1 654	1 447	0.87
Portugal	82	58	0.71	11	35	3.18	1 871b	1 847	0.99
UK	77	62	0.81	19	32	1.68	1 684	1 683	1.00
Unweighted Average	62	56	0.90	31	38	1.20	1 696	1 671	0.99

… Not available.
(a) Data are only for those who make a choice.
(b) 1986.

Source: CEPII calculations using European Commission (1995, page 19) and EUROSTAT.

however, that this preference has become weaker over time since the percentage of those preferring to work more declined from 62 % in 1985 to 56 % in 1994. Similarly, the share of those who would prefer to work less and have reduced income rose from 31 % in 1985 to 38 % in 1994. Thus, between the years 1985 and 1994 the data suggest that opinions have begun to shift in favour of more leisure (except in two of the less wealthy Member States, Greece and Spain, but not in Portugal).

It appears that a majority of women working part-time are voluntarily doing so and are more satisfied than full-time workers, and that more women would like to have access to part-time work. It seems that quality of life and the possibility to have time for their children is to some extent acceptable at the price of a reduced income. Increasingly, both partners of a family would prefer some type of reduction of working time during specific phases of their life cycle. Several countries aim at distributing part-time jobs more evenly between male and female workers, encouraging male workers to take part in the maternal/paternal leave or to share a reduction in working time. If part-time work became more of a choice or even a kind of "normality", and if it would not be confined to lower paid jobs, career opportunities and income expectations would not suffer after short part-time periods.

There are some indications suggesting that there are differences in preferences between the US and Europe. There is no strong popular support, if any, in the US to shorten the workweek or to increase holidays, while in Europe trade unions have actively sought longer holidays and shorter working hours. If trade unions or labour councils accept shorter working hours in exchange for lower wage increases this implicitly reveals a preference for leisure. Revealed preference for greater leisure is suggested in cases where workers voluntary agree to switch from full–time contracts to part–time contracts, and where trade unions negotiate the right of reducing work time for full-time employees (see the legal possibility to switch to part-time work in the Netherlands discussed in Visser, 2002).

On the other hand, there is evidence suggesting that a low employment rate is not always voluntary: the high rate of unemployment in several Member States clearly points to a shortage of employment opportunities. Some part-time employees would prefer full-time work (see Table 1.12). Also the existence of institutional constraints – which give part-time

Table 1.13: Total tax wedge as percent of labour costs for low-wage earners

	1996	1997	1998	1999	2000	2001	2002	Change 2002-1995
Belgium	50.5	49.5	51.1	51.0	49.9	49.1	48.9	-1.6
Denmark	41.3	41.7	40.4	41.3	41.2	40.6	40.4	-0.9
Germany	46.5	47.7	47.5	47.0	46.5	45.5	45.9	-0.6
Greece	34.9	35.0	35.1	34.3	34.3	34.3	34.3	-0.6
Spain	34.4	34.8	35.1	32.6	32.8	33.4	33.9	-0.5
France	44.3	41.6	42.5	40.3	39.6	38.4	37.8	-6.5
Ireland	26.5	24.9	23.4	21.5	18.1	17.3	16.6	-9.9
Italy	48.3	48.8	44.4	44.1	43.3	42.8	42.7	-5.6
Luxembourg	29.1	29.7	28.9	29.5	30.4	28.8	27.3	-1.8
Netherlands	39.3	38.8	39.2	40.2	40.6	36.8	37.2	-2.1
Austria	41.0	41.1	41.5	41.6	40.1	39.7	39.9	-1.1
Portugal	30.6	30.8	30.7	30.2	30.4	29.5	29.5	-1.1
Finland	44.4	44.2	44.0	42.6	42.4	41.0	40.4	-4.0
Sweden	48.6	49.2	49.3	48.7	47.9	46.8	45.9	-2.7
UK	26.8	28.4	28.5	25.8	25.3	24.5	24.7	-2.1
EU-15	40.6	40.8	40.3	39.1	38.6	37.7	37.8	-2.8
Japan	18.4	19.4	17.7	23.1	23.1	23.2	23.2	4.8
US	29.2	29.2	29.1	29.2	29.0	27.4	27.3	-1.9

Note: The tax rate is calculated for a single person without children earning 67 % of an average wage as a full-time production worker in manufacturing. The rate calculated is the average rate of tax on earnings and is defined as total income tax on gross earnings plus employee and employer social security contributions.

Source: Eurostat, Structural Indicators.

employees priority in switching to full-time jobs (at the cost of outsiders) - points to an unsatisfied demand for full-time jobs.[29]

1.4.5 Reducing the total cost of low wage earners

Clearly, the low employment rate in the EU compared to the US raises the question of whether measures should be taken aimed at those with greatest difficulties in obtaining a job – including, though not exclusively, low-wage workers[30]. In a rapidly changing competitiveness environment, low–wage/low–productivity workers could be favoured through training and education opportunities and through reductions in the cost of their employment. Efforts in both directions have been undertaken in recent years and some Member States have actively sought not only to help poorly qualified workers entering into the market with counselling and training, but also reducing the cost of hiring low qualified people. Some countries have been very active in that direction as can be seen in Table 1.13.

A critical variable in this context is the tax wedge, the difference between the wage paid by the employer and the wage received by the employee. Table 1.13 shows that in all Member States there has been a considerable reduction in the tax wedge on low wages since 1996. The size of the reduction ranges from half a percentage point in Spain to almost ten percentage points in Ireland. Despite the general trend towards reducing the tax wedge on low earnings, cross-country differences remain large in the Union. In 2002, Ireland had the lowest tax wedge on low-wage earners in the EU, amounting to 17 % of total labour costs. Ireland was followed by the UK and Luxembourg, which respectively had a tax wedge of 25 % and 27 %, levels which are comparable to those in Japan and the US. At the higher end of the range were Sweden, Germany and Belgium, where income taxes and social secu-

[29] Gordon (2002, pp.10ff) raises the question of whether "…Italian men who retire early or housewives sitting at home are doing this because they chose to, or because the economy or society does not provide sufficiently rewarding jobs for them" and answers with the wild guess, that one-third of the difference represents voluntary chosen leisure and two-thirds represent a lack of employment opportunities. The consequence is that a welfare corrected measure of efficiency of Europe relative to the US in 2000 is "neither 77 % nor 93 %, but something closer to 85 %".

[30] The importance of low–skilled workers in employment growth in recent years cannot be underestimated. While employment growth in the late 1990s was greatest amongst those with the highest educational and professional qualifications, correcting for the relative size of educational groups, the employment rate increased the most amongst those workers with the lowest educational qualifications; see European Central Bank (2002) for a discussion.

rity contributions for low-wage earners ranged between 46-49 % of gross earnings.

While measures such as education and training and reductions in the cost of hiring for the less qualified in the labour force could conceivably contribute, *ceteris paribus*, to raise the employment of low–wage earners and, correspondingly, the employment rate, there remains a potential conflict in that raising the employment of low–wage/low–skilled employees would, as a consequence, raise their share in employment. This would decrease productivity growth to the extent that the share of low productivity sectors where these workers will most likely find employment (such as retailing, renovation work, etc) will increase in our economies[31]. However, one should not lose sight that the reason why productivity growth is important is that there is a limit to the role played by participation and employment rate improvements in improving standards of living in the long run. A decrease in productivity growth due to the phenomenon just described, if accompanied by a sufficient increase in employment, will increase standards of living and therefore should not cause the same concern as a productivity deceleration resulting, for instance, from insufficient technological upgrading or lack of innovation efforts. Nevertheless, improving standards of living through this type of employment effect will only have, at best, a temporary impact and does not constitute a sustainable way of ensuring ever-higher living standards in the long run.

Thus, it is clear that the approach suggested by the Lisbon strategy, of increasing the employment rate and of enhancing the prominence of knowledge in all facets of our economies, provides the most effective answer to our ambitions.

1.5 Concluding remarks

The EU is currently experiencing a slow growth period, with three years of about 1 % growth per year. Relative to other slow growth periods, employment has been surprisingly resilient. 2.6 million jobs have been added in 2001 and 2002 combined, but in 2003 employment has not been rising and the unemployment rate will increase. A large share of the new jobs are part-time, with hours per worker decreasing by 0.5 %. However, at the background of the increase in employment during this slow growth period has been the low increase in productivity. In the past two years, productivity per person employed increased by an average of around half a percent point and productivity per hour worked by somewhat less than 1 percent.

Despite the recent slow growth in the US, productivity per person employed and per hour worked has increased on average by around 1.6 % while in the EU this increase has been 0.4 % and 0.9 %, respectively. Over the period 1995-2002, the cumulative difference between the US and the EU in GDP growth amounts to some 8 percentage points, while the cumulative difference in productivity growth amounts to 9 percentage points per person employed and 4.5 percentage points in terms of hours worked. Yet, there is hardly any difference in terms of growth in GDP per capita (it has increased by a cumulative 14.7 points in the EU and 14.3 points in the US) because demographic expansion was much stronger in the US, where population increased by 9.4 % from 1995 to 2002, while the EU saw a modest 2 % increase during the same period.

A key determinant of the superior US productivity performance relates to ICT investment and use. The contribution of ICT capital to hourly productivity growth in the EU rose from 0.22 percentage points in 1990-1995 to 0.34 points in 1995-2001. In the US, the average contribution of ICT capital during these periods is estimated, respectively, at 0.32 points and 0.57 percentage points. Trends in hourly labour productivity in the EU during the 1990s have been influenced by capital deepening, in particular in the area of other non-residential capital while the contribution of ICT capital and of total factor productivity has been of a lesser magnitude. In the US, the contribution of non-residential capital has been on a smaller scale than in the EU and the contribution of total factor productivity growth has been greater. The contribution of ICT investment in the acceleration of hourly labour productivity growth is largest in Ireland and Finland and smallest in Portugal, Spain and Germany.

The insufficient productivity growth in Europe over the last decade is important since it stopped or reversed a decade long catching-up process towards the US performance. Thus in the beginning of the current decade the EU GDP per capita was around 70 % of the corresponding US variable, while GDP per person employed was around 82 % and GDP per hour worked was 86 %[32].

The largest component determining the strikingly large income difference (GDP per capita at purchasing power parity) is the higher hourly productivity in the US

[31] Carnot and Quinet (2000).

[32] Note that previous estimates that showed the EU equal to the US in the level of hourly productivity have not used consistent data for GDP per person employed and hours per worker.

as compared with Europe. The second component is the lower fraction of the working age population active in the labour market (participation rate). Differences in age structure do not play a role. As far as convergence is concerned there is surprisingly no convergence in per-capita income, and the difference of about 30 % has been stable over several decades. Production per person employed did converge over the past decades slowly, but steadily. This convergence stopped in the 1990s and the US increased its lead in the seven most recent years. Cyclical stability, as well as higher investment or higher efficiency in growth drivers such as research, education and the rapid diffusion of new technologies seem to have reinforced the leading US position. Employment rates have been increasing in the US over more than two decades. The US overtook Europe in 1978 and the difference in employment rates has reached a maximum of 11.8 percentage points in 1997 but decreased to 8 percentage points in 2002. However, these recent improvements may not be of lasting nature if global growth remains weak. To achieve decisive progress in employment growth more structural reforms are needed.

In hourly productivity, Europe was catching up fast until 1995. Several European countries seemed to have reached the US level in the beginning of the 1990s. The EU on average was lagging in 2002 by around 13 percentage points. Belgium and Luxembourg are the only Member States with considerably higher productivity per hour than the US. France, the Netherlands and Ireland rank equal to the US, while Italy, Germany and Denmark rank below the US (from 5 % to 9 % below).

Performance across European countries differed in the 1990s. The only country that increased productivity and employment faster than the US was Ireland. It surpassed the EU average in GDP per head and per hour, but is still below average in Net National Product and in wages per head. Out of the countries catching up, Greece and Portugal both enjoy above-average growth. Among the countries with medium or high income, the performance of Sweden, Finland, the Netherlands and Denmark can be considered as especially successful (in terms of macro-economic performance), allowing a combination of high wages and comprehensive welfare systems. The strategy of these countries – in addition to fiscal prudence and institutional reforms - has been to enforce education, in a lifelong learning perspective, research and the diffusion of new technologies, which are central elements of the Lisbon strategy.

However, even within this group there are different strategies and unsolved policy issues. The Netherlands favoured part-time work while Sweden and Finland benefited from the ICT revolution, with the latter still having a rather high unemployment rate. Among the larger countries, only in the UK has the contribution of ICT to productivity growth been large, allowing the UK to overcome decades of below-average productivity growth. In the UK, the level of hourly productivity remains low compared to the EU average, but employment has risen markedly in recent years. France did spread employment by reducing working hours; relative to the EU, it has a high level of productivity, but only slightly above average per capita income. Germany did not close its gap in high-technology sectors. Restrictive macro-economic policy and insufficient structural reforms resulted in the lowest growth rate among the member countries.

The remarkably large and persistent differences in productivity, income, and working hours between the EU and US, and even within the EU itself, may partly reflect choices between higher income and more leisure. In addition, however, they also reflect constraints in the functioning of labour markets or are the consequence of policies to cope with competitiveness on the firm level or with unemployment on the national level. Facilitating part-time work has successfully been used to increase labour market flexibility and to increase the employment rate. For some workers part-time work is preferred to full-time work but for others it is involuntary and limits earnings and upward mobility. Reducing the labour costs of low qualified workers, or limiting wage increases are other strategies to increase employment and the employment content of growth. Raising incomes can finally be achieved only by techniques that increase the long-term growth potential of an economy. Removing growth barriers and investing in the future i.e. innovation, education and diffusion of new technologies does this. Although each European country is facing a unique combination of structural constraints, some countries seem to be on track to increase productivity and employment.

A key goal of the Lisbon strategy is to raise the employment rate to 70 % in the context of real GDP growth of around 3 % per year. These employment and growth ambitions limit, at first glance, the scope for policies that encourage substitution of leisure for income. However, the Lisbon strategy is an attempt to embark on an autonomous growth path with higher GDP and productivity growth and thus creating room for manoeuvre. Becoming the most competitive economy requires reducing existing barriers to growth and encouraging activities that increase the long-term growth path, such as research, education and the diffusion of new technologies. In order for this approach to succeed it is necessary to foster innovation, thus retaining policy flexibility in a changing environment – as demonstrated by some of the smaller countries in the EU.

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Appendix 1.1: Components of the gap between EU countries and the US in 2002

	Gap in GDP per head in percentage points	Components					
		Working age population	Participation rate	Unemployment rate	Employment rate	Hours worked	Productivity per hour
	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)	SI (GGDC)
Belgium	-23 (-24)	4 (4)	87 (58)	9 (4)	*96 (63)*	43 (83)	-39 (-50)
Denmark	-19 (-15)	0 (0)	5 (-33)	-5 (-7)	*0 (-40)*	53 (140)	47 (0)
Germany	-27 (-25)	-4 (-4)	22 (12)	7 (8)	*30 (20)*	48 (88)	26 (-4)
Greece	-53 (-51)	-2 (-2)	36 (22)	6 (6)	*42 (27)*	-17 (-2)	75 (76)
Spain	-40 (-40)	-5 (-5)	35 (18)	10 (10)	*45 (28)*	-15 (5)	73 (70)
France	-26 (-27)	8 (7)	58 (30)	12 (11)	*69 (41)*	35 (85)	-8 (-30)
Ireland	-13 (-11)	-8 (-9)	115 (64)	-8 (-9)	*108 (55)*	0 (100)	8 (-45)
Italy	-27 (-27)	-4 (-4)	59 (30)	11 (11)	*70 (41)*	15 (52)	19 (11)
Luxembourg	34 (33)	3 (3)	62 (94)	9 (9)	*71 (103)*	-6 (-42)	32 (36)
Netherlands	-20 (-20)	-10 (-10)	20 (0)	-15 (-15)	*5 (-15)*	100 (140)	0 (-20)
Austria	-21 (-22)	-5 (-5)	24 (18)	-5 (-5)	*19 (14)*	38 (86)	52 (5)
Portugal	-51 (-48)	-2 (-2)	4 (-6)	4 (4)	*8 (-2)*	-2 (6)	96 (98)
Finland	-27 (-26)	-4 (-4)	44 (12)	-4 (-4)	*41 (8)*	-4 (50)	67 (42)
Sweden	-28 (-27)	7 (7)	11 (-15)	-4 (-4)	*7 (-19)*	18(44)	68 (67)
UK	-26 (-27)	4 (4)	12 (-4)	-4 (-4)	*8 (-7)*	-4 (37)	96 (67)
EU	-29 (-28)	0 (0)	34 (14)	7 (7)	*41 (21)*	14 (54)	45 (29)

Notes: How to read the table: Belgium has a gap of income per head of 24 %; most of it is explained by the low number of hours (83 %) and by its low participation rate (58 %). Column 5 corresponds to an alternative decomposition and represents the contribution of the employment rate, which is identical to the combined contribution of the participation rate and the unemployment rate (sum of columns 3 and 4).

Source: Population, employment and hours: GGDC, Ratio working age to total population: OECD (2001 estimates); unemployment rate: Eurostat; the labour force is calculated as the sum of employment and unemployment.

Appendix 1.2 Countries with high and accelerating growth in Total Factor Productivity between 1990-1995 and 1995-2001

Growth contribution in percentage points 1990-1995 and 1995-2001

	ICT Investment		Non ICT Investment		Total factor productivity		Labour productivity	
	1990-1995	1995-2001	1990-1995	1995-2001	1990-1995	1995-2001	1990-1995	1995-2001
Finland	0.23	0.58	1.22	-0.02	1.29	2.12	2.73	2.68
Ireland	0.25	0.66	0.97	1.89	2.29	2.84	3.51	5.39
Austria	0.16	0.26	1.44	1.40	0.14	0.91	1.74	2.57
France	0.12	0.21	1.33	0.64	-0.04	0.80	-1.42	1.65
Sweden	0.28	0.53	1.13	0.65	0.46	0.54	1.87	1.72

Source: CEPII calculations using GGCD data (unpublished).

Appendix 1.3 Countries with deceleration in Total Factor Productivity between 1990-1995 and 1995-2001

Growth contribution in percentage points 1990-1995 and 1995-2001

	ICT Investment		Non ICT Investment		Total factor productivity		Labour productivity	
	1990-1995	1995-2001	1990-1995	1995-2001	1990-1995	1995-2001	1990-1995	1995-2001
Netherlands	0.19	0.33	0.89	0.38	0.01	-0.03	1.07	0.67
Denmark	0.35	0.48	1.35	1.57	0.67	-0.40	2.37	1.66
UK	0.29	0.52	1.54	0.98	0.77	0.05	2.61	1.54
Portugal	0.25	0.26	2.21	1.51	0.92	0.24	3.38	2.02
Germany	0.23	0.28	1.71	0.86	1.47	0.63	3.41	1.77
Italy	0.23	0.35	1.40	0.92	0.65	-0.24	2.28	1.03
Spain	0.10	0.12	1.76	0.32	0.38	-0.92	2.24	-0.47

Source: CEPII calculations using GGCD data (unpublished).

Chapter 2: ICT-Linked Firm Reorganisation And Productivity Gains

2.1 Introduction

Enterprises adapt to changes in their environment by adjusting their organisational structures or by introducing new management techniques. Many such changes have been necessitated by and linked to the use of new information and communication technologies (ICT). In recent years, many companies have invested heavily in e-business applications, such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM).

E-business can be defined as "the use of electronically enabled communication networks that allow business enterprises to transmit and receive information" (Fellenstein and Wood, 2000) and encompasses electronic business processes as well as e-commerce (buying and selling). Examples of typical business processes that may be carried out in electronic form include customer support, marketing, advertising and public relations, recruitment of new employees, information resource sharing among employees, strategic and tactical planning, distributed inventory control functions, payroll and benefits management. Note that none of these business processes involve the direct buying and/or selling of materials but mainly address the quality, flexibility and availability of the product or service. The Internet plays a key role as the supporting medium for various e-business practices such as supply chain management and online procurement. E-business processes are often referred to as "ICT-enabled organisational change" (Kling and Tillquist, 2000), "ICT-enabled business transformation" (Venkatraman, 1994) and "ICT-enabled Business Process Reengineering (BPR)" (Davenport, 1993).

Empirical studies find that the greatest benefits from ICT investments are realised when they are combined with organisational changes, such as new business strategies and practices and new organisational structures. ICT–enabled business practices can significantly increase efficiency and productivity through improved customer service, reduced cost and streamlined business processes. At the same time, their implementation can be difficult, time-consuming and expensive. Therefore, it is essential for individual firms to understand their cost and potential benefits. Given the importance of ICT for the competitiveness of the wider economy, it is also essential to explore and address possible policy issues that may arise from their diffusion.

The chapter is divided into five main parts. The section following the introduction provides a review of the literature on the complementarity between ICT and firm organisation as well as on the productivity effects of ICT enabled organisational changes. Section 3 looks at the incidence of reorganisation, particularly e-business practices and the relationship between labour productivity and e-business practices at the industrial sector level.. Section 4 investigates the impact of reorganisation on productivity change at the establishment level. As no data is available that permit an analysis of the productivity effects of e-business practices at the firm level, the focus is put on new forms of work organisation and on the interaction between the productivity effect of reorganisation and additional measures such as investment in ICT and training. Finally, section 5 concludes.

2.2 Complementarity between ICT and organisational change and their productivity effects

2.2.1 Definitions of organisational change

Organisational change can be defined as change in the strategies, structures and practices of organisations. This can involve a number of elements

including (Betcherman and McMullen, 1998, Murphy 2002):

— *Changes in organisational structure* of the firm including hierarchy, functional lines, and organisational boundaries;

— *Changes in the work process* or new forms of work organisation including the use of different production inputs, the flow of work, job design, work allocation, and the use of suppliers and subcontractors;

— Innovative *human resource practices* including compensation, information sharing, employee involvement in decision-making, and scheduling;

— *Industrial relations practices* involving the strategies and institutional structures affecting the labour-management relationship; and

— *New business practices and new management techniques* (Total Quality Management (TQM), Enterprise Resource Planning (ERP) Systems, Supply Chain Management (SCM) Systems, Customer Relationship Management (CRM), Lean Production[33].

New business practices often affect the external coordination of the firm, including changes in the interaction with suppliers (Just-In-Time delivery and Just-In-Time production, sub-contracting of production and outsourcing) (Murphy, 2002; Greenan and Mairesse, 2002).

Innovative human resource practices (also referred to as high performance work practices (HPW)) include employee involvement in decision-making (for example, self-managed teams, quality circles, labour-management committees, works councils, employee representation on the board of directors), employee participation in the company's financial results (e.g., profit-sharing and employee stock ownership), and supporting practices (such as information sharing, training and internal labour markets, job design, individual incentives, various pension schemes – see Ichniowski et al., 2000). This chapter addresses the most important elements of organisational change, with emphasis on e-business practices and innovative human resource practices.

2.2.2 Overview of e-business practices

A large number of innovative business management concepts have emerged recently, e.g. Business Process Reengineering, e-business, and Total Quality Management[34]. However, of all these, e-business and Business Process Reengineering (BPR; other aliases: Business Process Redesign, Organisational Redesign, Core Process Redesign, Value Reengineering) have probably the greatest influence (Light and Holland, 1998). BPR typically refers to the idea of radical changes to the operations of a business, often utilising new information technology or information systems.

Business Process Reengineering critically examines the business process for redundant steps and opportunities for entirely new ways of achieving the desired output. It attempts to break down outdated assumptions and rules, support teamwork, and shorten cycle times (Grover et al., 1998), if successfully implemented, breakthrough performance gains in productivity can be achieved. In addition to ICTs, the success of process change also depends on factors related to the organisational structure, the management system and human resources (Grover et al., 1998). Beginning in the late 1990s, companies invested heavily in e-business applications such as ERP, CRM, supply-chain management, e-procurement and data warehouse that influence directly the reengineering process.

2.2.2.1 Enterprise Resource Planning (ERP) systems

Enterprise Resource Planning (ERP) systems (also called enterprise-wide systems or enterprise systems) consist of a software package that uses database technology to control and integrate all the information related to a company's business, including customer, supplier, product, employee and financial data. A single enterprise-wide database is used in which all business transactions such as inventory management, customer order management, production planning and management, distribution, accounting, human resource management are entered, recorded, processed, monitored and reported (Davenport, 1998; Ragowsky and Somers, 2002; Umble and Umble, 2002). Thus, ERP systems connect the organisation to its customers and suppliers through the different stages of the product or the process life cycle.

It is well known that the implementation of an ERP system is an enormously expensive and complex

[33] See also Annex 2.1 for a glossary of acronyms used throughout this chapter.

[34] Total Quality Management (TQM) is frequently not considered as an element of reorganisation, however. Although business practices and Total Quality Management have much in common with each other, they are significantly different with respect to the interdependence with ICT. TQM focuses on minor continuous improvements of business processes and it is not related to the introduction of ICT.

task. ERP package implementation costs include consulting, process redesign, data conversion, training, integration and testing (Mendelson, 1999). For most of the ERP projects, the software portion only accounts for a small proportion of the total implementation costs. The other areas such as hardware, training and consulting tend to dominate the true costs of implementing ERP Systems (Mabert, Soni and Venkataramanan, 2001). Using data on 5,000 U.S. manufacturing firms engaged in ERP, Mabert, Soni and Venkataramanan (2001) find that the cost of licensing the software itself is only 30 percent of the overall cost of implementing the ERP system. Additional costs include expenditures on new hardware (18 percent) and, most significantly, fees paid to consultants and programmers (24 percent), training (11 percent) and costs for the implementation team (14 percent).

Box 2.1: Enterprise Resource Planning (ERP) systems and Knowledge Management Solutions (KMS)

"ERP (Enterprise Resource Planning Systems) comprise a commercial software package that promises the seamless integration of all the information flowing through the company - financial, accounting, human resources, supply chain and customer information." (Davenport, 1998).

KMS refer to the system and managerial approach to collecting, processing and organising enterprise-specific knowledge assets for business functions and decision making (Chen, 2001).

ICT enabled business practices such as ERP systems have direct implications for the organisational structure of the firm. The changes to the organisation can be substantial, and can affect virtually every business process or function within the organisation. ERP implementations induce changes to the organisation chart, to job descriptions, to responsibilities, to internal power structures, and to the organisation's culture. According to Davenport (1998), on the one hand, ERP systems allow organisations to streamline their management structures, creating flatter, more flexible and democratic organisations, by providing real-time access to operating and financial data. On the other hand, they also involve the centralisation of control over information and the standardisation of processes, which are qualities that are more consistent with hierarchical organisations. Often the outcome of an ERP implementation is flatter hierarchies and the distribution of decision-making to the lower organisational levels.

Most of the benefits of the ERP systems are expected from the change in business processes, in which the ERP software is just an enabler (Martin, 1998). Benefits of ERP systems include (Davenport, 1998):

— Integration of customer order information:
  - One order in one system;
  - Easier coordination and information sharing for departments;
  - Better customer service;

— Standardization and acceleration of business processes:
  - Save time (direct and easy access to essential data, improved information management, integration of systems and information within the enterprise);
  - Increase productivity (reduced administrative overhead for some business functions, simplified business processes, reduced paperwork);
  - Multiple sites could be managed as a single entity;

— Reduction in inventory;

— Integrated supply chain:
  - Reduced inventory obsolescence;
  - Integration with suppliers and increased visibility;
  - Standardization of HR information.

In summarising a number of studies, Ragoswky and Somen (2002) suggest that the benefit an organisation derives from using information technology (IT) is dependent on the characteristics of the organisation: not all companies will gain the same benefit from using the same ERP applications, and different ERP software packages will better suit different organisations. Umble and Umble (2002) listed a number of causes of ERP implementation failures including poor leadership from top management, automating non-value-adding processes in the new system, unrealistic expectations, poor project management, inadequate training, attempts to maintain the status quo and inaccurate data. Dignum (2002) suggests that the biggest mistake that companies have made is that they expected huge benefits from just implementing new IT components without changing the organisational structure.

2.2.2.2 Supply Chain Management (SCM) and Customer Relationship Management (CRM)

An important role of ERP is to serve as a platform for other applications, such as SCM and CRM (Ragoswky and Somen, 2002). SCM covers every aspect of the

corporate supply chain process, starting from the production of raw materials to establishing relationships with the customers (Yen, Chou and Chang, 2002). It provides instant data access to information about orders, forecasts, production plans, and key performance indicators such as inventory levels and filling rates, as well as the ability to increase service quality and reduce investments in inventory. In the last years, all major ERP suppliers have integrated SCM strategy into their ERP systems.

Customer Relationship Management (CRM) is also linked to ERP. It provides companies with better knowledge of and speedier and individualised relations with their customer basis. CRM and ERP have been converging for some time. Web-based product availability and delivery information are just a few of the common business applications that involve blending technologies from both disciplines.

Box 2.2: Customer Relationship Management (CRM), Application Service Provider (ASP) and Supply Chain Management (SCM)

Customer Relationship Management (CRM) enables companies to identify, select, acquire, develop, and retain profitable customers. CRM allows companies to build lasting relationships with its customers (O'Brien, 2003).

Application Service Providers (ASP) manage and deliver application capabilities to multiple entities from data centres across a wide area network (Verwaal et al., 2002).

Supply Chain Management (SCM) is associated with the process of optimising the delivery of goods, services and information from supplier to customer. This set of business processes encompasses a trading-partner community engaged in the common goal of satisfying the end customer (Gartner Group, 1999).

2.2.2.3 e-procurement and e-marketplaces

Online procurement (e-procurement) is another commonly used e-business practice, affecting the process of ordering goods and services. Company personnel can access and browse a list of goods and services directly from their desktops. Many e-procurement systems are components of ERP systems. One of the main benefits of e-procurement is the reduction in transaction costs. According to Dignum (2002), the cost reduction will be between 50 and 56 percent per order. However, the benefits of cost reduction may only arise for large firms that process hundreds of orders each week (Dignum, 2002). For small companies, the costs of the e-procurement system may outweigh the benefits.

Box 2.3: Online procurement (e-procurement)

Online procurement (e-procurement) can be defined as "a process which allows any designated user to requisition a product or service through a web interface and generate a purchase order to send to a supplier" (Boykin, 2000). E-procurement technologies include e-procurement software, B2B (business-to-business) auctions, B2B market exchanges, and purchasing consortia. Online procurement is focussed on automating workflows, consolidating and leveraging organisational spending power, and identifying new sourcing opportunities (Davila, Gupta and Palmer, 2002).

e-marketplaces

"Also called e-Hubs, net marketplaces, and B2B exchanges, e-marketplaces are purely digital meeting places that provide to their participants two broad categories of service: aggregation and facilitation. Aggregation refers to making available large numbers of potential partners – both buyers and suppliers – along with, in many cases, listings of the goods they want to buy or sell. In many cases, aggregation of suppliers entails creating a comprehensive online catalogue of their wares. Aggregation provides the obvious benefit of liquidity, an important consideration for all traders. Facilitation refers to helping e-marketplace participants interact with each other, before, during, and after their decisions to do business together. Prior to this decision, e-marketplaces facilitate by providing information about potential partners, including certification as to their demonstrated qualities (credit, fulfilment reliability, etc.). e-marketplaces often assist contracting and partnership decisions by conducting auctions, reverse auctions, and other dynamic pricing events. Finally, many e-marketplaces also offer post-partnership facilitation services such as arranging credit and logistics services, and in some cases taking responsibility for order fulfilment" (McAfee, 2000).

2.2.3 Productivity effects of ERP systems

There is a small but growing literature on the impact of ERP systems on performance and productivity. However, the majority of these studies are based on interviews, case studies or a collection of case studies and industry surveys, mainly using US data (see the literature reviews provided by Gattiker and Goodhue, 2002; Hitt, Wu and Zhou, 2002). None of these articles empirically tests the impact of ERP systems using a representative dataset. McAfee

(1999, 2002) studies the impact of ERP systems on self-reported company performance and finds that participating companies reported substantial improvement in several areas as a result of their ERP implementation, including their ability to provide information to customers, cycle times, and on-time completion rates. Hitt, Wu and Zhou (2002) empirically test for the productivity and business performance effects of ERP on firms that adopted ERP versus those that did not, and on firms before, during, and after the implementation to assess performance over time. They find that ERP adopters exhibit a consistently higher performance than non-adopters across a wide variety of measures. Most of the gains occur during the implementation period, although the authors do find some evidence of a decline in business performance and productivity shortly after the completion of the implementation. This result is in contradiction to the theoretical expectation that productivity should increase after the successful completion of the ERP implementation.

Using data on 5,000 U.S manufacturing firms, Mabert, Soni and Venkataramanan (2000) find that the top three ERP performance outcomes include quicker information response time, increased interaction across the entire enterprise and improved order management/order cycle.

2.2.4 Complementarity between ICT and firm organisation and their productivity effects

If complementarities between organisational investments and ICT investment exist, these factors are likely to be correlated and firms that combine complementary factors should have higher performance than firms that implement one measure but not the other (Holmstrom and Milgrom, 1994 or Athey and Stern, 1997). Even if there are clear complementarities between these measures, not all firms may introduce both simultaneously, however, because there are barriers to adoption, or the costs and benefits of the investments differ between firms, or managers do not fully understand all the complementarities (Brynjolfsson and Hitt, 2000; Wolf and Zwick, 2002b). These heterogeneities between firms allow for a measurement of the complementarities between ICT and firm organisation.

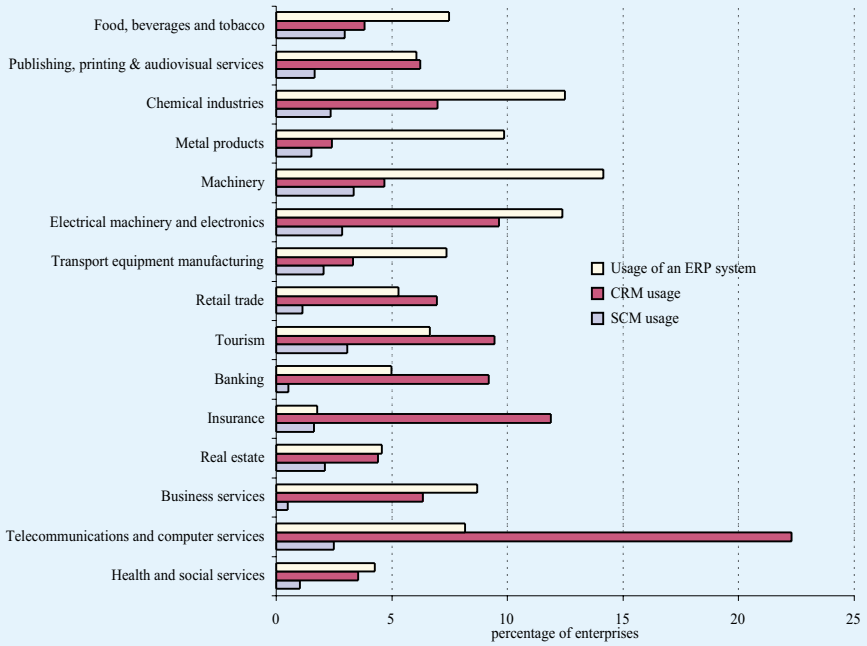
Brynjolfsson and Hitt (2000) argue that ICT are general-purpose technologies that lower the cost of intra- or interorganisational communication. In their literature survey, they find that ICT investment is greater in organisations that use increasing amounts of delegated staff, invest more in training and education and adopt corporate structures that involve less vertical integration. A problem for the measurement of complementarities is that positive effects frequently affect intangible characteristics such as speed in delivery or quality of the accompanying services. In addition, the necessary investments in consulting or business organisation software that usually accompany investments in ICT and/or reorganisation are also difficult to measure.

Furthermore, a number of authors argue that the decreasing costs of co-ordination, communication and information processing will lead to more freelancing (Malone and Laubacher, 1998), to a reduction in firm size (Brynjolfsson et al., 1994), increased variability in the number and types of partnerships explored by the average firm (Gurbaxani and Whang, 1991, Malone, 1997) and the rise of the "virtual factory" (Upton and McAfee, 1996). Kang and Sakai (2001) suggest that developments in ICT have given rise to the establishment of a growing number of inter-organisational relationships (e.g. alliances and joint ventures, especially in service sectors like banking, telecommunications, transport and trade). In other words, ICT is seen as an enabler of the increasing inter-organisational co-operation. This can be attributed to the fact that developments in IT diminish the importance of location and time (Canoy et al., 2001).

The relationship between organisational change, ICT and productivity is complex. Very few studies empirically examine effectiveness of organisational changes based on representative datasets. Using a sample of 300 American firms drawn from Fortune 1000, Bresnahan, Brynjolfsson and Hitt (2002) find a strong and significant interaction effect of decentralisation and ICT capital on productivity (i.e., output controlling for labour and non-ICT capital). These findings indicate that the impact of ICT capital is higher when firms are more decentralised and the authors conclude that information technologies and new work practices are complementary to each other. More recently, Brynjolfsson and Hitt (2002) identified a specific set of these practices that are important for productivity growth, including open information access and communication, decision rights, performance-linked incentives as well as heavy investment in training.

Using a sample of 400 British and 700 French firms from the Workplace and Industrial Relations survey (WIRS) and the "RÉPONSE" survey, Caroli and Van Reenen (2001) find little evidence for the complementarity between organisational and technological change measured as new equipment including new microelectronic technology. Using the French dataset RÉPONSE, Coutrot (1996) demonstrates that

Graph 2.1: Incidence of e-business practices in the larger EU countries (EU-4)



Source: e-business w@tch sector database 2002.

there is a strong correlation between technical change and organisational change. A study of the Danish Ministry of Business and Industry based on 515 Danish manufacturing companies find that companies that made no investment in either new equipment or new forms of work organisation achieved an annual growth in labour productivity of only 0.5 percent in the period 1990-1993. During the same period, companies that invested only in physical equipment had a labour productivity growth of 1.5 percent per year while companies that invested in both new equipment and new forms of work organisation achieved an annual growth in labour of 2.7 %.

2.3 New Business practices and productivity performance[35]

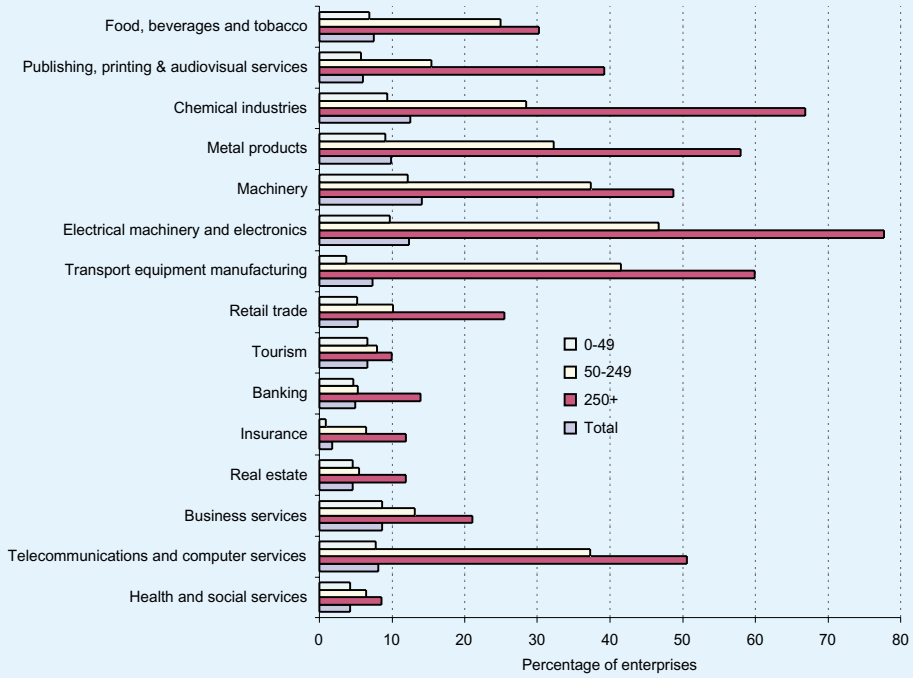
2.3.1 Incidence of the use of e-business practices

The present analysis of the incidence and consequences of e-business practices draws heavily on the e-business w@tch sector database. These data provide the first cross-country and industry information on this issue, covering up to 15 industries in the manufacturing and service sector. The analysis is based on data for the four larger EU Member States, Germany, France, Italy and the UK, in 2002[36]. The e-business w@tch data indicate that in the EU-4, the percentage of firms using ERP systems is much higher than the percentage of firms using SCM (see Graph 2.1). CRM is also important, particularly in telecommunications and computer services as well as in banking and insurance. Overall, CRM systems are used by 22 % of firms in the ICT service sector as compared to 7.5 % on average in the non-ICT service sector (see Graph 2.1). In manufacturing, ERP is the most frequently used e-business practice followed by CRM and SCM. The chemical industry, transport equipment as well as the electrical industry have the highest share of enterprises using ERP. Overall, only few firms use SCM with an EU-4 share of less than 5 %. The low share of ERP and SCM in some service industries is due to the low importance of intermediate materials such as raw materials and energy.

[35] This section heavily draws on the e-business w@tch sector impact studies as well as the e-business w@tch sector database 2002. Findings presented in the report are based on data weighted by enterprises.

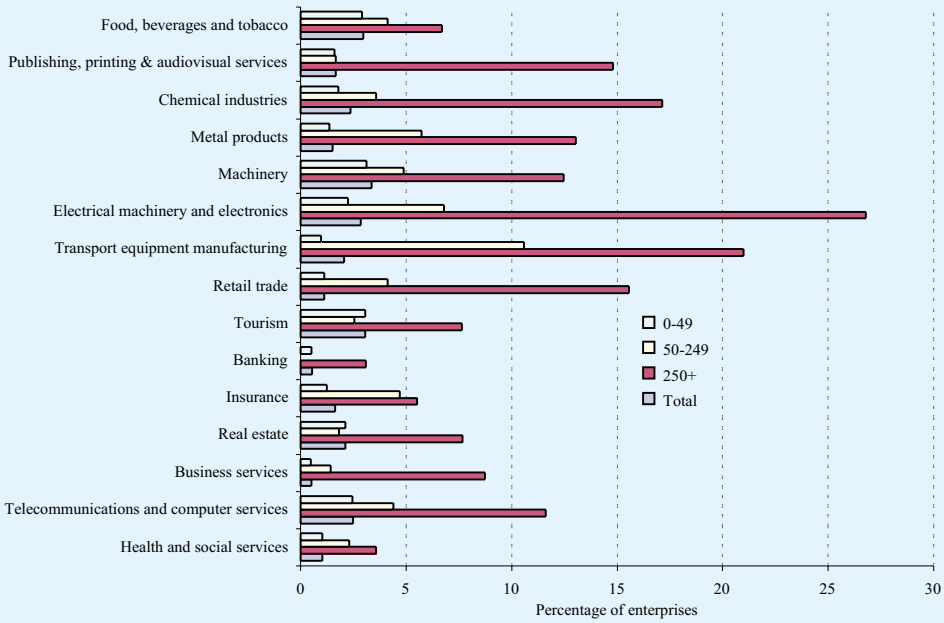
[36] For Germany, France, Italy and the UK information for each of the 15 industries is available. For Austria, Belgium, Denmark, Luxembourg and Portugal the E-business w@tch sector database covers three industries. For Finland, the Netherlands, Spain and Sweden information is available for five industries.

Graph 2.2: Use of ERP-systems in larger EU countries (EU-4) by industry and firm size



Source: e-business w@tch sector database 2002.

Graph 2.3: Use of SCM-systems in larger EU countries (EU-4) by industry and firm size



Source: e-business w@tch sector database 2002.

When comparing survey results according to firm size, it is possible to see that e-business practices are used by a majority of large companies (see Graph 2.2 for ERP systems and Graph 2.3 for SCM). The percentage of firms with ERP systems in large manufacturing companies (>250 employees) ranges from 30 percent in food and beverages to almost 80 percent in the electrical goods industry. This is consistent with Hitt, Wu and Zhou (2002) who note that ERP systems have been implemented in more than 60 % of multinational firms. Turning to plans to use an ERP system in the future, it is also evident that larger firms are more likely to adopt ERP systems. Among large firms, the percentage of firms that will implement ERP systems in the next months is highest in metal products, followed by insurance, banking, computer services, and the food industry.

With regards to ERP diffusion in individual countries, Italy is above average in all service industries, the UK is below average and France and Germany are in the middle range. In chemicals, French enterprises reported the highest level of ERP (35 %). Enterprises from Italy reported the highest level in machinery, insurance and telecommunications sectors. UK firms are again below average in all manufacturing industries. In the ICT sector, companies from the UK, in particular, make extensive use of CRM systems (see e-business sector reports).

Turning to the complementarity hypothesis, we find that certain business practices are complementary to each to other. In particular, the use of SCM and ERP are highly correlated with a correlation coefficient of 0.87 (see Table 2.1).

The e-business w@tch data suggest that e-procurement is one of the most widely used application. In EU-4, the percentage of companies currently taking advantage of e-procurement is approximately 37 % (unweighted average across EU-4 industries). Procuring online is more common in skill-intensive service industries such as telecommunications and computer services and business services (see Graph 2.4). Moreover, evidence suggests that online procurement is more common in Germany and in the UK (with unweighted means of 57 % and 44 %) followed by Italy and France with 27 % (see e-business w@tch sector impact studies). Furthermore, the use of online procurement does not differ across firm size. Small firms lag behind but the difference is less pronounced than for other e-business applications such as ERP-systems (see e-business w@tch sector impact studies).

Although the incidence of online-procurement is relatively high, the volume shares are still low. In the EU-4, the share of firms with less than 5 % of their online purchasing volume is highest in manufacturing industries, such as metal products, machinery and transport equipments (see Table 2.2). Conversely, firms with a high share of online purchasing (50 % or more of their purchasing volume) can be found in business services, telecommunications and computer services and retail trade.

In the EU-4, the percentage of firms participating in e-marketplaces is still small with an unweighted average of 4.5 % (see Graph 2.4). e-marketplaces are more frequently used by large firms (see Graph 2.5).

2.3.2 Relationship between e-business practices, sectoral labour productivity growth and performance

Table 2.3 shows the correlation coefficients between various e-business practices in 2002 and

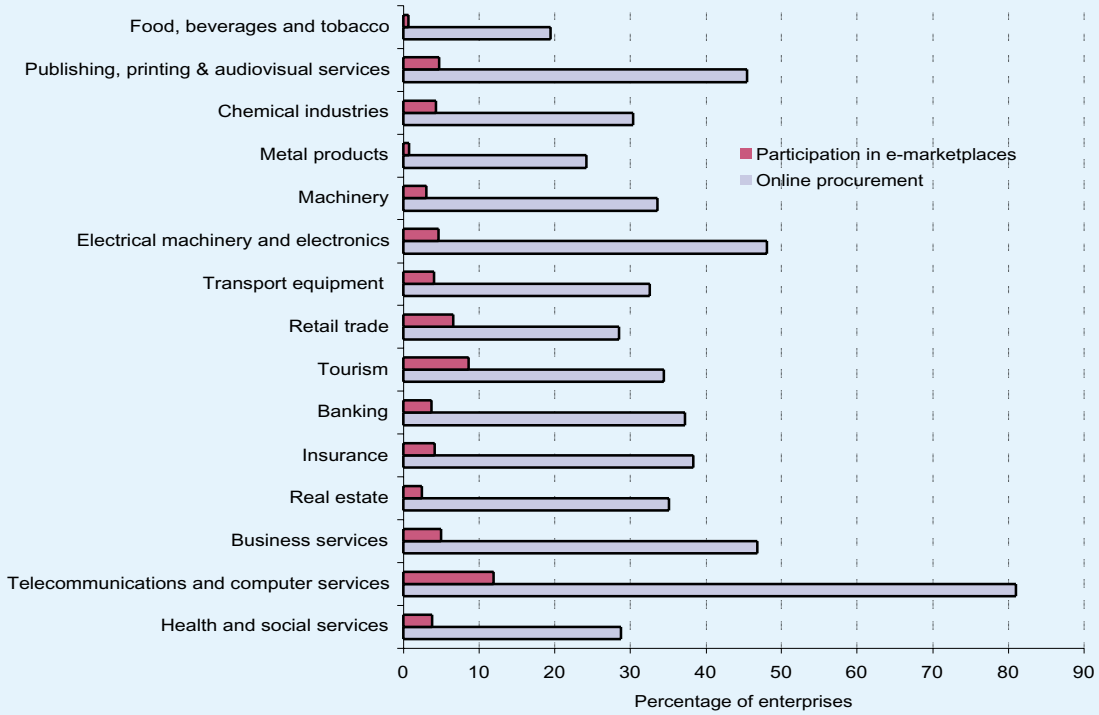
Table 2.1: Correlations between different types of e-business activities, EU-4

	ASP	CRM	ERP	Knowledge Management Solution
CRM	0.78	1		
	(0.00)			
ERP	0.33	0.56	1	
	(0.03)	(0.00)		
Knowledge	0.58	0.68	0.32	1
Management Solution	(0.00)	(0.00)	(0.03)	
SCM	0.46	0.60	0.87	0.42
	(0.00)	(0.00)	(0.00)	(0.00)

Note: p-value in parentheses. Number of observations 45 (15 sectors x 3 firm size classes).

Source: Calculations based on e-business w@tch sector database 2002.

Graph 2.4: Participation in e-marketplaces and online procurement in the larger EU countries (EU-4)



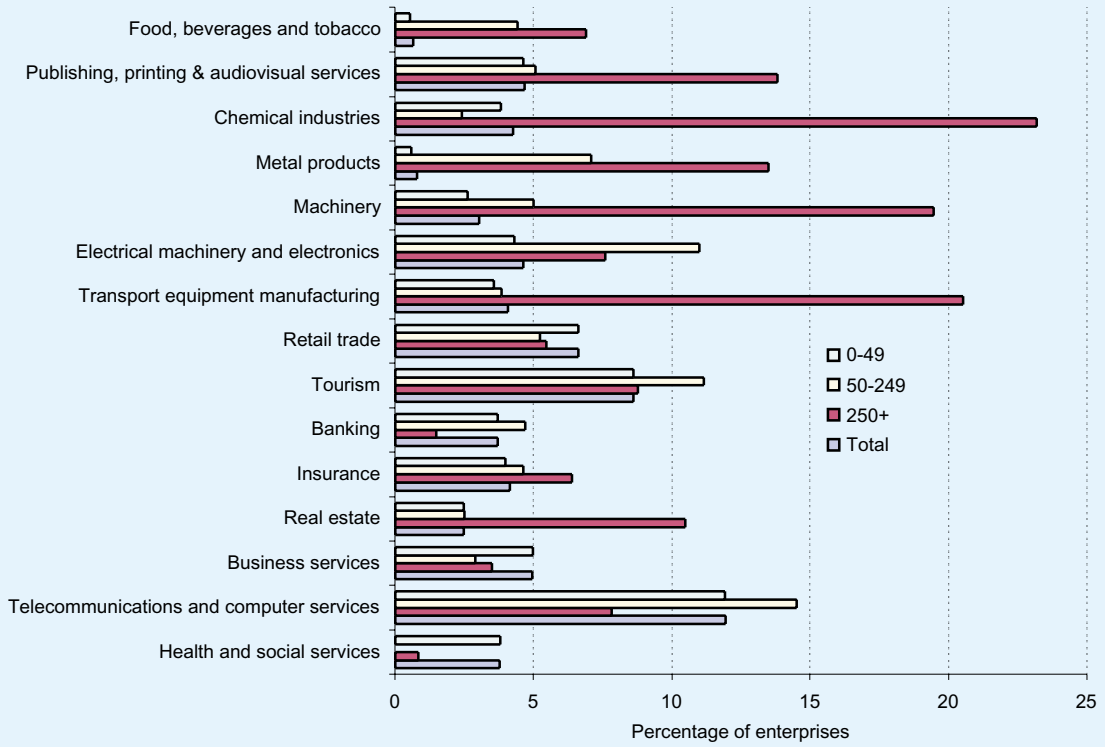
Source: e-business w@tch data 2002.

Table 2.2: Share of online procurement in total procurement, EU-4

	Online share of total procurement < 5 %	Online share of total procurement: 5-10 %	Online share of total procurement: 11 to 25 %	Online share of total procurement: 26 to 50 %	Online share of total procurement: > 50 %
Food, beverages and tobacco	43.8	32.6	22.7	0.9	0.0
Publishing, printing & audiovisual services	41.0	27.0	21.0	8.6	2.3
Chemical industries	43.3	41.6	10.3	3.1	1.8
Metal products	49.4	36.0	9.7	2.6	2.4
Machinery	52.0	31.8	12.5	1.8	1.9
Electrical machinery and electronics	39.0	29.3	14.1	8.5	9.0
Transport equipment manufacturing	57.1	22.5	12.5	6.6	1.3
Retail trade	33.7	19.0	19.6	13.9	13.8
Tourism	48.0	26.6	10.1	10.9	4.4
Banking	41.2	30.8	17.5	5.6	4.9
Insurance	41.4	28.7	18.9	5.1	5.9
Real estate	41.1	32.6	17.6	8.7	0.0
Business services	34.8	17.9	23.6	8.6	15.1
Telecommunications and computer services	16.1	19.2	23.2	21.5	20.0
Health and social services	35.1	39.6	19.6	4.5	1.2

Source: e-business w@tch sector database 2002.

Graph 2.5: Participation in e-marketplaces by industry and firm size, larger EU countries (EU-4)



Source: e-business w@tch sector database 2002.

the average annual change in labour productivity between 1995-2000 based on EU-4 industry data. The correlation is calculated on data for the individual EU-4 countries. There is a significant correlation between the change in labour productivity during the period and ERP use[37]. This means that industries with a higher productivity growth rate are more likely to implement ERP systems. Graph 2.6 illustrates the relationship between the percentage of firms with ERP use and labour productivity growth. It shows that industries with a higher proportion of ERP use have had a higher productivity growth in 1995-2000[38]. However, the direction of causality may be ambiguous or open to interpretation. Since the time period refers to past rather than future productivity growth, the most direct interpretation is that the causality runs from labour productivity growth to ERP use. Nevertheless, the two phenomena (productivity growth and ERP implementation) are to a large extent simultaneous, since ERP systems were developed in the 1990s and have grown rapidly since the mid-1990s. In this case, it is plausible that a higher level of ERP use might have influenced labour productivity growth and higher labour productivity growth have lead to a higher level of ERP use.

The correlation coefficients between the other types of e-business practices and change in labour productivity are also positive in most of the cases but are not significant at the five percent level. The negative correlation between SCM and change in labour productivity may be due to the fact that the usage of SCM is more pronounced in specific resource-intensive industries.

Table 2.4 shows the correlation coefficients between the percentage of firms using online procurement and the change in labour productivity between 1995-2000 based on EU-4 industry data. In order to investigate whether the improvement in labour productivity is mainly due to labour shedding, correlations for value added growth are also presented.

A significant correlation is found between the change in labour productivity over the period and the use of online procurement. The results are robust with respect to the measurement of online procurement (percentage of firms, or alternatively the percentage

[37] The significance is even greater when the correlation is based on robust standard errors corrected for heteroskedasticity (p-value: 0.04).

[38] The correlation is also significant when disaggregated EU-4 data are used (60 observations).

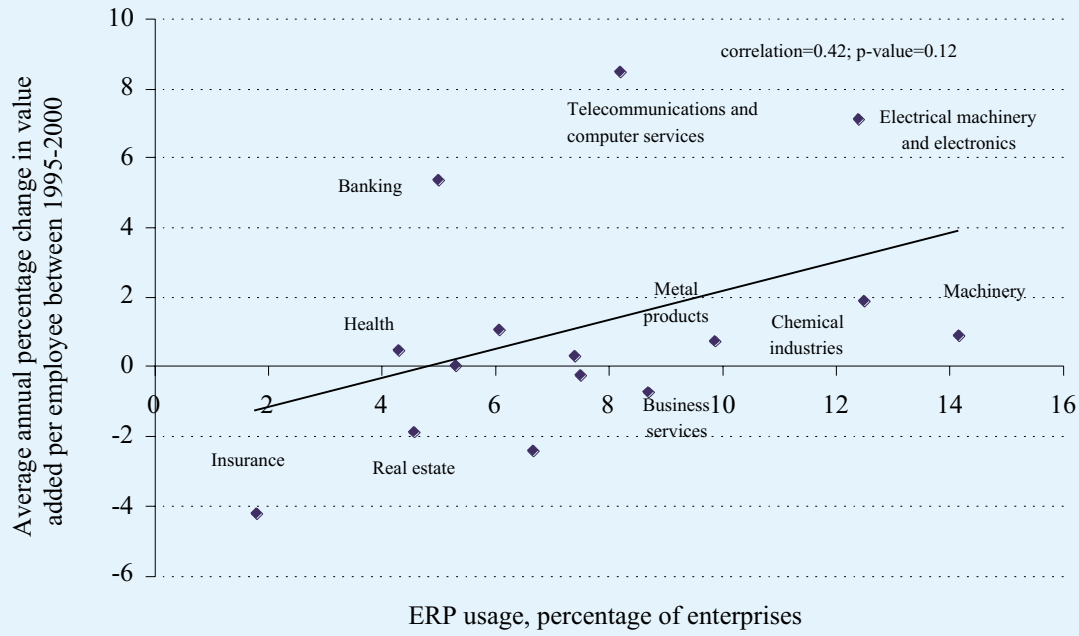
Table 2.3: Correlation coefficients between various e-business practices and growth in labour productivity and in value added, EU-4

	Use of an ASP	CRM use	Use of an ERP system	Use of a Knowledge Management Solution	SCM use
Change in value added in constant prices per employee	+0.21 (0.11)	+0.19 (0.15)	+0.23 (0.08)	+0.18 (0.17)	-0.10 (0.46)
Change in value added in constant prices	+0.32 (0.01)	+0.17 (0.19)	+0.07 (0.59)	+0.18 (0.18)	-0.20 (0.12)

Notes: p-value in parentheses. Number of observations is 60 (15 industries for each of the following countries: Germany, France, Italy and the UK). Average annual change in value added refers to the period 1995 -2000 (UK, Italy and Germany) and 1995-1999 (France).

Source: Stan Database, e-business w@tch sector database 2002, own calculations, p-value in brackets.

Graph 2.6: ERP use and labour productivity growth, EU-4 (aggregated)



Notes: The graph contains data for EU-4. The number of observations is 15.

Source: Stan Database, e-business w@tch sector database 2002, own calculations.

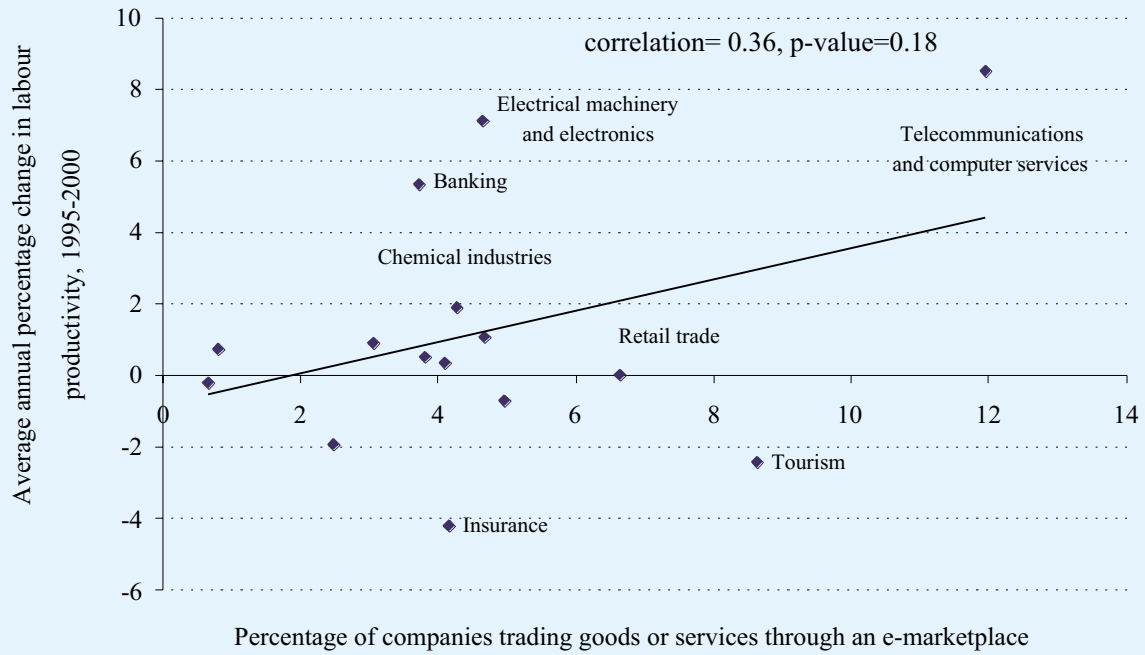
Table 2.4: Correlation coefficients between online procurement, e-marketplaces use and growth in labour productivity and in value added, EU-4

	Percentage of companies trading goods or services through an e-marketplace	Percentage of companies purchasing goods or services online	Percentage of companies that procure at least 25 % the goods or services online
Change in value added constant prices per employee	+0.16 (0.22)	+0.33 (0.01)	+0.30 (0.02)
Change in value added in constant prices	+0.26 (0.05)	+0.38 (0.00)	+0.38 (0.00)

Notes: Number of observations is 60, p-values in brackets.

Source: e-business w@tch sector database 2002, own calculations.

Graph 2.7: Participation in e-marketplaces and labour productivity growth, EU-4



Notes: The graph contains data for EU-4. The number of observations is 15.

Source: e-business w@tch sector database 2002.

of firms with an online procurement share of 25 % or more). This means that industries with a higher productivity growth rate are more likely to use online procurement. The correlation coefficient between participation in e-marketplaces and labour productivity growth is also positive but not significant at the 10 percent level (see also Graph 2.7).

When surveyed in the framework of e-business w@tch, the majority of firms expresses a highly or fairly positive opinion of the impact of e-procurement on procurement costs. This confirms the results obtained from the correlation between labour productivity and e-procurement. The sectors where procurement has had the highest impact are telecommunications and computer services, business services, insurance and tourism.

2.3.3 Relationship between e-business practices and organisational change

Table 2.5 shows the percentage of firms reporting that e-business has significantly changed different aspects of the organisation of the firm in EU-4 (only firms with 250 or more employees). Overall, the largest change can be observed for internal work processes, followed by changes in the organisational structure and relationships to suppliers. The largest impact e-business had on the internal work process can be observed in telecommunications and computer services, followed by publishing and multimedia.

In machinery, the electrical industry and transport, between 6 % and 9 % of firms state that e-business has significantly changed their organisation. The impact of e-business on internal work processes is more pronounced: between 8 % and 15 % of the firms in these industries reported that e-business significantly changed their internal work processes.

Correlations between different types of organisational change indicate that changes in the organisational structure of a company and changes in internal work processes go hand in hand (see Table 2.6 based in all enterprises). This confirms the theoretical predictions that e-business changes the organisational structure, responsibilities and internal power structures simultaneously.

2.3.4 Determinants and barriers to e-business practices

Rapid advances in computer and software technologies combined with the explosive growth of the

Internet have led many companies to rethink their business practices, to put a greater emphasis on their use of IT, and to invest more in enterprise organisation (Mendelson, 1999). It is well known that adoption of new technologies involves significant costs in terms of learning. Using U.S. data, Bartel and Lichtenberg (1987) find evidence that educated workers have a comparative advantage in implementing new

Table 2.5: Companies reporting a significant change in organisational structure and practices due to e-business, EU-4 (large firms)

	Organisational structure of company		Internal work processes		Relationship to suppliers	
	Significant	Somewhat	Significant	Somewhat	Significant	Somewhat
Food, beverages and tobacco	4.4	15.7	2.5	34.2	3.1	18.4
Publishing, printing & audiovisual services	11.7	30.9	17.8	40.1	2.4	46.3
Chemical industries	1.8	21.4	2.8	42.7	1.8	28.4
Metal products	1.6	14.8	0.0	21.3	0.0	8.4
Machinery	6.9	16.7	15.2	19.5	7.1	15.9
Electrical machinery and electronics	9.1	27.8	10.1	38.3	13.0	15.6
Transport equipment manufacturing	9.7	9.4	9.0	18.1	6.9	23.4
Retail trade	12.9	16.2	15.1	20.2	4.2	36.7
Tourism	13.4	29.5	23.8	33.2	15.7	13.8
Banking	5.9	33.2	9.8	37.1	4.8	18.8
Insurance	6.4	37.0	13.8	44.5	3.7	30.6
Real estate	2.3	11.9	0.0	24.7	4.5	19.4
Business services	6.7	22.5	12.6	32.3	6.2	25.4
Telecommunications and computer services	21.0	19.6	14.5	38.3	8.9	31.2
Health and social services	6.8	15.7	14.9	16.1	0.9	27.4

Source: e-business w@tch sector database 2002.

Table 2.6: Correlation coefficients for various e-business effects (firms reporting significant effects), EU-4

	Organisational structure of company	Internal work processes	Customer relationship	Relationship to suppliers	Offers of products / services
Internal work processes	0.80	1			
	(0.00)				
Customer relationship	0.69	0.61	1		
	(0.00)	(0.00)			
Relationship to suppliers	0.72	0.62	0.61	1.00	
	(0.00)	(0.00)	(0.00)		
Offers of products / services	0.67	0.62	0.62	0.73	1
	(0.00)	(0.00)	(0.00)	(0.00)	
Has e-business changed the way of conducting business?	0.67	0.61	0.66	0.73	0.77
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Number of observations is 60 (number of sectors x number of countries). All enterprises.

Source: e-business w@tch sector database 2002.

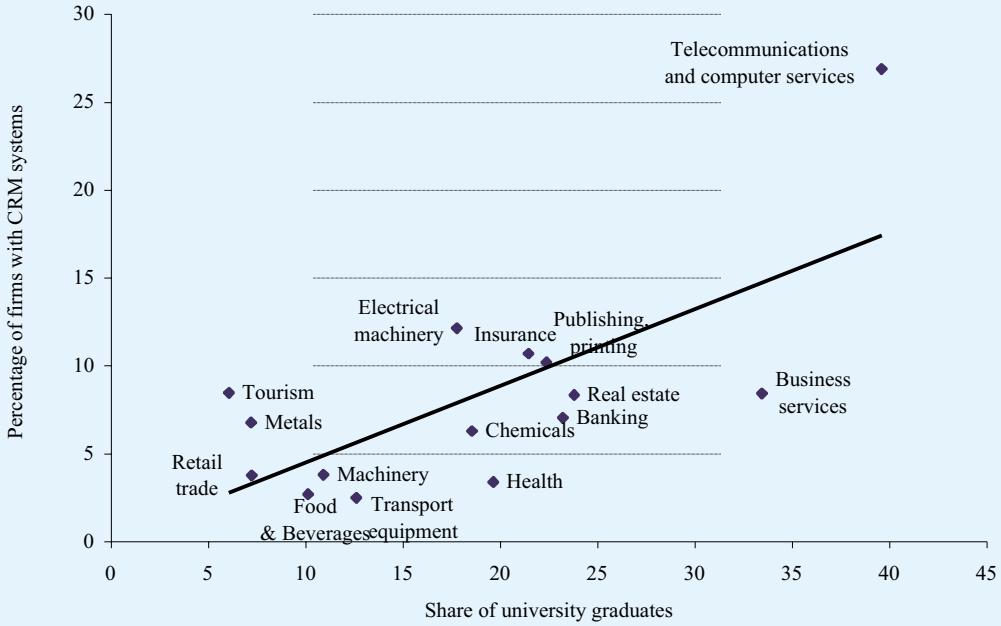
Table 2.7: Correlation coefficients between various e-business practices and IT/skill intensity

	# of observations	CRM use	Use of an ERP system	Use of a Knowledge Management Solution	SCM use
Share of university graduares (based on LFS data)	30	+0.48 (0.01)	-0.14 (0.46)	0.65 (0.02)	+0.17 (0.37)
Size of IT-department	60	+0.45 (0.00)	-0.05 (0.72)	+0.53 (0.00)	+0.09 (0.51)
Share of IT personnel (based on LFS data)	30	+0.73 (0.00)	-0.03 (0.88)	+0.82 (0.00)	+0.20 (0.28)

Note: p-value in parentheses. Number of observations is 30 (15 industries for each of the following countries: Germany and United Kingdom).

Source: UK Labour Force Survey 2000, Mikro Census, e-business w@tch sector database 2002, own calculations.

Graph 2.8: CRM use and skill intensity, UK



Notes: Skill intensity is defined as the number of university graduates in 2000.

Source: UK Labour Force Survey, e-business w@tch data 2002, own calculations.

technologies because they assimilate new ideas more readily. Since better-educated workers enjoy a comparative advantage in implementing new technologies, the diffusion of e-business practices should be higher in skill-intensive industries such as computer services and business services.

Furthermore, since various e-business practices are enabled by information technologies, it is likely that the diffusion of e-business practices is positively related to the degree of information technology intensity. Table 2.7 shows the correlation coefficients between various e-business practices and skill/IT intensity. For two countries, Germany and the UK, industry–level data based on the national labour surveys are matched with the e-business w@tch data. The data suggest that the use of Knowledge Management Solution systems and CRM systems are significantly and positively related with the sectoral skill intensity[39] (see Table 2.7). For the UK, Graph 2.8 illustrates that industries with a higher share of highly skilled workers have a higher-

[39] Skill intensity in the UK is measured as the share of workers with a higher level of qualification such as National Vocational Qualification (NVQ) 5 (post-graduate qualification) and NVQ 4 first degree. In Germany, skill intensity is measured as the share of workers with a university degree.

than-average share of firms using CRM. The data also suggest that Knowledge Management Solution systems and CRM systems are significantly and positively related to the sectoral IT intensity measured as the share of IT workers (such as computer software engineers, computer systems analysts, programmers, network and computer systems administrators, computer hardware engineers etc.). However, no significant relationship between ERP use and IT intensity is found.

Table 2.8 shows the correlation coefficients between IT/skill intensity and both participation in e-marketplaces and use of online procurement. The use of online procurement is significantly related to the skill intensity of the firm, with a correlation coef-

Table 2.8: Correlation coefficients between participation in e-marketplaces and online procurement and IT/skill intensity

	# of observations	Participation in electronic marketplaces	Online procurement	Online procurment in percent of total procurement between 26 and 100 %b
Share of university graduares (based on LFS data)	30	+0.22 (0.25)	+0.51 (0.00)	+0.38 (0.04)
Size of IT-department	60	+0.62 (0.00)	+0.73 (0.00)	+0.66 (0.00)
Share of IT personnel (based on LFS data)	30	+0.36 (0.05)	+0.62 (0.00)	+0.47 (0.01)

Notes: Size of IT-department is defined as the number of employees per thousand employees mainly occupied with maintenance of IT and networks.
[b] The categories >50 % and 26-50 % are added together.

Source: UK Labour Force Survey 2000, Mikro Census, e-business w@tch sector database 2002, own calculations.

Table 2.9: Barriers to procuring online, EU-4 (firms that agreed "completely")

	Requires face-to-face interaction	Suppliers do not sell online	Concerns about data protection, security issues	Technology is expensive	Suppliers' technical systems are not compatible	Cost advantage is insignificant
Food, beverages and tobacco	49.3	42.9	32.4	20.5	13.8	23.6
Publishing, printing & audiovisual services	37.6	36.8	31.3	25.1	13.5	27.6
Chemical industries	39.4	44.5	27.9	23.5	13.9	20.3
Metal products	48.9	41.3	27.0	23.4	15.5	23.4
Machinery	49.0	45.7	32.9	24.7	14.3	21.4
Electrical machinery and electronics	36.2	36.8	32.5	21.0	12.1	23.0
Transport equipment manufacturing	39.7	44.8	35.0	36.3	18.7	30.5
Retail trade	41.4	34.5	33.5	24.4	17.6	23.2
Tourism	37.1	33.9	27.8	25.3	15.1	21.1
Banking	34.0	25.7	38.5	23.3	11.8	20.5
Insurance	33.4	33.7	45.0	22.9	14.8	20.9
Real estate	36.5	35.1	35.3	28.1	10.6	22.8
Business services	31.0	26.3	25.1	18.6	7.9	17.4
Telecommunications and computer services	20.9	14.8	25.0	12.7	9.7	17.4
Health and social services	40.8	27.2	34.6	27.9	10.6	25.8

Source: e-business w@tch sector database 2002, own calculations.

ficient of 0.50. The results are robust when the share of online procurement in percent of total procurement is used. Again, there is a significant relationship between IT intensity, measured as the share of IT-personnel and use of online procurement. The results are robust with respect to the definition of IT-personnel (size of IT-department vs. IT-personnel based on the Labour Force Survey).

Concerning factors that affect negatively the implementation of e-business practices, the principal barrier to the use of online procurement is that many products and services require face to face interactions. This factor is particularly important in some manufacturing industries such as food, metals and machinery. The second most important factor is that suppliers do not sell online. Other factors such as concerns about data protection, security issues and compatibility of the suppliers' technical systems are less important (see Table 2.9).

2.3.5 Summary

The results from the empirical analysis at the industry level can be summarised as follows: First, the actual use of enterprise resource planning and online procurement is positively related with labour productivity. Second, certain e-business applications, such as Knowledge Management Solution (KMS) systems and CRM systems are related to either the skill intensity or the information technology intensity of the industry. Finally, evidence confirms that the introduction of e-business applications change the organisational structure, responsibilities and internal power structures simultaneously.

2.4 Reorganisation and productivity performance: establishment level analysis

2.4.1 Incidence of organisational change and new management techniques: Evidence based on CIS III data

As already indicated in section 2.2.2, various new organisational practices are complementary in the sense that the implementation of one practice (say, business or advanced management techniques) is enhanced by the implementation of others (such as changes in the organisational structure). The Community Innovation Survey (CIS) allows an investigation of the connections between changes in the organisational structure and the introduction of new management techniques. In the last CIS, enterprises were asked whether they had made major changes to their organisational structure or introduced important new management techniques (alternatively referred to as modern management practices or business practices) during the three-year period 1998-2000.

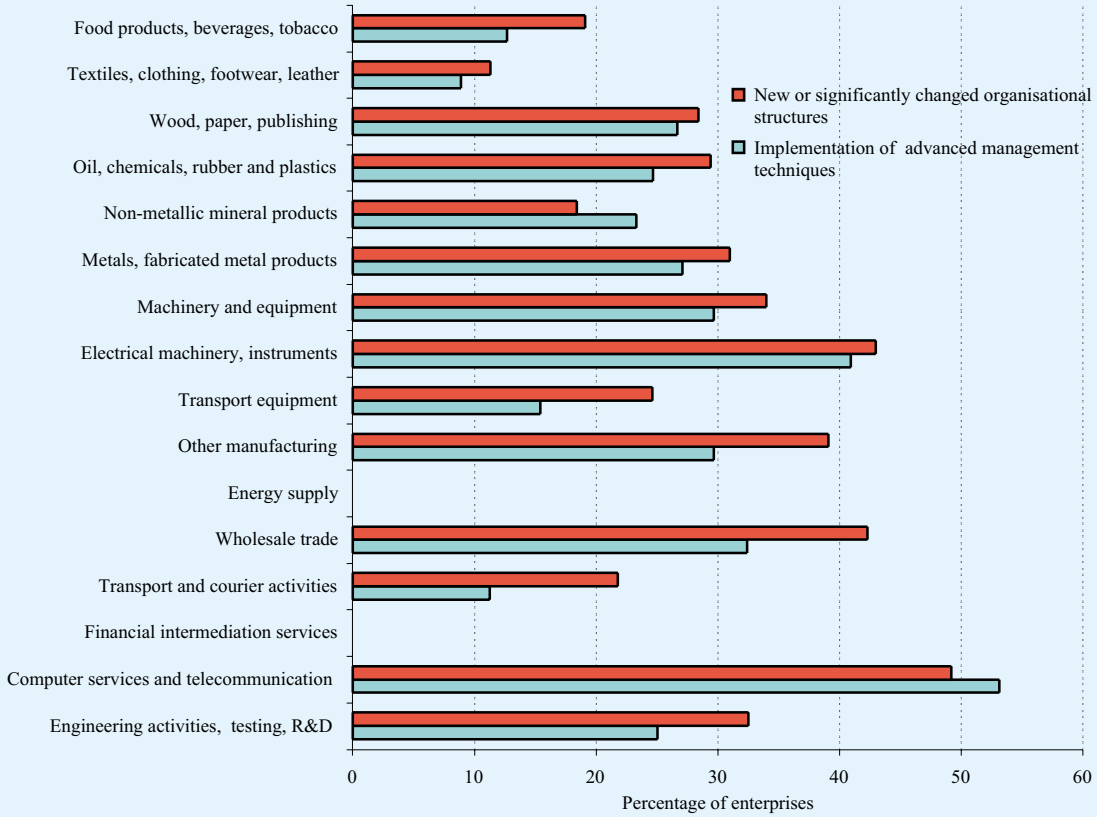
Three areas of business/organisational practices could be distinguished: implementation of advanced management/business techniques within the firm, implementation of new or significantly changed organisational structures and implementation of new or significantly changed corporate strategies. New business/management practices may include total quality management, Business Process Engineering (through ERP and SCM) and lean manufacturing, although this was not clearly defined. Changes in organisational structure may include the introduction of new profit centres and a flattening of the traditional hierarchical pyramid. At preparing this report, data were available only for Finland, Germany, Austria and Sweden.

Graph 2.9, Graph 2.11, Graph 2.12 and Graph 2.13 show the percentage of firms implementing either new management techniques or changes in the organisational structure for those countries. Both types of organisational practices seem to be highly correlated with correlations coefficients of 0.92 in Finland, 0.68 in Germany, 0.79 in Austria and 0.84 in Sweden, all significant at the one percent level. This is consistent with the prediction that management techniques such as ERP lead to significant organisational changes such as streamlining of management structures, flatter, more flexible and democratic organisations (Davenport, 1998).

In Germany, the percentage of firms implementing new management techniques is on average 36 % in manufacturing and 31 % in services. The percentage of firms reporting major changes to their organisational structure in manufacturing and services is 49 % and 44 %, respectively. Within the manufacturing sector, machinery, metals and chemicals have higher-than-average shares (see Graph 2.11). Moreover, evidence suggests that large firms (> 499 employees) are more likely to introduce a major organisational change or new management practices (69 % for firms with 500 and more employees vs. 44 % for firms with less than 500 employees).

The results for Finland show that telecommunication and computer services have the highest share of firms implementing either new management techniques or changes in the organisational structure. A high proportion of firms with organisational changes can also be found in wholesale trade as well as in electrical machinery (Nace 30-33) (see Graph 2.9).

Graph 2.9: Introduction of new organisational practices and advanced management techniques, Finland 1998-2000



Notes: Energy supply and financial intermediation services are not covered by the survey.

Source: CIS 2000 Finland, own calculations.

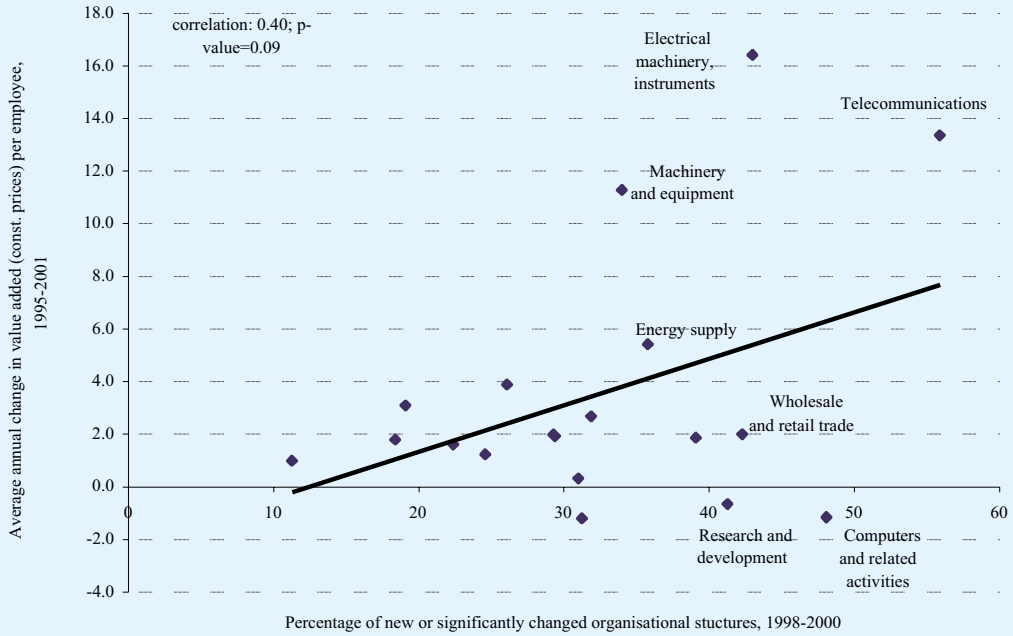
In Austria, the telecommunication and computer services industry, and low-skill intensive industries such as textiles, leather and wearing apparel as well as the transport industry have the highest share of firms with new organisational practices (see Graph 2.12).

In Sweden, telecommunication and computer services have the highest share of firms implementing either new management techniques or changes in the organisational structure (see Graph 2.13). A high proportion of firms with organisational changes can also be found in electrical machinery. Engineering activities, testing, R&D, machinery and electrical machinery have higher-than-average shares of firms implementing new management techniques.

Overall, the results suggest that ICT intensive industries, such as telecommunications and computer services, and R&D intensive industries, such as machinery or electrical machinery, are more likely to introduce organisational changes.

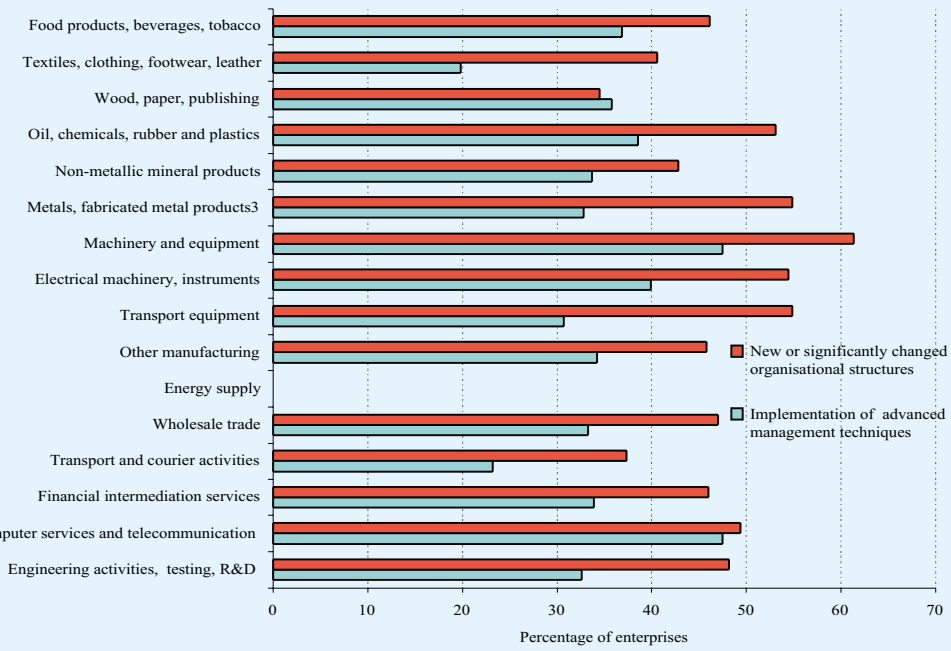
Graph 2.10 plots labour productivity growth and the percentage of enterprises with new or significantly changed organisational structures based on industry data for Finland. Industries such as telecommunication services, electrical machinery (including computer hardware, telecommunications equipment) can be identified as the industries with an above-average growth rate of labour productivity. It is surprising that computer services experienced negative productivity growth between 1995 and 2001. This may be partly due to measurement problems in the 'unmeasurable sector' (financial sector, market services such as computer services) (Griliches, 1992). For instance, in many service industries information on inputs (such as labour income) is used as a proxy of output. Furthermore, it is difficult to disaggregate the change in output value into a quantity and a price component. This problem may be even more severe in industries that are affected by changes in the quality of services. Van Ark (2001) pointed out that the difference in the labour productivity change between the measurable sector and unmeasurable sector is highest in

Graph 2.10: Organisational change and labour productivity growth, Finland



Source: CIS 2000 Finland, OECD STAN database Wifo calculations.

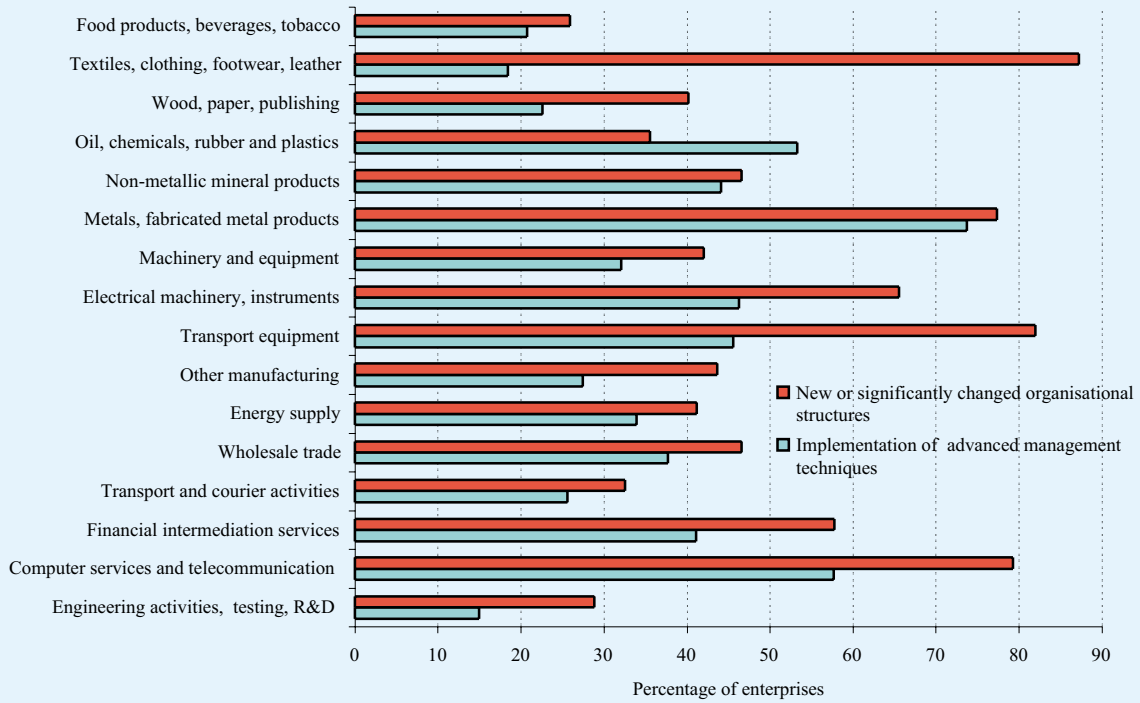
Graph 2.11: Introduction of new organisational practices and advanced management techniques, Germany, 1998-2000



Notes: Energy supply is not covered by the survey.

Source: CIS 2000 (Germany). We would like to thank Christian Rammer (ZEW) for providing us with the cross-tables.

Graph 2.12: Introduction of new organisational practices and advanced management techniques, Austria 1998-2000



Source: CIS 2000 (Austria), Statistic Austria, Wifo calculations.

Finland. This suggests that measurement problems may be more acute in Finland than in other European countries.

Excluding the outlier computer services, the correlation between organisational change and labour productivity depicted in Graph 2.10 is highly significant (p-value = 0.02). Positive and significant correlations between the share of firms with organisational changes on one hand and employment and value added growth (in constant prices) on the other, indicate that organisational change is accompanied by a higher labour productivity growth achieved mostly through output growth rather than labour-shedding.

There is also a positive relationship between the proportion of firms with organisational changes and labour productivity in Germany, but the correlation is not significant at the 10 percent level.

2.4.2 The productivity effect of reorganisation: Evidence based on establishment level data

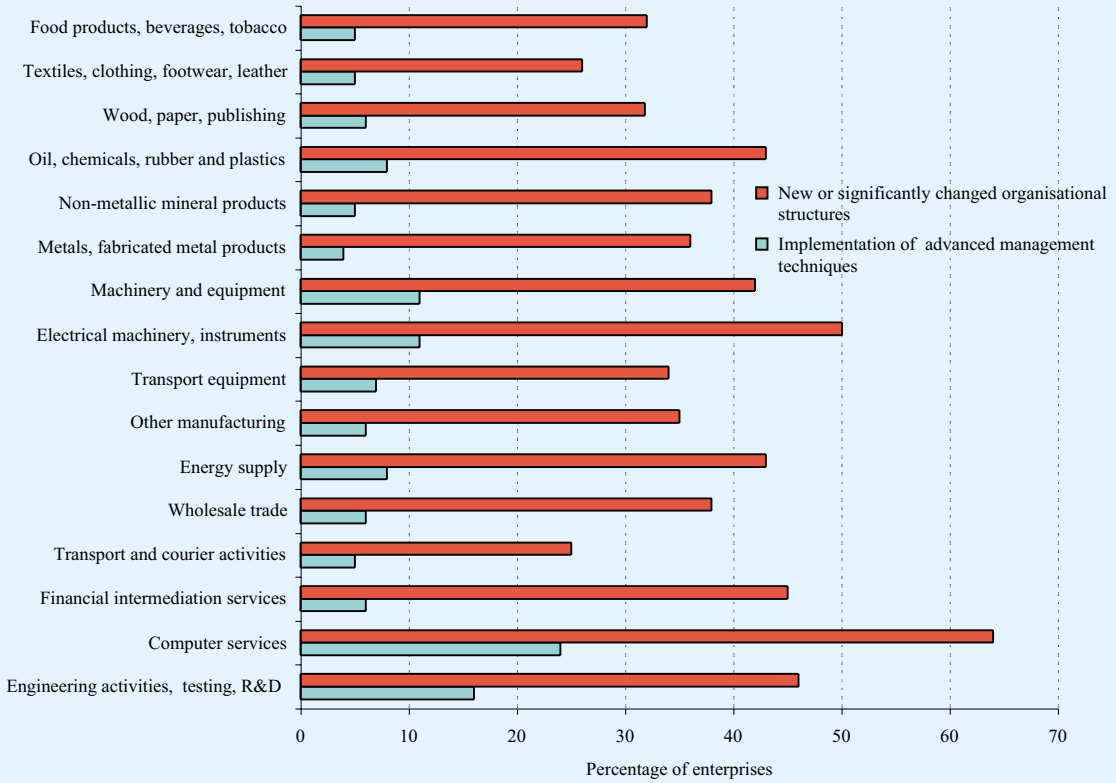
Cross-country comparisons of the diffusion of new forms of work organisation are very limited. They are typically drawn from small samples and are therefore not representative. The most reliable evidence concerning changes in work organisation in Europe is provided by the 1996 survey titled "European Direct Participation in Organisational Change (EPOC)" in ten European countries, which was initiated by the European Foundation. The results of the EPOC survey have been well documented in the literature (OECD 1999; Sisson 2000).

Concerning the relationship between organisational change and productivity the EPOC survey is of no help. More generally, neither the theoretical nor the empirical literature concur on the productivity effect of reorganisation. Therefore, clearly more research is warranted. Unfortunately, no internationally comparable data sets are available for an empirical assessment of this issue.

To investigate this further, the present section is based on the German IAB establishment data[40]. This data set, deriving from the largest survey of this kind in Europe, is a representative sample of German establishments employing at least one employee belonging to the compulsory social security scheme.

[40] See Annex 2.1 for more detailed presentation of the empirical approach and results.

Graph 2.13: Introduction of new organisational practices and advanced management techniques, Sweden 1998-2000



Notes: Transport and courier services include telecommunication. Data for computer services should be interpreted with caution due to small sample size. This also holds for the category "organisational change" in other manufacturing, energy supply and minerals. We thank Maria Säfström for her advice on the data interpretation.

Source: CIS 2000 (Sweden), Statistics Sweden, Wifo calculations.

The section concentrates on an important aspect of reorganisation, the increase in employee participation, i.e. the reduction of hierarchies, teamwork and autonomous work groups. These forms of reorganisation are frequently associated with stepped up ICT investments while other forms of reorganisation, such as new incentive schemes (profit sharing, employee share owning) do not share this association and are not considered here. Our hypothesis is that the introduction of measures that increase the participation of employees increases the productivity of the establishment.

The main diagonals of Table 2.10 provide an overview of the incidence of the selected reorganisations in a representative sample for German establishments in 1997. The most common reorganisation measure in 1997, with 11.4 %, is the delegation of responsibility and decisions to lower levels of hierarchy. Teamwork has been introduced by 5.5 % and work groups with independent budget have been introduced by more than 4 % of the establishments. Continuous training is offered by about 37 % of the establishments in the first half of 1997, while ICT investments have been undertaken by 28.4 % of the establishments in 1997.

The figures in the lower triangle of Table 2.10 describe the incidence of different combinations of the measures. That is, for example 3.3 % of the establishments in our sample aimed at improving the participation of their employees by shifting responsibility to lower levels of hierarchy *and* by implementing teamwork and self-responsible teams. If we only consider the group of establishments that introduce work groups with independent budgets (i.e. set as 100 %), almost 60 % of these establishments introduce both measures. Teamwork and self-responsible teams have been introduced by almost 30 % of those establishments that have work groups with independent budgets. Among the firms that implemented teamwork and self-responsible teams, a shift of responsibility to a lower level of hierarchy is also very widespread.

Table 2.10: Incidence of Reorganisations, ICT Investments, and Training in 1997 (in %)

	1	2	3	4	5
1 Shift responsibility to lower level of hierarchy	11.4				
	(100)				
2 Teamwork and self-responsible teams	3.3	5.5			
	(59.3)	(100)			
3 Work groups with independent budget	1.9	1.2	4.1		
	(46.5)	(28.4)	(100)		
4 Continuous training	7.2	3.9	2.9	37.1	
	(19.4)	(10.5)	(7.9)	(100)	
5 ICT investments	6.2	3.3	2.6	15.5	28.4
	(21.8)	(11.7)	(9.0)	(54.6)	(100)

Notes: The figures present the percentage of establishments applying a certain measure or combination of measures (based on the whole population). The figures in parentheses describe the percentage of establishments that use a given combination of measures (based on the number of establishments in the corresponding category).

Source: IAB Establishment Panel, Waves 1997 and 1998, own calculations.

Nevertheless, the joint incidence of combinations between investments in ICT, training and the three organisational changes is clearly lower. The percentage of establishments which offer all five measures is infinitesimal. These findings indicate that most German establishments selected only a small number of those measures analysed here. Similar results are obtained from waves 1999 and 2000 of the IAB panel. While the incidence of reorganisation measures decreased in 1998 and 1999, training and ICT investments increased.

It is not easy to detect empirically if organisational changes increase firm productivity because changes are perhaps introduced for reasons that also affect productivity. The OECD points to this problem as follows: "If firms only began to experiment with new forms of working practices when they faced dire trouble, the existence of practices might be associated with poorer performance, at least over the short-term. On the other hand, if flexible practices were introduced mainly into firms with more highly skilled workforces, there is the danger that higher performance may be attributed to the working practices rather than the higher skills" (OECD, 1999, p. 182). Empirical analysis[41] shows that indeed both factors, selectivity caused by temporary shocks (endogeneity) and unobserved structural differences (unobserved heterogeneity) have an impact on the estimated productivity effects of reorganisation. Productivity effects are assessed with lags up to 3 years.

The regressions indicate that if establishments introduced all three measures to increase employee participation in 1996 or 1997, average establishment productivity can be significantly increased by 8 % on average for the time period 1997-2000. Those establishments that introduce more than one measure to increase employee participation have a productivity advantage with respect to those that introduce only one. Therefore there are positive complementarities between the reorganisations studied. The interaction effect between organisational changes and investments in ICT and training stays insignificant, however, when both, endogeneity of HPW measures and unobserved heterogeneity are controlled.

Additional regressions show that not taking endogeneity of these measures and unobserved heterogeneity into account underestimates the productivity effect. With selection control, the effect of reorganisation is larger than without selection control for most regressions (see Table 2.11). This may mean that establishments introduce reorganisations when they have a temporary productivity problem. In addition, the regression on the average productivity effect for the period 1997-2000 exhibits higher productivity effects of reorganisation than the separate cross-section regressions for 1998, 1999, and 2000. As the regression on the averages controls for unobserved time-invariant heterogeneity, it can be deduced that these unobserved factors have a negative impact on the establishments or, in other words, that establishments with structural productivity problems introduce reorganisations. These last two findings would tend to confirm that reorganisation is often a response by enterprises falling behind. Alternatively, it confirms the importance of competitive pressure as a factor for introducing innovative practices.

[41] See Appendix 2.1.

Table 2.11: Productivity Effects of Reorganisation

	without selection control	with selection control	without selection control	with control selection	without selection control	with selection control	without selection control	with selection control
	1998		1999		2000		average 1997-2000	
Reorganisation in 1997	0.01	-0.01	0.01	0.08*	0.00	0.03	0.02**	0.08*

Notes: Significance levels are: **<5 %, *<1 %.

Source: IAB Establishment Panel, Waves 1999 and 2000, own calculations.

The bulk of the evidence on the productivity effects of human resource management methods can be found for the USA. For most European countries, studies on this topic are limited by the scarcity of data sets with the relevant information drawn from a representative sample of firms. Outside Germany, Fernie and Metcalf (1995) and Addison et al. (2000) show on the basis of the Workplace Industrial Relations Survey (WIRS) that efforts of the management to increase employee involvement in the three prior years have a significantly positive impact on firm or labour productivity in Britain (at least for non-union firms). They survey several British studies, however, that do not find significant productivity effects of employee participation. Ramsey, Scholarios and Harley (2000) include 24 human resource practices and identify some of them as High Performance Workplaces (HPW) on the basis of the Workplace Employment Relation Survey (WERS). British firms that adopted these measures had a relatively high labour productivity, however neither selection bias nor unobserved heterogeneity are controlled here. Caroli and Van Reenen (2001) find on the basis of the RÉPONSE survey that French firms increased their productivity by a reduction in managerial levels and that the effect is strongest in firms with a high share of qualified employees. NUTEK (1999) derives positive but frequently only marginally significant productivity effects of new work practices for Danish, Swedish and Finnish firms.

2.5 Summary and conclusions

Most large firms in the EU use e-business applications, such as enterprise resource planning and online procurement. The implementation of e-business applications is often accompanied by additional investments in hardware, software and training. The changes to the organisation can be substantial, and may have an impact on virtually every business process or function within the organisation. E-business applications such as ERP (Enterprise Resource Planning) require changes to the organisation chart, job descriptions, responsibilities, internal power structures, and to the organisation's culture.

Attached to ERP projects is not only the promise of productivity improvement but also the risk of failure if badly managed. Many projects fail because of the lack of organisational change, poor project management, inadequate training and the underestimation of the amount of time needed. Case studies and academic research indicate that ERP implementation leads to improvements in short-term productivity. However, it is still unclear whether ERP contributes to a long-term competitive advantage for the firm (Cotteleer, 2002).

Positive correlation between e-business practices and productivity growth

On the basis of e-business w@tch data for Germany, France, Italy and the UK, the actual use of ERP and online procurement is positively correlated with past or simultaneous labour productivity growth. However, there is no significant relationship between other e-business applications (i.e Supply Chain Management (SCM), Customer Relationship Management (CRM)) and labour productivity. Finally, certain e-business applications, such as Knowledge Management Solution (KMS) systems and CRM systems are correlated to either sectoral skill intensity or information technology intensity.

Positive correlation between organisational change and and productivity growth

The results from the empirical analysis based on CIS data confirm the hypothesis that the introduction of new business practices and new organisational practices are highly correlated. Furthermore, on the basis of industry data in Finland, there is a statistically significant relationship between labour productivity growth and the percentage of enterprises with new or significantly changed organisa-

tional structures. This indicates that industries with an above-average growth rate of labour productivity such as telecommunication services and electrical machinery have a higher share of firms with new or significantly changed organisational structures. However, this relationship is less clear in other countries such as Germany.

Simultaneous introduction of reorganisation measures increases productivity

The last part of this chapter shows that changes in the work organisation introduced in order to increase employee participation raises the productivity of establishments. The results indicate that the simultaneous introduction of teamwork, autonomous work groups and the reduction of hierarchies in the years 1996 or 1997 increases the average productivity of a representative sample of German establishments by 8 % in the period 1997-2000. It is also found that the three measures complement each other and the establishments that introduce all of these measures have an additional productivity advantage. The interaction effects between reorganisations and investments in ICT and training were not significant, however. The analysis suggested that the decision to engage in reorganisation is often the result of competitive pressure.

Policy implications

Given the positive relationship between e-business applications such as ERP systems and labour productivity growth, policies should aim at increasing the firms' incentives for productivity enhancing investments in e-business solutions. Many e-business applications are widely available but utilisation is not widespread especially within SMEs. The European Commission (2003) suggests several issues that should be considered, in particular: (i) improve the managerial understanding and skills for e-business in SMEs, (ii) promote the availability of SME friendly e-business solutions, and to facilitate effective participation of SMEs in electronic marketplaces and business networks. The managerial understanding and skills for e-business in SMEs should be enhanced by an increased knowledge transfer. Furthermore, managers and system users must be able to understand the integration of e-business applications into the overall company operation. Thus, firms should increase their investment in training and retraining programmes that give attention to the organisational culture and work organisation (EITO, 2003). E-business support networks may provide a way to develop and share knowledge. Some member states such as the UK already established SME business support networks. These typically aim at providing targeted knowledge and practical assistance to SMEs in the various stages of their effort to adopt concepts such as e-business.

Government policy, in general, can take responsibility for the following areas. Given the key role of ICT in the process of organisational change, governments must ensure the provision of a high quality ICT infrastructure. Given the positive externalities associated with human capital investment, governments have a major role in developing human capital. Government support is required in various areas, particularly tertiary education, worker training and lifelong learning (OECD, 2001). EU member implemented measures under the e-Europe 2002 Action Plan, which focused on the key objectives of achieving a cheaper, faster, and secure Internet, investing in people and skills and stimulating the use of the Internet. It is important that this momentum is sustained and intensified in the e-Europe 2005 Action Plan, focused on only three priorities, of which two are e-business and e-learning. Furthermore, governments can disseminate information on the benefits and costs of ICT enabled organisational change. This is particularly important for small and medium sized firms, as well as for firms in low skill intensive industries such as food & beverages and textiles, leather and clothing that seem to be late adopters of e-business practices. Encouraging the further growth of e-business solutions in these industries should be a key issue for sector-specific policy actions.

APPENDIX 2

Appendix 2.1
Establishment level estimates

Methodological Remarks

The Data

In order to assess the productivity impact of organisational changes for the average establishment in an economy and give an overview of the incidence of reorganisation, we need representative establishment panel data covering at least several sectors (Black and Lynch, 2001). Internationally comparable data sets suitable for such analysis do not exist and even national data sets are scarce. Therefore, for the present study the effects are measured exemplary for Germany, using the IAB establishment panel survey.

The establishments covered by the survey are asked every year about their turnover, number of employees, personnel problems, apprenticeship training, investments, ICT usage, innovations, and public subsidies since 1993 (in East Germany since 1996). From time to time, additional topics such as training and establishment reorganisation are added to the questionnaire. The establishments participating in the IAB Establishment panel are selected from the parent sample of all German establishments that employ at least one employee covered by social security.[42] Thus, self-employed and establishments that employ only people not covered by social security (mineworkers, farmers, artists, journalists, etc.) as well as public employers with solely federal employees do not belong to the original sample. The random draw on this sample covers information that increased from almost 9,000 German establishments in 1997 to almost 14,000 German establishments in the year 2000.

For the purpose of this analysis, we only include profit-oriented establishments and establishments that have not bought other establishments or been bought by other establishments.[43] The variables describing the reorganisations to increase the participation of employees, ICT investments and training refer to the year 1997. The impact of these measures on productivity are estimated for cross-section production functions from 1998 until 2000. In addition, a panel estimation includes the average productivity of the establishments in the years 1997 – 2000. In 1998, there are 2,287 establishments in our gross sample, in 1999 2,506 establishments and in 2000 4,314 establishments while during the years 1997 – 2000, 11,322 enterprises are covered in total.[44]

Productivity estimations in a cross-section analysis

The productivity effects of reorganisations that increase the participation of employees are determined by estimating Cobb-Douglas production functions (see also Black and Lynch, 2001). The dependent variable denotes the economic value added (turn over minus input costs) and the explanatory variables include capital, the number of employees, reorganisation, ICT investments and continuous training as well as other control variables.

The first estimation model describes a cross-section regression of a simple production function, where capital stock, labour input, variables describing the

[42] A detailed description of this dataset can be found in Kölling (2000).

[43] We sort the establishments into the following sectors: Agriculture and forestry, mining and basic materials, food, consumer goods, production goods, investment goods, construction, trade, traffic and communication, credit and insurance, hotels and restaurants, education, health and social affairs, electronic data processing and research and development as well as business consulting, other business services, and other personal services.

[44] The number of observations in the net sample is shown in the tables with the estimation results.

introduction of reorganisation and selected control variables are regressed on value added. Here, the introduction of three reorganisations that increase the participation of the employees are central: shift in responsibility to lower levels of hierarchy, teamwork and self-responsible teams, and work groups with independent budgets. The dummy variables indicating if an establishment introduced reorganisations in the years 1996 or 1997 (see Table 2.10 in main text) have a strong coherence and it seems difficult to disentangle the effect of one individual measure on productivity. Therefore the three observed measures are aggregated to one independent "reorganisation" factor by a factor analysis.[45] This approach captures the complementary nature of the three reorganisations better than using dummy variables for individual measures because it does not reduce the index value to zero if a single practice is absent in an establishment. Instead, the absence of one practice only reduces the value of the factor (Osterman, 1994; Youndt et al., 1996, Wolf and Zwick, 2002b).

First, the productivity effects of the factor "reorganisation" is estimated in a Cobb-Douglas production function for the cross-section equations:

$$(1) \quad \ln Y_t = \alpha \ln K_t + \beta \ln L_t + \gamma R_{t-l} + \phi ICT_t + \varphi T_t + \delta X_t + \varepsilon_t$$
with t=1998–2000,

where Y is value added, K is capital which is constructed from replacement investments by the perpetual inventory method (see also Black and Lynch, 2001 or Hempell, 2002), L is the number of employees, R is the factor "reorganisation", ICT is a dummy for ICT investments, T a dummy for continuous training investments and X represents the vector of control variables including the share of qualified employees, the legal form of the establishment, dummies for exporters, establishments with work councils and collective bargaining, and the state of the technical equipment. The productivity is measured in the respective values of the year observed. It can not be expected that reorganisations have an instantaneous effect on establishment productivity and therefore their productivity impact is lagged (Wolf and Zwick, 2002b; Zwick, 2002b; Kato and Morishima, 2002). In addition, by lagging the reorganisation variable, the endogeneity of this variable in the productivity regression can be mitigated (Caroli and Van Reenen, 2001). The symbol l indicates the lags that are between one for the 1998 and three for the 2000 cross section estimation. The parameters α, β, γ, φ, ϕ, and ä are the regression coefficients to be estimated and å is the normally distributed error term with expected value zero and variance σ^2.

In addition to the inputs capital and labour, further establishment characteristics are added as explanatory variables. It can be expected that a high share of qualified employees and modern technical equipment increase the productivity of the establishment (Addison et al., 2000; Black and Lynch, 2001; Wolf and Zwick, 2002b). Also exporters and establishments with work councils and collective bargaining usually exhibit a significantly higher productivity (Hübler and Jirjahn, 2002; Addison et al., 2000; Zwick, 2002b; Zwick, 2003c). East German establishments may still have lower productivity, differences between the business sectors are captured by 16 dummy variables and four dummies for legal establishment forms are added. A definition of all variables as well as their average values can be found in table A.2.2.

Column 2 and 3 of table A.2.5 show the effects of reorganisation introduced in 1996 and 1997 on value added in 1998 (model 1).[46] The establishments in our sample produce with a capital intensity of around 0.16.[47] The low and insignificant coefficient of the factor reorganisation surprises in the light of the theoretical considerations in Section 2. The control variables all have the expected effects on the productivity of the enterprises, however. The productivity gap between East and West Germany is still persistent and the productivity differentials between sectors are jointly significant.

The complementarities between different measures are widely ignored in the empirical literature (Cappelli and Neumark, 1999). Frequently mentioned complements to reorganisations that decentralise decision-making and increase the participation of employees are investments in information and communication technologies (ICT) and training (Brynjolfsson and Hitt, 2000; Bresnahan, Brynjolfsson and Hitt, 2002). Therefore, in model 1 in addition to the factor reorganisation, also interaction terms between organisational changes, ICT investments and training investments as well as an interaction term between all three measures are added. In contrast to our theoretical considerations in section 2 – though in accordance with comparable estimations (McNabb and Whitfield, 1999, Wolf and Zwick, 2002b) – the interaction terms are insignificant for all

[45] A main component factor analysis is applied to reduce the three reorganisation measures to one independent factor with an eigen value of 1.82 (see Osterman, 1994; Ramsay, Scholarios and Harley, 2000). The resulting factor "reorganisation" explains 61 % of the total variance. The factor loadings are shown in table A.2.3.

[46] The results for 1999 and 2000 are qualitatively the same and, therefore, they are not shown here.

[47] The low capital coefficient may be a consequence of the approximation of capital by replacement investments. The measurement errors incurred by this method lead to the well-known bias of the capital coefficients toward zero (Griliches and Mairesse, 1998).

cross section regressions.[48] This means that establishments that increase the participation of their employees can not further increase productivity by additionally offering continuous training or investing in ICT at the same period of time.

We do not know, however, if ICT investments and training efforts in the establishments are intended to support the introduction of the reorganisation. We only observe the joint incidence of these measures in some establishments. Therefore, it can not be excluded that ICT and training investments specifically designed to improve the adoption of reorganisation have a positive impact on productivity as it was shown by Ichniowski, Shaw and Prennushi (1997) for the American steel industry. Another reason for the insignificant interaction terms might be that the experiences in one firm or sector might not be easily transferred to other firms with a different business environment and industrial relations (Ichniowski, Shaw and Prennushi, 1997). We take the universal view that looks at productivity effects irrespective of sector or specific business strategy of the establishment (Huselid, 1995). Probably the complementarity between ICT, training and reorganisation is strongly dependent on firm-specific conditions, however. Finally, formal training might not be the most efficient reaction of the establishment on the introduction of reorganisation. Borghans et al. (2000) show that most employees in a Dutch insurance company received the necessary information from colleagues or superiors when organisational changes are introduced. When new ICT measures are introduced, mainly training and instruction is used, however, see table A.2.1.

Table A.2.1: What kind of support did the workers get?

	IT (in %)	Organisational change (in %)
Training	43	4
Instruction	30	21
Supervision	13	25
Colleagues	13	38
Other	3	13

Source: Borghans et al. (2000).

[48] The results do not differ from those in model 1 and are therefore not shown here.

Endogeneity of Reorganisation

The cross section regressions in the last section can give only first indications on possible productivity effects of measures that increase the participation of employees, because possibly important unobserved establishment characteristics and endogeneity of the personnel measures are not taken into account. In a next step, it is explored on the basis of instrumental variable regressions if the results presented in the previous estimations are biased because the introduction of reorganisation is endogenous (Model 2).

Most data sets do not provide suitable additional variables that meet the requirements for qualifying them as identifying variables in an instrument regression. In the case of panel data, lagged values or differences of the explaining variable in question are often used as instruments. This strategy is problematic, however, because the instruments are often only weakly correlated with the endogenous variables, and explanatory variables, such as capital, are only weakly correlated over time. Therefore, it is preferable to use external instruments that intuitively explain the selection process in the establishment and exhibit the necessary statistical properties (Griliches and Mairesse, 1998).[49] The wave 1997 of the IAB establishment panel contains information on expected training activities and on expected personnel problems, which may serve as identifying regressors. Seven suitable external instruments can be found: three variables on expected personnel problems concerning skill gaps and organisational changes[50] and four training forms whose incidence is expected to increase in the next two years.[51] Each of these variables is correlated with the introduction of reorganisation because we can expect that the introduction of these measures increases the qualification demand of the work force. In addition, the identifying variables are uncorrelated with establishment productivity and therefore satisfy the statistical requirements.

The instrument equation for the factors organisational change R can be described as follows:

$$(2) \quad R=\alpha_1 I_1+...+\alpha_7 I_7+\delta X+\varepsilon,$$

[49] Nevertheless the list of identifying variables used has an impact on the estimated coefficient of the instrumented variable. Therefore several different identifying variables are used here.

[50] The dummy variable has the value one if the establishment expects problems to find suitable skilled employees on the labour market, organisational problems due to maternal leave and a large demand for training and qualification. It is based on the question, "Which personnel problems do you expect in the following two years?".

[51] The four training forms are formal external courses, job rotation, self-induced training and quality circles. The dummy variable has the value one if the establishment expects that the incidence of these training forms increases during the next two years.

where $I_1 - I_7$ are the identifying variables and X is the vector of control variables from equation (1). In Model 2, equation (2) is estimated simultaneously with the production function (1) using a two stage least squares procedure. This implies that the endogenous factor R that is correlated with the error term in equation (1) is replaced by the instrumented factor estimated in equation (2), Rhat. This factor is correlated with the original factor but independent from å in equation (1) and therefore exogenous. The results of the instrumental equation (2) can be found in table A.2.7[52].

Columns 4 and 5 of table A.2.5 show the estimation results of the production function of Model 2 with the instrumented reorganisation for 1998. The coefficients of the input factors capital and labour and the additional control variables are almost unchanged in comparison to the estimation results of model 1. Also the estimated impacts of reorganisation are relatively unchanged and still do not significantly differ from zero. Finally, the interaction terms between reorganisation, ICT and training investments are not significantly different from zero again (not shown here). These results apply also for the cross sections of the year 1999 and 2000. Therefore endogeneity of reorganisation does not have an impact on the results in the cross-section regressions.

Unobserved Heterogeneity

Even if we control the endogeneity of the establishment´s decision to introduce reorganisation, the cross-section production function estimation may be biased because other explanatory variables, especially capital and labour, are endogenous (Griliches and Mairesse, 1998). Important reasons for the endogeneity of labour, capital, and other variables in the production function may be that unobserved time-invariant factors, such as management quality, industrial relations, or technological change, have an impact on the explanatory variables *and* on the value added. Therefore the impact of time invariant unobserved heterogeneity on the estimation results is estimated in model 3. If unobserved characteristics of the establishment, such as management quality or industrial relations, are correlated with both, the introduction of reorganisation *and* productivity, cross-section estimates are inconsistent. A possibility to correct the estimation bias is to use panel estimation methods that eliminate the establishment fixed effects. When, for example, deviations from an establishment's mean or first differences in equation (1) are taken, all time-invariant variables such as the introduction of certain measures during a period of time, industry sector, the existence of work councils as well as other variables in the production function, can not be identified, because they drop out (Ichniowski, Shaw and Prennushi, 1997; Black and Lynch, 2001). This feature proves to be a crucial hindrance in our case, because we only know if an establishment has ever introduced the reorganisation in 1996 or 1997. Therefore we do not know the exact implementation date and we do not have yearly data on the incidence of these measures.

Therefore, the two step estimation procedure suggested by Black and Lynch (2001) is used. In this model, the parameters of the time-variant input factors are determined by a simple Cobb-Douglas production function on the basis of panel data from 1997 to 2000, while the effects of the (almost) time invariant determinants are regressed on the fixed effects from the panel analysis in the second step. Therefore, the fixed effects estimation in the first step can be written as:[53]

(3) $\ln Y_t = \alpha \ln K_t + \beta \ln L_t + \upsilon + \varepsilon_t$ with t=1997–2000,

where õ is the unobserved time invariant establishment specific fixed effect and $å_t$ the idiosyncratic component of the error term. The estimation results of equation (3) can be found in table A.2.4. Striking is again the low coefficient of the input capital that has a similar size to that in the comparable estimation in Black and Lynch (2001), however. If input and output are chosen simultaneously or if there are measurement errors for the input factors (especially for capital), the within estimator will be inconsistent and we may observe too low capital intensities in the production function (Griliches and Mairesse, 1998).[54]

On the basis of these first step regression results, the average fixed effect for every establishment in the period 1997-2000 is calculated. The average fixed effect can be interpreted as the average establishment specific difference from productivity predicted on the basis of the inputs. This time invariant variable therefore indicates whether total factor productivity was below or above the average of the other establishments during the observation

[52] The instrumental regressions only differ slightly for the different years in the cross section regressions and the fixed effects regressions. Therefore just the instrumental regression for the fixed effects regressions (see below) is displayed in table A7.

[53] The necessary assumptions for a random effects regression were rejected by a Hausman test.

[54] Some papers demonstrate that these problems can be avoided by using estimators based on differences or lags such as (system) GMM or the two-stage least-squares first-differenced estimator (Anderson and Hsiao, 1981), see Black and Lynch (2001) or Hempell (2002). This approach is not possible with the data because the number of observations would decline dramatically.

period. It serves as dependent variable for the second estimation step. The vector of explanatory variables in the second step contains all (almost) time invariant establishment characteristics from model 1, that is the reorganisation factor, ICT investments, the continuous training dummy and all variables in *X*. All explanatory variables are included with their values for the year 1997:

(4) $\bar{\upsilon}=\gamma R+\phi ICT+\varphi T+\delta X+\varepsilon.$

The estimation results are shown in table A6. Reorganisation introduced in 1996 or 1997 have a significant positive impact on the establishment specific fixed effects (model 3). In comparison to the results of the first model, taking into account unobserved heterogeneity increases the positive impact of organisational changes on establishment productivity. This suggests that establishments which introduce organisational changes have unobserved time invariant characteristics that decrease their productivity. In other words: establishments with structural productivity problems try to improve their situation by changing their organisational structure. This is also found by comparable contributions, see Nickell, Nicolitsas and Patterson (2001) and Wolf and Zwick (2002b). If one ignores the impact of these unobserved fixed effects, the measured productivity effect of organisational changes is too low. The relative impact of the other variables on productivity is roughly the same in models 1 and 3 while the significance of the explanatory variables is somewhat larger in model 3.

Final statements on the effects of reorganisation can only be made, however, if we control for both, unobserved fixed effects and endogeneity. Therefore, in a next step, the reorganisation factor *R* in estimation equation (4) is instrumented using equation (2), see the regression results of model 4 in table A.2.6. Controlling endogeneity clearly increases the measured productivity impact of reorganisation on the average fixed effect. The coefficients of the other explaining variables are more or less the same. This result shows that taking account of selection effects can be decisive for the evaluation of the productivity effects of reorganisation even after controlling unobserved heterogeneity. When we take into account the decision of the firm to restructure their internal organisation, the assessment of these organisational measures is clearly more positive. The regression indicates that if establishments introduced all three measures to increase employee participation – flatter hierarchies, team work and autonomous work groups – in 1996 or 1997, average establishment productivity could be significantly increased by 8 % on average for the time period 1997-2000. The construction of the reorganisation factor makes it clear that those establishments that introduce more than one measure to increase employee participation have a productivity advantage with respect to those that introduce only one. Therefore there are positive complementarities between the reorganisations studied. The interaction effect between organisational changes and investments in ICT and training stays insignificant, however, when both, endogeneity of HPW measures and unobserved heterogeneity is controlled.[55]

[55] Estimation results are not shown here, but they are available upon request.

Table A.2.2: Descriptive statistics of variables used

Variables	1997	1998	1999	2000	Comments
Value Added	12.90	12.85	12.99	13.07	Turnover minus inputs, in DM, logs
Capital	12.44	12.45	12.38	12.44	Constructed from expansion investments by perpetual inventory method, in DM, in logs
Labour	1.95	1.95	1.97	1.96	Number of employees, in logs
Share qualified employees	0.51	0.48	0.53	0.53	Share of employees with professional degree on all employees
Exporter	0.11	0.10	0.18	0.25	Establishment exports, yes=1, no=0
State of the art technical equipment	0.70	0.72	0.74	0.76	Technical state of equipment is modern or state of the art, yes=1, no=0
Work council	n.a.	0.20	0.22	0.26	Establishment has work council, yes=1, no=0
Collective bargaining	0.54	0.67	0.67	0.70	Establishment is subject to or orients itself on sector or establishment specific collective wages, yes=1, no=0
Individual establishment	0.58	0.60	0.59	0.56	Establishment is an individual firm, yes=1, no=0
Partnership	0.09	0.09	0.09	0.11	Establishment is a partnership, yes=1, no=0
Publicly listed establishment	0.01	0.01	0.01	0.02	Establishment is publicly listed, yes=1, no=0
Limited (reference)	0.32	0.30	0.31	0.31	Establishment is a public limited company, yes=1, no=0
Expected skill shortage	0.19				Establishment expects skill shortages in next 2 years, yes=1, no=0
Expected organisational problems due to maternal leave	0.04				Establishment expects organisational problems due to maternal leave in next 2 years, yes=1, no=0
Expected large demand for training and qualification	0.07				Establishment expects large demand for training and qualification in next 2 years, yes=1, no=0
Expected increase in internal formal courses	0.11				Establishment expects increase in internal formal courses in next 2 years, yes=1, no=0
Expected increase in job rotation	0.02				Establishment expects increase in job rotation in next 2 years, yes=1, no=0
Expected increase in self-induced training	0.06				Establishment expects increase in self-induced training in next 2 years, yes=1, no=0
Expected increase in quality circles	0.03				Establishment expects increase in quality circles in next 2 years, yes=1, no=0
East German establishment	0.20	0.20	0.22	0.24	Establishment has head quarter in East Germany, yes=1, no=0

Notes: Averages are derived from cross section samples and weighted according to establishment weights.

Source: IAB establishment panel, waves 1997-2001, own calculations.

Table A.2.3: Rotated[a] component matrix of factor analysis

Factor	Variables	Factor loadings
Organisational changes	Shift responsibilities	0.82
	Teamwork	0.80
	Independent work groups	0.72

Notes: [a] The factors have been rotated by promax.

Source: IAB establishment panel, wave 1999, own calculations.

Table A.2.4: Fixed effect production function 1997-2000, endogenous variable: Value Added

Variables	Coefficient	z-Value
Capital	0.02**	2.54
Labour	0.44***	12.38
Year 1998	-0.00	-0.04
Year 1999	0.02	1.55
Year 2000	0.07***	4.55
Constant	12.82***	85.58
Number of observations = 11322		
Number of groups = 6293	R^2 = 0.83	
	F(5,5024) = 37.91	
	Prob > F = 0.0000	

Notes: Significance levels: ***<1 %, **<5 %.

Source: IAB establishment panel, wave 1999, own calculations.

Table A.2.5: Productivity effects of reorganisation in 1997 on productivity 1998, endogenous variable:Value Added 1998

	Model 1 (OLS regression)		Model 2 (2 stage least squares instrumental variables regression)	
	Coefficients	z-values	Coefficients	z-values
Reorganisation 1997	0.01	0.53	-0.01	-0.27
Capital	0.16***	11.42	0.15***	9.61
Labour	0.82***	35.91	0.82***	28.17
ICT investment	0.07*	1.92	0.05	1.04
Training 1997	0.07**	2.03	0.06	1.46
Share qualified employees	0.42***	6.03	0.47***	5.92
Exporter	0.18***	3.64	0.19***	3.32
State of the art technical equipment	0.07*	1.80	0.09**	2.07
Work council	0.14***	2.64	0.16**	2.56
Collective bargaining	0.05	1.40	0.09**	1.99
Individual establishment	-0.26***	-5.47	-0.30***	-5.72
Partnership	-0.01	-0.18	-0.01	-0.13
Publicly listed establishment	0.16*	1.87	0.21**	2.16
East German establishment	-0.35***	-9.60	-0.32***	-7.85
Constant	9.23***	47.16	9.29***	41.49
	N=2287		N=1835	
	R^2=0.88		R^2=0.89	

Notes: Significance Levels: ***<1 %, **<5 %, all values are for 1998, except indicated otherwise (training investment is only available for 1997). 16 sector dummies are included, standard errors are heteroscedasticity robust.

Source: IAB Establishment Panel, Waves 1999 and 2000, own calculations. All standard errors are heteroscedasticity robust.

Table A.2.6: Productivity effects of reorganisation on average productivity 1997-2000

	Model 3 (OLS regression)		Model 4 (2 stage least squares instrumental variables regression)	
	Coefficients	z-values	Coefficients	z-values
Reorganisation	0.02**	1.98	0.08*	1.65
ICT investment	0.14***	4.40	0.11***	2.74
Training	0.19***	5.31	0.17***	4.38
Share qualified employees	0.58***	9.58	0.58***	9.53
Exporter	0.26***	5.67	0.25***	5.35
State of the art technical equipment	0.18***	6.64	0.17***	5.23
Work council	0.48***	10.14	0.48***	10.09
Collective bargaining	0.15***	4.32	0.15***	4.22
Individual establishment	-0.52***	-11.99	-0.51***	-11.69
Partnership	-0.13***	-2.59	-0.12***	-2.30
Publicly listed establishment	0.15**	2.00	0.14**	1.79
Establishment size 20-199	0.79***	18.12	0.77***	16.67
Establishment size 200-499	1.50***	22.11	1.50***	20.24
Establishment size 500-999	1.81***	20.21	1.75***	16.85
Establishment size 1000+	2.43***	25.59	2.30***	15.56
East German establishment	-0.36***	-11.10	-0.36***	-11.09
Constant	-1.19***	-11.57	-1.17***	-11.26
	N=3168		N=3168	
	R^2=0.73		R^2=0.72	

Notes: Significance Levels: ***<1 %, **<5 %, all values are for 1997, except work council which is only available for 1998. Also 16 sector dummy variables added, standard errors are heterosedasticity robust.

Source: IAB Establishment Panel, Waves 1999 and 2000, own calculations. All standard errors are heteroscedasticity robust.

Table A.2.7: Instrumental variable regression, endogenous variable: Reorganisation

Variables	Coefficient	z-Value
ICT investment	0.45***	8.35
Training	0.14***	2.32
Share qualified employees	0.02	0.25
Exporter	0.07	0.98
State of the art technical equipment	0.15***	2.69
Work council	-0.10	-1.25
Collective bargaining	0.03	0.49
Individual establishment	-0.11	-1.52
Partnership	-0.19***	-2.19
Publicly listed establishment	0.19	1.46
Establishment size 20-199	0.26***	3.66
Establishment size 200-499	0.34***	2.72
Establishment size 500-999	0.79***	4.97
Establishment size 1000+	1.83***	11.38
East German establishment	0.13***	2.36
Expected skill shortage	0.20***	3.39
Expected organisational problems due to maternal leave	0.16**	1.87
Expected large demand for training and qualification	0.19***	2.33
Expected increase in internal formal courses	0.22***	3.04
Expected increase in job rotation	0.36***	3.21
Expected increase in self-induced training	0.35***	3.79
Expected increase in quality circles	0.32***	3.09
Constant	12.82***	85.58
Number of observations = 11322		
Number of groups = 6293	R^2 = 0.83	
	F(5,5024) = 37.91	
	Probe > F = 0.0000	

Notes: Significance levels: ***<1 %, **<5 %. All variables take the values of year 1997 (except work councils that are only available for 1998), also 16 sector dummy variables added, standard errors are heteroscedasticity robust.

Source: IAB establishment panel, wave 1999, own calculations.

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Appendix 2.2 Glossary - list of abbreviations

ASP: Application Service Provider

B2B: Business-to-business

BPR: Business Process Reengineering

CRM: Customer Relationship Management

EDI: Electronic Data Interchange

ERP: Enterprise Resource Planning

HR: Human Resources

ICT: Information and Communication Technologies

IS: Information Systems

IT: Information Technologies

KMS: Knowledge Management Solutions

SCM: Supply Chain Management

VO: Virtual Organisation

Chapter 3: Regional Aspects of Competitiveness

3.1 Introduction

Regional diversity in the EU will increase sharply with the forthcoming enlargement as will the competitiveness challenge. The present EU–15 is already characterised by substantial income, employment and productivity disparities reflecting differing resource endowments and innovation performance. Certain EU regions perform very well and constitute clusters of innovation and productivity growth, associated with high real wages and standards of living and providing substantial external economies that attract new firms and foster the process of innovation. Other regions perform poorly (see European Commission (2003)). A key competitiveness challenge for the EU on the eve of enlargement is to ensure that the conditions that are necessary for regional productivity growth are developed across all regions including those of the acceding nations. Such conditions will ultimately determine whether regional disparities are eased and cohesion is advanced or whether disparities continue to be present or to widen over time.

This chapter has two main purposes. In order to understand better the problem of regional disparities in the EU, it is, firstly, necessary to explain success at the regional level – where success is understood to mean high levels of competitiveness; secondly, it is necessary to determine whether the factors underlying success can be applied elsewhere, in particular in less successful regions.

It is essential, to begin with, to define more precisely what is understood by success choosing from a number of possible measures of competitiveness suggested in the literature. Once this is accomplished, a review of the theoretical aspects of (regional) competitiveness should help determine the causes of success. A review of available data and analytical approaches should make it possible to consider how to measure success in practical terms, and to determine which factors affecting success are the most important or relevant. Finally, by looking more broadly at a selection of regions which have performed well in recent history it will be possible to assess the transferability of the factors behind success.

The present chapter begins with a literature review, in section 3.2, to help determine the structure behind regional competitiveness and what makes this different from the concept of national competitiveness. An overview of the theories explaining regional competitiveness is followed by a specific focus on how knowledge-based factors influence the outcome. The role of knowledge-based factors is of particular importance to the study in view of their presence in many of the growth areas in the economy. The section concludes by proposing a set of variables and concepts which give structure to the subsequent empirical analysis.

An assessment of the availability of European[56] regional data is presented in section 3.3. In particular, the section looks at what indicators are available to approximate the factors determining regional competitiveness. Ultimately, a European regional databank is established from which empirical analysis is undertaken.

In sections 3.4 to 3.6 three methodologies are used to help determine how success, i.e. regional competitiveness, can be explained: associations and correlations of competitiveness with key indicators, econometric analysis, and case studies.

The methodologies enable a picture of competitiveness to be constructed, which gradually moves towards more robust conclusions of the causes.

[56] The empirical parts of the study are limited to the EU regions.

Section 3.7 summarises the main conclusions and, finally, section 3.8 reviews some policy conclusions regarding the potential of transferring those factors found to be important in regional competitiveness to regions that have been lagging behind.

3.2 Regional Competitiveness: A Brief Literature Review

Competitiveness can be defined in many ways. A common indicator is GDP per capita, which can be broken down into various component factors, each with an economic interpretation. Thus, the fundamental relationship is:

$$\frac{GDP}{Population} =$$

$$\frac{GDP}{Total\ Hours\ Worked} \bullet \frac{Total\ Hours\ Worked}{Employment} \bullet$$

$$\frac{Employment}{Working\ Age\ Population} \bullet \frac{Working\ Age\ Population}{Population}$$

(Productivity) • (Work-Leisure choice) • (Employment Rate) • (Dependency Rate)

Although some interrelation is likely between the indicators (highly productive regions, for example, using skilled labour may well display high rates of employment), for the purpose of this chapter the focus will be on productivity, defined in terms of output per hour worked.

The relative merits of GDP per employee and GDP per hour worked as a measure of productivity have been discussed in Chapter 1. The regional implications of choosing an hours worked measure are perhaps more profound than at the national level. Regions are more likely to be specialised in particular sectoral activities, and this means that adjusting for different hours worked profiles will more accurately represent the true labour effort involved in producing the output against which it is measured.

By analysing success at the sub-national level one assumes that despite the presence of both competitive and less competitive firms in every region there will be common features within a region, which affect the competitiveness of all firms located there.

Clearly, there are many parallels with the study of national competitiveness and certain indicators are likely to be common to both country-level and regional analyses. However, regions are different from countries in some key respects. Sub-national regions are part of the national monetary union and subject to common rules governing their international trade, and the degree of price and wage flexibility is generally less than across nations, whereas generally there is full and unrestricted capital and labour mobility. Regions do not have the same set of adjustment mechanisms as countries, and therefore the concept of macro-economic competitiveness cannot be fully applied to the regional level; on the other hand, as part of a national fiscal system, regions enjoy substantial benefits related to fiscal transfers that constitute an important adjustment mechanism.

As regional competitiveness shares many features with its national counterpart, most theoretical approaches are usually present in both areas of work. Graph 3.1 provides a broad overview of the theoretical foundations and of the array of factors that can be considered to play a role in determining regional competitiveness. The concepts from neo-classical, new growth theory and cost competitiveness apply equally well to regions as to nations. On the other hand, knowledge and innovation, and localisation/specialisation effects are critical factors in regional competitiveness. The rest of this section reviews these more closely.

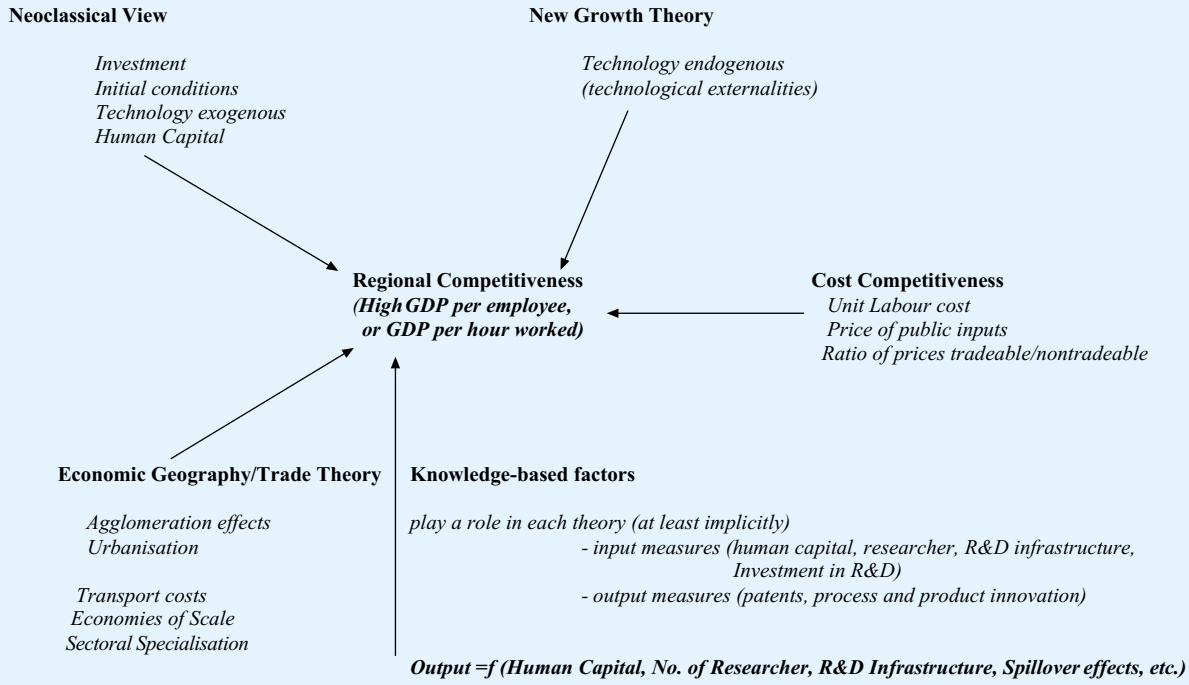
3.2.1 Theories concerning localisation and specialisation

3.2.1.1 New economic geography

The attempt to find more convincing and robust explanations for the tendency of economic activities to cluster in a limited number of places and within clearly defined boundaries, and to link this with the concept of regional competitiveness, has stimulated a resurgence of interest for space-related issues in economic theory, after concepts such as distance and transportation costs had long been marginalised by mainstream (neo-classical) economists.

The most compelling testament to this has been the birth of what is often referred to as 'new economic geography' recently reviewed by Schmutzler (1999) and inspired by the influential core-to-periphery model proposed by Krugman (1991a). In its essence, the new paradigm maintains that geographical concentration is the equilibrium outcome of countervailing forces (centripetal and centrifugal) which, while they attract consumers and firms to the same location, they prevent the production of one good from being entirely located in a single massive centre.

Graph 3.1: Aspects of Regional Competitiveness



New economic geography theories have stimulated a wealth of empirical work. However, few studies have attempted to test directly the market-size effects on agglomeration posited by the core-to-periphery framework. Davis and Weinstein (1999) confirmed the existence of the "home market effect" described by Krugman (1991b), which postulates that differences between two regions in demand for a good can induce amplified differences in the production of the good, leading the high-demand region to become a net exporter.

These findings contrast with evidence previously found by the same authors using OECD data at the country level (Davis and Weinstein, 1999). Higher trade costs (transport costs and trade barriers) between countries and greater mobility of factors across regions are two factors put forward in Davis and Weinstein (2001) to explain the different predictions obtained from their regional and international analyses, respectively.

Amiti (1998), using data on 5 EU countries and 65 manufacturing industries, finds that a 1 percent increase in scale economies - measured as the ratio between total employment in each industry and the number of enterprises - leads to 0.5 percentage points increase in industrial concentration. Brülhart (1998) using employment data on EU industries finds a positive relationship between industries characterised by strong internal scale economies like manufacturing and chemicals and centrality indices. In other words, these industries tend to be localised at the EU core.

Haaland et al. (1998) empirically address the question of what determines the economic geography of Europe. Using cross-section data on thirteen Western European countries disaggregated by sector at the 4-digit level, they test the relative importance of a wide range of factors on the relative and absolute indices of geographical concentration proposed by Amiti (1998). Among the explanatory variables the authors include market size effects (concentration of expenditure), between-country differences in labour (number of employees to value added) and human capital (average labour compensation) intensities, differences in technology (labour productivity), input-output linkages (proportion of own industry inputs on output), economies of scale (percentage reduction in average costs for each percent increase in output), and trade costs (non-tariff barriers).

The results indicate that the most important determinant of industrial concentration in Europe is the demand bias generated by the localisation of expenditure. This factor alone accounts for nearly half of the total variation in industry concentration across countries. This result is taken as evidence in

favour of the home market effect postulated by the new economic geography theories. *Ceteris paribus*, differences in factor intensities are also found to be significant forces behind concentration, suggesting that the Hecksher-Ohlin and Ricardo theory of comparative advantage also contributes, albeit to a lesser extent, to explaining economic geography in Western Europe.

3.2.1.2 Spillover effects

The observation that knowledge tends to flow freely between proximate firms operating within the same or related industries lies at the heart of the empirical literature investigating the link between innovation and location. A sizeable body of empirical studies have shown that knowledge spillovers not only increase productivity, but their effect also decays with geographic distance (Jaffe et al., 1993; Almeida and Kogut, 1997; Acs et al., 1994).

Von Hipple (1994) argues that non-codified knowledge is "sticky" and consequently it is best transmitted via face-to-face interaction. Geographical proximity matters because tacit knowledge - if non-rival, in the sense that the use of a piece of information by a firm does not reduces its content for other firms (Arrow, 1962) - can more easily spill over from a firm to a closely located firm through employees or researchers interaction. Along similar lines Glaeser et al. (1992) observe that the diffusion of technical knowledge may be highly localised and transfer is more likely to occur in places densely packed with organisations that share similar interests (local milieu). The attention devoted to the measurement and the effect of knowledge spillovers is also linked to the new growth theory (Romer, 1986; Lucas, 1988; Grossman and Helpman, 1991). Unlike neo-classical growth theory (Solow, 1956), endogenous growth models identify externalities, rather than scale economies, as the main engine of growth. Given that knowledge spillovers are an important source of externalities, regional differences in growth rates may result from increasing returns to knowledge.

Agglomeration economies

A related theoretical debate that has attracted a considerable amount of empirical work concerns the disaggregation of agglomeration economies – as conceived by Marshall (1890), Weber (1909) and Lösch (1940) – into localisation economies and urbanisation economies, or alternatively, distinguishing between specialisation and diversity economies.

Localisation economies, attributed by Glaeser et al. (1992) to the *Marshall-Arrow-Romer externality (MAR)*[57], are defined as knowledge spillovers external to firms but internal to an industry within a geographic region. On the other hand, urbanisation economies reflect Jacob's (1969) view of a cross-fertilisation of ideas across firms from different industries within a city. According to this view, the most important sources of knowledge spillovers are external to industries and are realised through the exchange of complementary knowledge across firms sharing a common science base within a geographic region.

Empirical results tend to support the second hypothesis, that knowledge spillovers are associated to diversity rather than industry specialisation. Glaeser et al. (1992) using a dataset on the growth of the top five industries in 170 different cities test the relative importance of specialisation and diversity and find that diversity is relatively more conducive to higher growth than specialisation. Acs et al. (1999) find that specialisation has a negative effect on local employment growth and Audretsch and Feldman (1998) find that diversity is more conducive to innovation than specialisation[58].

Local competition, knowledge externalities and innovation

Contextual to the debate on whether regional specialisation (rather than regional diversity) is more conducive to innovation and growth, a second controversy has involved the link between the degree of local competition, knowledge externalities and innovation.

The MAR model predicts that local monopoly dominates local competition as the means to economic growth, because it allows firms to maximise their ability to appropriate the economic value generated by their investment in innovative activities. Conversely, Jacobs (1969) and, more recently, Porter (1990) claim that local competition is superior to local monopoly, because it creates incentive to emulate best practice and boosts pressure to innovate. This debate has also stimulated a number of empirical studies. Armington and Acs (2002) look at the effect of new firm entry rates on local

[57] Marshall (1890) suggested that knowledge transfers were important for the growth of cities. Arrow (1962) framed this concept into a general equilibrium formulation, which was later expanded by Romer's model of endogenous growth (1986).

[58] Some successful examples of diversified innovative (biotech and IT) clusters in Europe (with NUTS codes) are: East Anglia (Cambridge) UK40; Stockholm-Uppsala SE0(1-2); Central Scotland (Edinburgh, Glasgow, Dundee) UKA(1-2); Uusimaa (Helsinki) FI11; Karlsruhe (Heidelberg) DE12 (winner of the Bio-Regio Contest, this clusters hosts the European Molecular Biology Laboratory); Dublin IE002.

employment growth. They find that high rates of entry have a positive impact on the growth of local economies. Fosfuri and Ronde (2002) study firms' incentive to cluster in order to benefit from reciprocal technological spillovers and find support to the hypothesis that weak market competition leads to more clustering. Firms might try to locate in distant areas in order to minimise technology spillovers and preserve their competitive advantage, especially when trade secret protection is low. Saxenian (1994) shows that this is not the case for Silicon Valley where the annual labour turnover among highly skilled personnel is very high (25-30 %) but this does not prevent firms from competing vigorously in the product market.

Box 3.1: Example - European biotechnology clusters

The recent evolution of the high tech industries such as biotechnology and ICT has revealed a marked tendency toward clustering of dedicated start-up firms and R&D activities in selected regions. Concurrently, the development of a dense network of collaborative relationships among a variety of different actors have been pinpointed as a distinctive feature of the evolution of the biotechnology sector and several studies have provided sound analyses of the basic structural features of an ever-widening network of collaborations (Barley et al., 1992; Kogut et al., 1992; Arora and Gambardella, 1994; Gambardella, 1995; Zucker and Darby, 1997; Powell et al., 1996; Orsenigo, Pammolli, Riccaboni, 2001).

Furthermore, recent empirical work has revealed that radical technological shifts act as a powerful mechanism of de-hierarchisation and de-localisation of biotechnology activities worldwide. Orsenigo et al. (2001) show that, starting from 1992, the emergence of baseline technologies has significantly reduced the degree of hierarchisation of the overall network of R&D collaborations. Owen-Smith et al. (2002) reveal that the growing interdependence and reaching out of traditional biotechnological clusters toward new emerging areas in the US is driven, at least partially, by new general purpose techniques. Finally, Allansdottir et al. (2002) document that the recent growth of new European biotechnology firms and regions is largely based on the emergence and proliferation of new research tools[59].

Presently, the ability of firms to benefit from agglomeration economies and simultaneously to access and make efficient use of networks of collaborative relations has become a crucial source of competitiveness in new markets for technology (Arora, Fosfuri, Gambardella, 2001; Owen-Smith et al., 2002). Arguably, the growth of an international network of R&D collaborations represents a crucial factor that ought to be taken into account in order to understand the leading forces toward clustering in this sector.

Many economists, analysts and policy-makers focused their attention on spatial concentration of innovative and industrial activities as a fundamental pre-requisite for the successful development of biotechnology activities. Innovative policies have been devised (e.g. the German BioRegio Contest) with the explicit aim to support clustering of biotechnology activities[60]. Nonetheless, most of them focus on interaction within clusters and pay little attention to the interplay between co-localization and reaching out. As a result, Allansdottir et al. (2002) show that EU biotechnology clusters appear to be highly fragmented as compared to US ones and tend to stay at the periphery of the international network of division of innovative labour[61].

3.2.2 Regional characteristics of innovation

Within the various approaches presented in Graph 3.1 there are also regional aspects other than the specific localisation and specialisation theories discussed in the previous section.

Higher education institutions are easily identified as sources of human capital within a region. The decision to stay and work in the region after graduation is, however, highly dependent on locational factors such as the quality of the living environment and employment opportunities (Simmie et al., 2002). In empirical studies, the attraction and retention rates of trained and educated workers, which might act as a measure of the return on investment in education, are often ignored (De Gaudemar, 1996). There is as of yet little knowledge on how students flow into the labour market and how this affects

[59] A recent report by the French Ministry of Education (reference?) comes essentially to the same conclusion.

[60] See as an example the recommendations for public initiatives supporting the development of biotech regions in the UK invoked by Lord Sainsbury's 'Biotechnology Clusters' report (Department of Trade and Industry, 1999).

[61] 27.7 % of US dedicated biotech firms (DBFs) are located in California while Germany, the leading country in terms of number of DBFs, accounts only for 24 % of European companies. Even moving from a nation/state level to regions the picture does not change: 28.5 % of US dedicated biotechnology enterprises concentrate in only three regions: San Diego, the Bay Area, and Boston while to reach a comparable level of concentration in Europe, we must consider seven regions: Ile de France, Cambridgeshire, Greater London, Oxfordshire, Bayern, Stockholm-Uppsala and Medicon Valley.

economic performance (Goddard, 1997a, 1997b; Besson and Montgomery, 1993).

Apart from contributing to the quality of the labour force, higher education institutions can also play a valuable role in the *regional knowledge infrastructure,* for example through business–university linkages to promote the transfer of knowledge and of human capital. The development of effective linkages – especially involving technology–based industries and businesses – has proved to be successful in promoting regional economic development, for instance in the case of the university of Limerick (Dineen, 1995) and the science parks in various locations in Sweden and Finland (Cooke, 2002). Research grants by the government can further strengthen the regional knowledge infrastructure, which can prove to be influential in the location decisions of multinational enterprises. The attractions of the scientific knowledge infrastructure in Scotland and East Anglia may help to explain how the technological efforts of non-UK businesses tend to be drawn relatively strongly to these regions (Cantwell and Iammarino, 2000). Regional governments can also improve the knowledge infrastructure by formalising co-operation between firms in *manufacturing technology centres,* as is the case in the United States (Feller, 1997). These centres aim to strengthen the competitiveness of existing SME's through improvements in production, managerial and marketing processes.

The *regional business climate* can spur firms to be more innovative. The prospect of profitable exploitation is an incentive for the entrepreneur to innovate. This perspective becomes all the more attractive if product demand expectations are high, for instance because of high disposable income in a region. An empirical study by Stadler (1999) confirms that prospects for significant market power, favourable technological opportunities, the availability of qualified labour and high product demand expectations all have an unambiguous positive influence on innovation.

The sum of all factors mentioned above is described by Storper (1995) as the *untraded interdependencies* (traded interdependencies concerns information exchange by user-producer relations as described in the previous subsection). These interdependencies cover not only labour market, regional knowledge infrastructure, business climate, but also regional conventions, norms and values and public or semi-public institutions. When these untraded interdependencies are concentrated, Storper considers the region to be of pivotal importance in the *supply architecture* of learning and innovation. This notion may seem provocative in the light of on-going globalisation, which is supposed to make spatial considerations less and less important. But globalisation and localisation need not be mutually exclusive processes and are actually much more interwoven than is generally acknowledged. This can be seen in practice, where foreign direct investment is often attracted to, and has a reinforcing effect upon, *innovation clusters* in the targeted country (Storper, 1992; De Vet, 1993; Cantwell and Iammarino, 2000; Wolfe and Gertler, 2001).

Economically significant innovation and learning takes place mostly at the firm level. But the innovative and knowledge-adapting capacities of a firm are determined by its surroundings: its partners, competitors, customers, the available human capital, the regional knowledge infrastructure, institutions, regulation and legislation, untraded interdependencies and a host of other factors that influence innovation directly or indirectly. All these factors combined can be defined as the *regional innovation system*.

Following Braczyk et al. (1998), several typologies of regional innovation systems (*RISs*) can be distinguished. These typologies can prove instrumental in determining the success factors of regional innovation and economic development further on. From a governance point of view, three modes of technology transfer can be identified: *grassroots*, *network* and *dirigiste*. *Grassroots RISs* are characterised by local initiatives, diffuse funding (banks, local governments, chambers of commerce), applied, near-market research, low level of technological specialisation and low supra-local co-ordination. *Network RISs* can be initiated at several levels: local, regional, federal or governmental. Consequently, funding is more likely to be agreed by banks, firms and government agencies. The research is mixed, aimed at both applied and 'pure' technology with flexible specialisation given the wide range of participants. *Dirigiste RISs* are more animated from outside and above the region itself, initiated and funded typically by central governments. The research is rather basic or fundamental, to be used in large firms or beyond the region in question. As it is state-run, the level of co-ordination is high and the level of specialisation is also likely to be high.

Complementing the governance dimension is the business innovation dimension, distinguishing between *localist*, *interactive* and *globalised RISs*. *Localist RISs* have few large firms, either indigenous or multinational. The research reach of individual firms is not great, but there is a reasonably high degree of association among entrepreneurs and between them

and local or regional policy makers. In *interactive RISs* there is a balance between large and small firms. There will be a mix of public and private research, reflecting the presence of large firms and of a local authority that is keen to promote the innovation base of the economy. Such regions will be characterised by a higher than average degree of association, expressed in research networks, forums and clubs. *Globalised RISs* are dominated by global enterprises, often supported by clustered supply chains. The research will be mainly internal and highly private, rather than public. Association is hardly present and is conducted only on the terms of the large companies.

Both dimensions are combined in Table 3.1, creating a total of nine different types of regional innovation systems.

3.2.3 Summary

A variety of general factors affecting competitiveness are suggested by the literature. Neo-classical theory points to physical and human capital as key influences, while technology remained largely exogenous, whereas new growth theory brought technology within the system, suggesting that the accumulation of knowledge could generate increasing returns. Knowledge could be measured as the skills of the workforce, such as education levels or spending on education, or through measures such as R&D expenditure.

Theories more in tune with regional economics, such as new economic geography, look at the effects of localisation on productivity. A number of studies link spillover effects, in particular knowledge spillovers, with productivity gains. This links ideas from new growth theory with the concept of knowledge spillovers as important sources of externalities.

Work on knowledge and innovation has suggested a variety of relevant indicators. While it is recognised that many of the indicators will be related/correlated with each other, it is necessary to respect a basic idea of causality, i.e. not to explain one output indicator with another. A variety of indicators can be linked to productivity to assess bivariate relationships over time and across regions.

Econometric approaches such as the Barro regressions (discussed later) rely on explaining productivity growth by a list of factors, including the concept of catch-up suggested originally by neoclassical theory. The list of other factors has gradually been added to by more recent theoretical advances. In addition, new growth theory suggests it is important to test for, and take account of, spillover effects across regions.

Clearly, there are factors suggested by theory as having an effect on competitiveness for which there is no quantifiable approximation. Much of government policy falls into this category, as do indicators measuring the extent of venture capital activity, business registration rates, and the presence of high-tech clusters. Such features can be examined to see whether they are present in the characteristics of those regions which display productivity growth in excess of what would be expected when taking account of the more measurable influences.

3.3 Regional Data Audit – Definitions and Data Sources

This section deals with how to measure regional competitiveness and its determinants as identified in the review of literature.

Regions are defined at the NUTS-2 level. Table 3.2 provides a brief summary of the number of regions, and their conventional (i.e. native) names. A full list of regional codes that are used in subsequent data analyses are readily available from Eurostat.

Table 3.1: Typology of Regional Innovation Systems

	Grassroots	Network	Dirigiste
Localist	Tuscany (I)	Tampere (FIN) Denmark (DK)	Tohoku (Japan)
Interactive	Catalonia (E)	Baden-Württemberg (D)	Québec (Canada)
Globalised	California (Silicon Valley) Nord-Brabant (NL)	North Rhine-Westphalia (D)	Midi-Pyrénées (F) Singapore

Source: Braczyk et al., 1998.

Table 3.2: NUTS-2 Regional Definitions by Country

Country	Number of Regions	Administrative Definition
Belgium	10	Provinces
Denmark	1	Whole country
Germany	45	Regierungsbezirke
Greece	13	Development regions
Spain	18	Comunidades autónomas + Ceuta y Melilla
France	22	Régions
Ireland	2	Regions
Italy	20	Regioni
Luxembourg	1	Whole country
Netherlands	12	Provinciën
Austria	9	Bundesländer
Portugal	7	Comissoes de coordenaçao regional + Regioes autónomas
Finland	6	Groups of lääni
Sweden	8	Groups of län
United Kingdom	36	Groups of counties[1]
EU	210	

1 Grouping for Community purposes.

There is an issue of regional homogeneity when dealing with NUTS-2 level regions due to the wide spread of regional types and sizes of population, which could affect the results. However, although this must be borne in mind when interpreting the findings, the classification is well known and cannot be replaced by some more economically meaningful area grouping.

There are various sources[62] of regional data.

Table 3.3 provides a description of the information available to undertake subsequent data analysis and empirical work.

3.3.1 Measures of competitiveness and knowledge-based indicators

The focus of the study is on analysing productivity, which can be defined as GDP, or Gross Value Added, per employee or per hour worked.

The main available indicator to represent innovation is R&D expenditure. This indicator can in principle be computed for three sectors (Government, Business, and Higher Education Establishments), although in practice the very sparse nature of the data means that total R&D expenditure is the better choice to ensure reasonable coverage across space and time.

The stock of human capital can be proxied by the working population (by age structure if necessary), personnel employed in R&D, employment in high-tech sectors, total number of students and those involved in tertiary education.

Aside from the knowledge-based factors, the literature suggests a number of other influences on competitiveness which will need to be borne in mind when undertaking empirical analysis, as it is important to account for all the important factors not just those with a link to innovative activity:

— *Sectoral structure* - The most prosperous regions (i.e. those with the highest GDP per capita) are seen to be those with a high (70 %+) share in market services, but success depends on the type(s) of market service(s)which dominate, e.g. tourism services are not associated with particularly high productivity levels.

— *Investment* -The size of a region's capital stock and the amount it invests in maintaining this capital stock are fundamental influences on the ability to produce more output per unit of labour.

— *Spillover effects* - Spillover effects are seen as an important factor when explaining regional

62 The two sources used here are the REGIO database of Eurostat and the Cambridge Econometrics' European regional database.

Table 3.3: European Regional Database Coverage

Indicator	Units	Years	Disaggregation
Gross Domestic Product (GDP)	m PPS and euro 1995m	1980 - 2001	n/a
Gross Value Added (GVA)	m PPS and euro 1995m	1980 - 2001	15 sectors (ESA95)
Employment	000s	1980 - 2001	15 sectors (ESA95)
Hours worked	average number per week	1980 - 2001	Total
Population	000s	1980 - 2001	selected age cohorts within working age population
Employment in high-tech areas	000s	1994 - 2001	total and 3 sub-sectors (manufacturing, services and knowledge-intensive services)
Human resources in science and technology (HRST)	000s	1994 - 2001	total and high-tech
Number of students	000s	1993 - 2001 sporadic coverage	total and those in tertiary education
Investment	m PPS and euro 1995m	1980 - 2001	5 sectors (ESA95)
Employee compensation	Euros	1980 - 2001	5 sectors (ESA95)
Research & Development expenditure	m PPS and euro 1995m	1980 - 2001 1999 and 1997 as most complete	total and across three institutional sectors
Research & Development personnel	head count	1985 - 2001 1997 and 1995 as most complete	total and across three institutional sectors
Patent applications to European Patents Office	number of patents	1989 - 2001 reasonable coverage across most Member States	total and high-tech

productivity, as discussed previously. They reflect the importance for the performance of a given region of proximity to other, well performing regions.

— *Unquantifiable factors* - There are some factors which affect competitiveness for which no available data exist, for example cultural aspects and government intervention. This is an inevitable feature of empirical work and this will be examined further in the case study section.

Obviously, some of these factors will be related to each other. For instance, a favourable sectoral structure will be accompanied by high levels of investment, R&D and the presence of a skilled work force.

3.4 Regional Productivity Analysis

This section investigates how success, understood to mean high regional productivity, has been achieved. This is done by studying associations between productivity and the set of available indicators expected to be part of the causal framework.

3.4.1 Associative and correlation analysis

This section looks at the evidence for relationships suggested by economic theory through a series of cross-plots of productivity and various input indicators. There is a danger when analysing a single year of cross-sectional data that the association may reflect the time period chosen rather than any fundamental relationship. To circumvent this problem ratios are chosen which are more likely to be stable over time - for example when reviewing R&D expenditure, R&D intensity (relative to GDP) is used. In addition, and where possible, different years have been investigated to verify the same associations, although the results are not reported in this chapter.

3.4.1.1 Productivity and initial wealth / catch-up

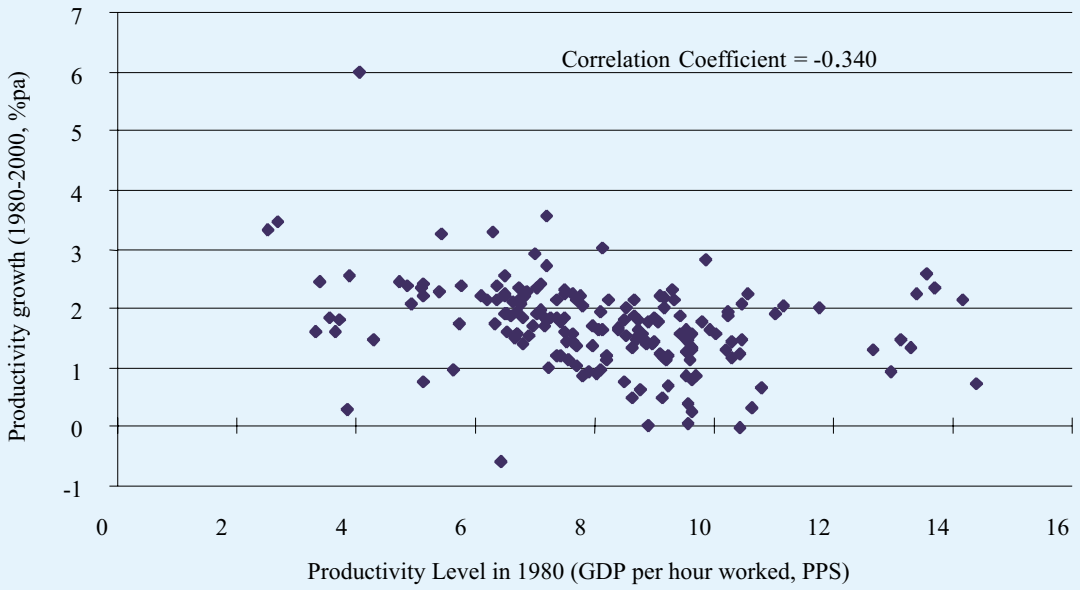
Differences in growth rates of productivity across regions can be explained by differences in initial endowments of key factors of production and the subsequent 'catch-up' effect through diffusion of knowledge facilitated by trade or foreign direct investment. Graph 3.2 illustrates this catch-up effect

by displaying a negative relationship between productivity growth over the period 1980-2000 and its initial level in 1980. A negative correlation exists, although there is a multitude of other factors, mentioned in section 3.2, which can help to improve the explanation of productivity growth.

3.4.1.2 Productivity and R&D

Growth theory views R&D expenditure as an indicator positively linked to productivity. To make the indicator relative, a measure of intensity has been calculated, i.e. the ratio of R&D expenditure to

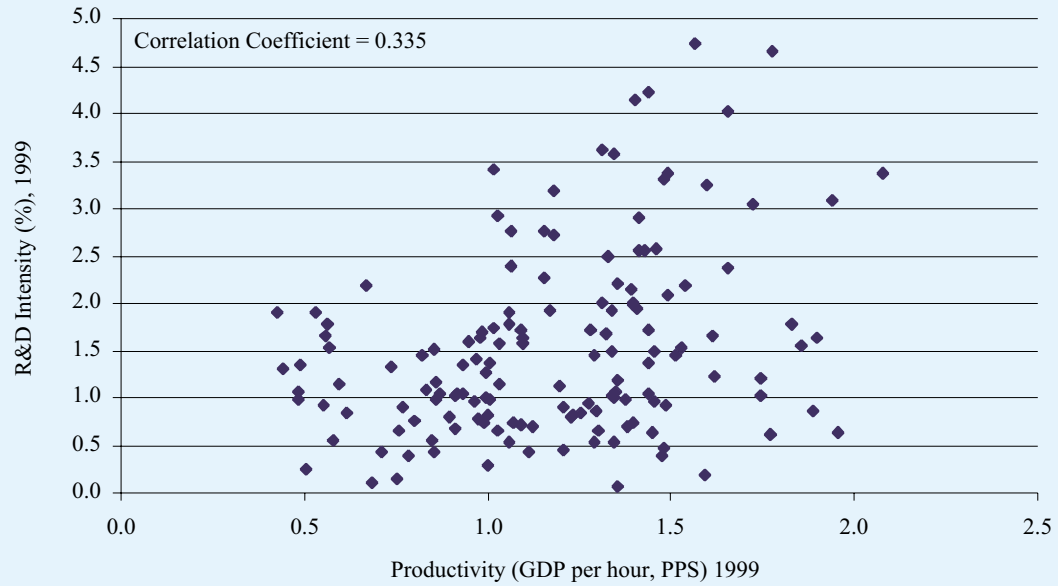
Graph 3.2: Productivity level and growth



Note: 179 NUTS-2 regions used in the correlation.

Source: Cambridge Econometrics European regional database (April 2003).

Graph 3.3: Productivity level and R&D intensity



Note: 179 NUTS-2 regions used in the correlation.

Source: Cambridge Econometrics European regional database (April 2003).

regional GDP. Graph 3.3 plots R&D intensity against productivity and indicates a positive correlation. However, the postulated positive relationship is weak.

3.4.1.3 Productivity and high-tech specialisation

The debate on whether regional specialisation — rather than regional diversity – is more conducive to innovation and growth remains unresolved in the literature on specialisation and location. With the more specific focus of this study on the role of knowledge in innovation links, a location quotient has been established to measure specialisation in high-tech activities[63], using employment as the relevant indicator (GVA in high-tech sectors does not exist in the Regio database).

The location quotient (LQ) is defined as the proportion of high-tech (employment) activity in region r divided by the equivalent proportion in the European Union. A value of unity therefore implies no specialisation away from the EU average, while higher values show an above average proportion of high-tech activity. The results for 190 NUTS–2 regions are presented in Graph 3.4. A positive correlation exists between productivity and the location quotient, the magnitude of which is comparable to the other indicators. Nevertheless, the correlation does not appear to be especially strong.

3.4.1.4 Productivity and human capital

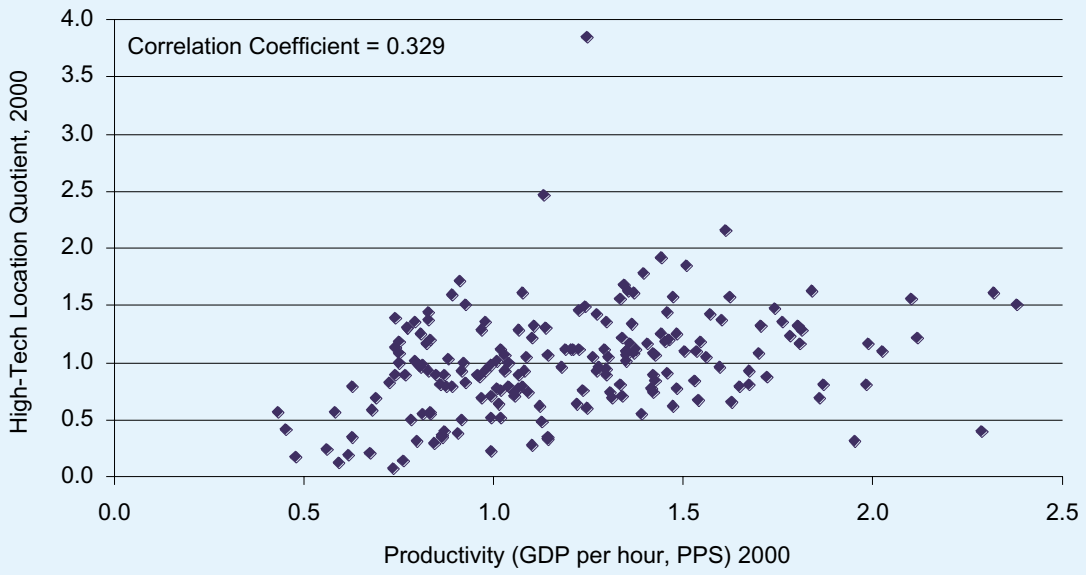
The role of the quality and quantity of human capital as a source of innovation and regional competitiveness is a key part of new growth theory. It is, therefore, important to examine whether such an association exists in the regional EU data.

Data availability becomes an issue, however, as there is no direct measure of the quality/level of education of the regional labour force in Europe. There is a survey of the number of students at various levels of education, and this may serve as a rather imperfect proxy for the quality of the regional workforce. The ratio of students in tertiary education relative to total population was chosen as the measure most likely to represent the knowledge-oriented segment of the labour force. Data is sparse, with Denmark, German NUTS-2 regions, Portugal and the UK recording missing values - 1999 is the most recent year with most observations available. There is also little scope for analysis over time as the quality of coverage deteriorates further in earlier years.

Graph 3.5 presents the results, with a positive correlation across the regions available. Again, as previously, the correlation is weak.

[63] NACE Rev. 1: 24 (manufacture of chemicals and chemical products), 29 to 35 (manufacture of machinery and equipment n.e.c., manufacture of electrical and optical equipment, manufacture of transport equipment), 64 (post and telecoms), 72 (computer and related activities) and 73 (research and development).

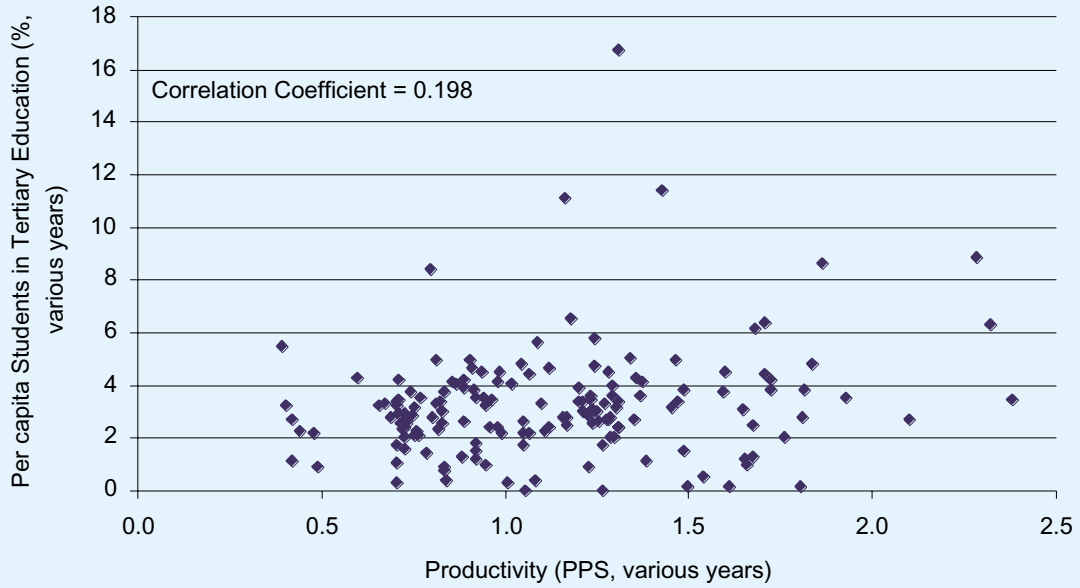
Graph 3.4: Productivity level and high-tech specialisation



Note: 190 NUTS-2 regions used in the correlation.

Source: Cambridge Econometrics European regional database (April 2003).

Graph 3.5: Productivity level and students per head of population



Note: 160 NUTS-2 regions used in the correlation.

Source: Cambridge Econometrics European regional database (April 2003).

As mentioned in section 3.2, little is known about the mechanism through which students disperse after their study period has ended. Some larger regions - possibly capital cities - with a cluster of universities may retain a large proportion of students within their boundaries once they start work, while other (smaller) regions with a strong university presence may act as feeder regions into larger urban areas. In this respect, a high correlation should not be expected, but some positive association is nonetheless justified. Unfortunately, the data do not provide an opportunity to investigate thoroughly these possibilities.

3.4.1.5 Productivity and spillovers

Thus far the investigation of the relations between regional productivity and indicators representing various facets of the growth literature has focused on the region as an independent unit. This section considers the interdependence among regions through the concept of spillovers, a topic which is central to new economic geography as a mechanism by which productivity gains are transmitted.

Graph 3.6 presents a cross-plot of productivity in any one region against the weighted average of productivity in all other regions. The weighting mechanism is the inverse of the physical distance between regions, i.e. the further regions are apart, the smaller the weight attached to them. The results show a reasonably high degree of positive correlation, indicating that the potential for spillover effects across the 209 NUTS–2 regions in the EU should be assessed in further empirical work.

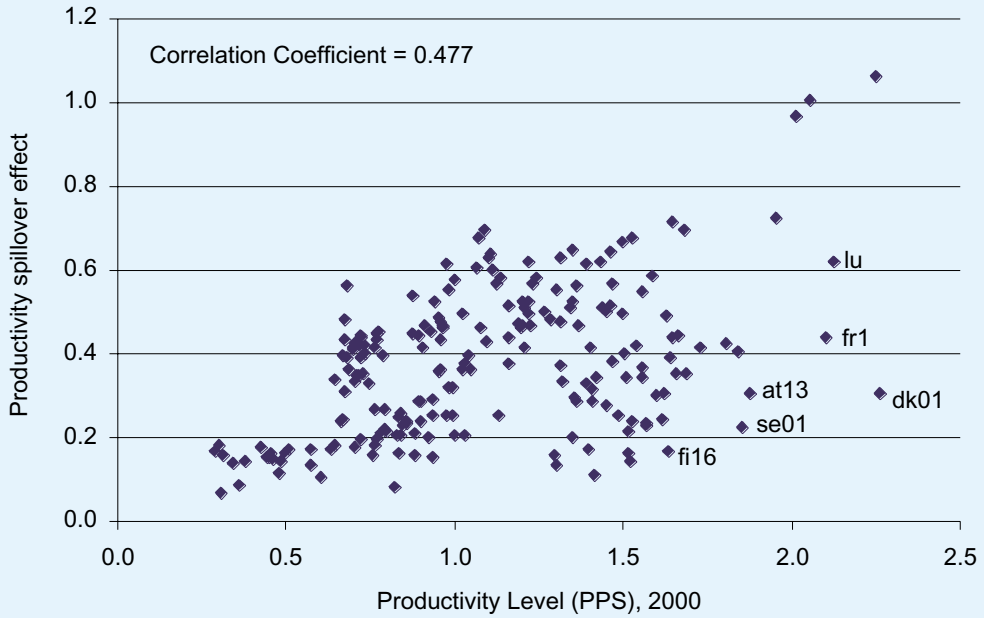
3.4.1.6 Productivity rankings

The next two tables present regional rankings (top and bottom ten) for productivity level (Table 3.4) and growth rates (Table 3.5) over the period 1995-2000. The tables also include measures, where data are available, of the indicators described above. The purpose of this presentation is to establish an empirical record of the productivity characteristics of the top and bottom EU regions.

It is clear from Table 3.4 that the higher productivity regions tend to more established, urban areas such as Île de France and Vienna (Wien). The main exception is Sterea Ellada in Greece. However, and generally speaking, the data do not suggest that the top-ten productivity regions have a slower rate of growth than the bottom-ten. Indeed, where data are available for comparison, most of the competitiveness indicators seem to be higher in the top-ten regions than in the bottom-ten, although the picture is far from conclusive.

The regions experiencing the fastest growth in productivity over 1995-2000 are predominantly

Graph 3.6: Productivity spillovers



Note: 207 NUTS-2 regions used in the correlation.

Source: Cambridge Econometrics European regional database (April 2003).

Table 3.4: Regional productivity ranking – levels

Region Name	Region Code	Productivity Level	Productivity Growth	R&D Intensity	Regional share of high tech employment	Number of tertiary students per head of population	Productivity Spillover Index
		PPS	1995-2000, % pa	1998 or 1999, R&D / GDP (%)	Location Quotient (relative to EU)	%	
				Highest 10 Regions			
Luxembourg	lu	71.29	4.08	n/a	0.32	0.56	0.62
Vlaams Brabant	be24	71.24	2.81	n/a	1.50	3.42	1.06
Île de France	fr1	69.83	3.22	3.37	1.21	4.80	0.44
Wien	at13	68.85	2.01	3.07	1.10	8.59	0.31
Sterea Ellada	gr24	68.69	3.55	0.29	0.35	n/a	0.15
Salzburg	at32	67.59	2.28	0.64	0.81	2.75	0.41
Lombardia	it2	67.41	1.19	1.72	1.31	2.64	0.36
Vorarlberg	at34	66.36	2.28	0.85	1.17	0.17	0.43
Liguria	it13	65.61	1.22	1.73	0.93	2.40	0.32
Trentino-Alto Adige	it31	65.23	1.69	0.71	0.49	1.70	0.40
				Lowest 10 Regions			
Thüringen	deg	31.81	3.07	1.59	0.93	1.29	0.45
Cornwall and Isles of Scilly	ukk3	31.53	2.84	n/a	0.69	n/a	0.34
Madeira(PT)	pt3	29.47	3.67	0.92	0.00	0.90	0.08
Algarve	pt15	28.30	2.90	1.06	0.00	2.22	0.14
Chemnitz	ded1	28.25	2.81	1.51	0.89	4.96	0.45
Anatoliki Makedonia, Thraki	gr11	27.66	3.66	0.99	0.17	5.48	0.15
Alentejo	pt14	25.36	0.67	1.35	0.00	2.16	0.16
Açores (PT)	pt2	25.09	2.01	n/a	0.00	1.11	0.07
Norte	pt11	24.23	1.77	1.30	0.40	2.70	0.18
Centro (P)	pt12	23.13	1.57	1.89	0.56	3.19	0.17

Source: Cambridge Econometrics European regional database (April 2003).

Table 3.5: Regional productivity ranking – growth rates

Region Name	Region Code	Productivity Growth 1995-2000, % pa	Productivity Level PPS	R&D Intensity 1998 or 1999, R&D / GDP (%)	Regional share of high tech employment Location Quotient (relative to EU)	Number of tertiary students per head of population %	Productivity Spillover Index
			Highest 10 Regions				
Peloponnisos	gr25	7.83	35.98	0.85	0.21	n/a	0.15
Ipeiros	gr21	6.98	38.20	1.52	n/a	n/a	0.17
Dytiki Makedonia	gr13	6.67	41.70	0.15	n/a	n/a	0.17
Southern and Eastern	i.e.02	5.84	57.43	n/a	1.10	4.78	0.24
Notio Aigaio	gr42	5.53	46.35	0.11	n/a	n/a	0.11
Voreio Aigaio	gr41	5.42	43.83	0.44	n/a	n/a	0.13
Dessau	dee1	4.91	34.84	0.64	0.92	n/a	0.46
Kentriki Makedonia	gr12	4.89	37.82	1.14	0.34	n/a	0.16
Thessalia	gr14	4.85	33.82	0.55	0.19	n/a	0.16
Border, Midland and Western	i.e.01	4.68	40.03	n/a	0.90	2.78	0.25
			Lowest 10 Regions				
Groningen	nl11	0.19	53.46	2.56	0.67	6.14	0.51
Berlin	de3	0.18	41.54	3.62	0.94	4.49	0.38
Gelderland	nl22	0.15	38.95	2.76	0.74	2.19	0.62
Overijssel	nl21	0.14	39.88	1.63	0.73	3.30	0.57
Saarland	dec	0.07	41.20	0.94	0.93	2.57	0.58
Drenthe	nl13	-0.13	38.99	0.73	0.77	0.41	0.55
Münster	dea3	-0.19	40.75	0.84	1.04	n/a	0.57
Zeeland	nl34	-0.54	43.61	0.89	0.63	0.90	0.63
Valle d'Aosta	it12	-0.60	59.20	0.53	n/a	0.00	0.37
Kent	ukj4	-0.96	40.51	n/a	1.00	1.44	0.48

Note: 207 NUTS-2 regions used in the analysis. Data are for 2000 unless otherwise stated.

Source: Cambridge Econometrics European regional database (April 2003).

those in Cohesion Fund countries, and therefore tend to be among those with the lower initial productivity levels. This is consistent with the convergence hypothesis. The exception is Southern and Eastern Ireland, which has caught up sufficiently to have a high level of productivity and yet has still maintained impressive growth. There is likely to be less correlation with the competitiveness indicators as they are represented in levels rather than growth rates; unfortunately, the lack of data availability does not permit a comparable average growth period to be calculated.

3.4.2 Conclusions

The analysis in this section has provided a variety of findings which can assist in the formulation of the econometric modelling, but which are also useful in their own right.

Productivity has been shown to be correlated with a range of competitiveness indicators suggested by the economic literature. The associations include:

— the growth of productivity and its level are found to have a negative correlation, providing support for the (unconditional) convergence hypothesis;

— R&D intensity is positively correlated with productivity, which supports the contribution that expenditure in these activities has on a region's knowledge base and its subsequent ability to innovate and raise productivity levels;

— specialisation in high-tech activities has a positive association with productivity, supporting the argument that these sectors are an important factor explaining regional success;

— the number of students in tertiary education per head of population (used as a proxy for the presence for higher education establishments and/or the educational quality of the work-force) is positively related to the level of productivity;

— spillover effects, measured through the distance-weighted productivity effects in other regions, seem to be present and may therefore be considered in any econometric work.

These correlations provide some evidence of a relationship between productivity and key indicators of knowledge and innovation, but the fact that most of the variables are trended over time, and possibly influenced by the year chosen for the correlation, make conclusions difficult. The next section adopts a more robust framework by using a well-established econometric methodology to test the influence that many of the above indicators may have had on productivity growth (and the aspect of the theory they are representing) through the period under analysis.

3.5 Econometric Analysis

Following the work on analysing regional productivity by association/correlation, this section looks more at causality through an econometric framework, specifically the Barro regression (Barro and Sala-i-Martin, 1995) and the associated β - and σ - convergence estimates[64]. The objectives are to assess the degree of convergence across the EU NUTS-2 regions using the latest data, test the association of this convergence with human capital and R&D inputs if possible, and provide a sound basis for choosing particular case study examples for further analysis of convergence forces. The methodology and technical results are discussed in detail in Appendix 3.2.

The Barro test for β-convergence is that the value of β is non-zero and negative, that is, the lower the initial level of productivity, the higher the growth rate. Thus, poorer regions on average grow faster than rich ones and, as a consequence, productivity levels are expected to converge. This property is consistent with the neo-classical approach to convergence whereby trade provides efficiency advantages for all regional participants through specialisation, with factor-price equalisation then bringing ultimate convergence in productivity[65].

To undertake such empirical testing, it is not absolutely necessary to have developed specific hypotheses about the exact role played by the factors that are perceived as important in driving regional competitiveness and growth. Since many of the theoretical perspectives emphasise in different degrees the overlapping effects of a diverse set of components, the need for a comprehensive detailed empirical explanation is less essential. This is especially useful since the empirical correlates of many of the required variables at NUTS–1 and –2 levels are poorly proxied or often missing.

In the context of this study, the Barro regression is being used to explain growth in productivity over 1987-2001 by a number of factors. First, an *unconditional* Barro regression (which are specified as a relation between productivity growth and the level of productivity in the starting year) is used. Here, one generally expects a negative correlation because if the level of productivity of regions converge over time, it must be those regions with the lowest starting value which grow fastest, and vice versa.

Adding more explanatory factors – such as R&D expenditure and the level of education of the population – can help to provide a richer description of the determinants of productivity growth and convergence. This is called the *conditional* Barro regression, because it is conditioning on other factors which are expected to explain that different regions begin with different qualities and quantities of the various factors of production. One would still expect a negative (i.e. converging) coefficient on starting level productivity, while the other factors should also contribute in line with prior beliefs.

The main results from the unconditional and conditional Barro regressions are outlined below. Appendix 3.2 contains more detailed discussion.

3.5.1 Unconditional Barro regression

Estimation results, based on a sample of 207 regions for the period 1987-2001, and shown in Table 3.6, demonstrate a significant and negative coefficient on the starting level of productivity. They imply a rate of β-convergence of 1.5 % per year over 1987-2001[66].

[64] β-convergence indicates how much poor economies grow faster than rich ones while ó-convergence measures the dispersion of regional measures (ref. Appendix 3.2).

[65] An extensive and interesting discussion of these issues can be found in chapter 5 of European Commission (2000).

[66] The estimated coefficient value of $(1-e^{-\beta T})/T = .0165$, where T = 14, solves to give a rate of β-convergence value of β = 0.15 (see Appendix 3.2).

This and the associated σ-convergence analysis show a consistent story of the rate of convergence slowing during the fastest growth phases of the European economy and accelerating during the slower phases, a common finding in other studies. For example, Appendix 3.2 shows that the rate of regional convergence accelerated to 2_ % per year over the slow-growing period for the EU of 1991-96, while remaining at close to 1.5 % per year for the preceding and following faster growing periods of 1987-91 and 1996-2001 respectively. The 1991-96 acceleration in convergence was marked by the strong productivity catch-up in the Eastern Länder of Germany as unification progressed into integration, while a sharp decline in the position of the highest value regions in Finland reflected the experience of these export–led regions from the direct loss of trade associated with the troubles of the Russian Federation.

While comparisons are not direct, a rate of β-convergence of about 2 % per year for GDP per capita has been found in many cross-section studies in different regions of the world. A notable European example is Sala-i-Martin (1996) who estimated a convergence rate of 1.5 % per year for GDP per capita for a set of 90 European regions over the period 1950-90. Neven and Gouyette (1994) estimate convergence in GDP per capita over 1980-89 for the set of EU NUTS -2 regions at just 0.5 % per year, while European Commission (2000) reports a rate of convergence of 1.3 % per year over 1980-96 as a whole.

The analysis of σ-convergence over 1987-2001 shows systematic convergence over the period, with divergence in the fast growing years of the late 1980s and slower convergence at the end of the 1990s, with more rapid convergence experienced in the early 1990s. Analysis of the most disadvantaged regions in the EU, i.e. those covered over this period by the Objective 1 support framework, demonstrates that these regions in particular provided a strong component of this σ-convergence with their productivity position as a whole also improving relative to the rest of the EU. While this stronger σ-convergence may equally well be a result that is compatible with the Objective 1 regions falling into a low-equilibrium 'convergence club' (see Durlauf and Quah, 1998) the relative improvement in productivity levels in these regions is more consistent with a positive effect from Structural Fund and Cohesion Fund support, enhancing productivity and competitiveness through improved infrastructure and increased human capital stocks.

One potential problem when using Barro regressions is spatial autocorrelation, which means that issues such as spillover effects between regions cause the unexplained part of the model (residuals) to be related spatially.

Graph 3.7 provides evidence of clustering of residuals (EHAT), providing primary evidence that additional explanations are required apart from the starting level of productivity. The graph suggests that there are strong regional clusters of positive residuals in the eastern Länder of Germany, southern Greece and southern Ireland (suggesting a better than average 'catching up' of these regions from their low starting productivity levels), with other strong positive residual growth peaks in a number of high starting-level productivity regions. These are in and around the capital cities of London and Paris, the regions in southern Germany and Austria, and the northern border regions of France and Benelux. Other peaks are located in the south east of Sweden and southern Finland. Particularly negative residual peaks are located in the regions of southern and eastern Spain and Portugal.

3.5.2 Conditional Barro regression

The introduction of additional variables into the Barro regression is designed to capture other factors that would move the long-term equilibrium or help to

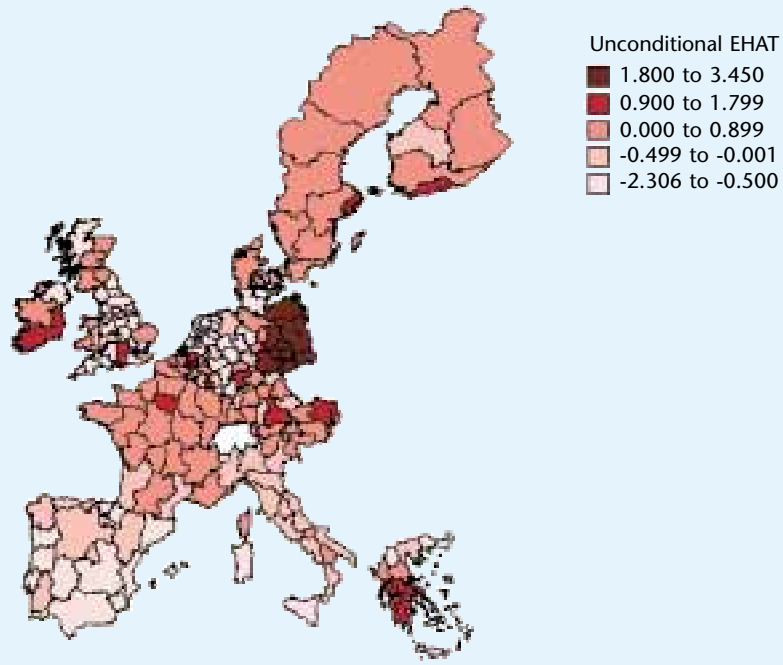
Table 3.6: Results from unconditional Barro regression (1987-2001)

Dependent variable: Productivity Growth	Coefficient	Standard Error	T-Ratio	T-Prob
Intercept	0.0182	0.0007	24.6386	0.0000
Productivity Level	-0.0165	0.0017	-9.6726	0.0000

R-Squared	0.31337	207 observations (regions) used
Durbin Watson-statistic	1.3492	
Aikaike Info. Criterion	-290.80	
Schwartz Bayesian Criterion	-294.13	
Analysis of spatial autocorrelation		

Source: Cambridge Econometrics European regional database (April 2003).

Graph 3.7: Map of unconditional residuals



Source: Cambridge Econometrics European regional database (April 2003).

Table 3.7: Results from the conditional Barro regression

Dependent variable: Productivity growth	Coefficient	Standard Error	T-Ratio	T-Prob
Intercept	0.0194	0.0026	7.5510	0.0000
Productivity level	-0.0143	0.0020	-7.2379	0.0000
Proportion of higher-education students	0.0008	0.0007	1.1491	0.2528
R&D intensity	0.0001	0.0004	0.3059	0.7602

R-Squared	0.34414	124 observations (regions) used
Durbin Watson-statistic	0.92400	83 observations (regions) dropped
Aikaike Info. Criterion	-134.99	
Schwartz Bayesian Criterion	-140.63	

Analysis of spatial autocorrelation

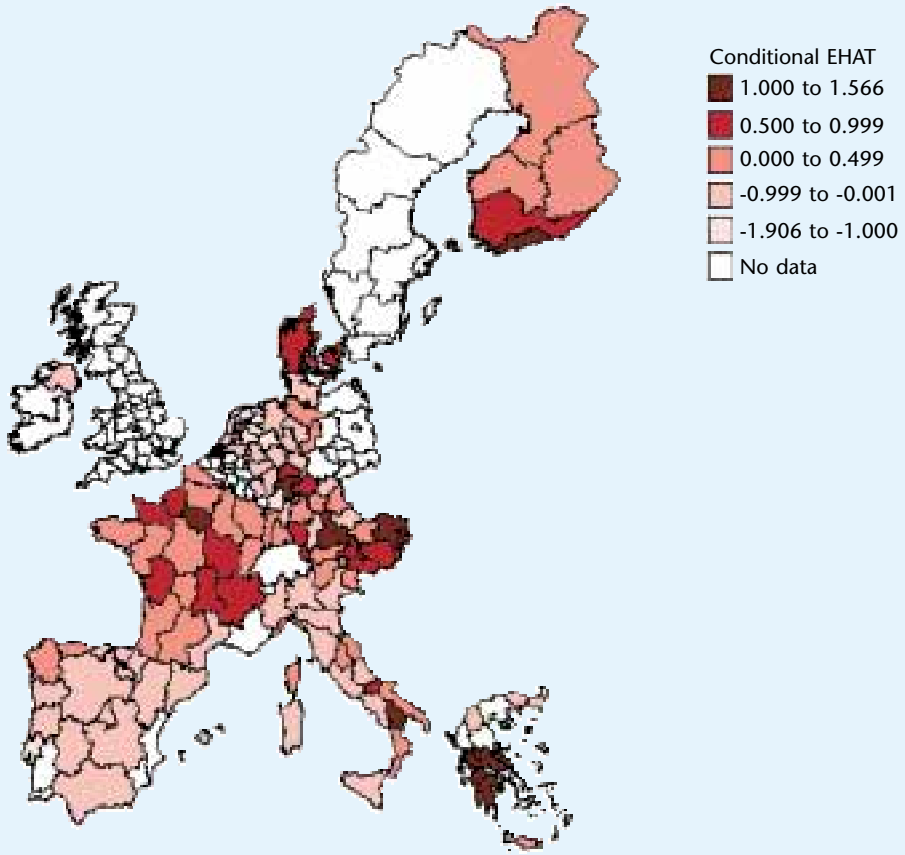
Source: Cambridge Econometrics European regional database (April 2003).

explain faster growth in some regions. There is a limited set of data that is currently available at regional level to assess the contribution that theory suggests comes from human capital factors. The results reported here are illustrative but suggest some of the possible drivers of faster convergence come from increased tertiary education and R&D inputs by region.

The results in Table 3.7 confirm that the catching up effect (implied by the coefficient of the productivity level variable) continues to be of correct sign and significant. The other variables in the regression are correctly signed but do not have a significant influence on the results. It should also be noted from Table 3.7 that more than a third of the observations were left out in this regression due to missing data on the additional explanatory variables.

Graph 3.8 displays the map of conditional regression residuals (EHAT) and also illustrates the problem for analysis of missing data for the human knowledge variables in many regions. The nature of the spatial correlation effects seems broadly to match that in the unconditional case. Thus, as before, Greece stands out but also Denmark and the eastern parts of Austria as well as the region in the gulf of Taranto in Italy show a high concentration of clustering of positive residuals.

Graph 3.8: Map of conditional residuals



Source: Cambridge Econometrics European regional database (April 2003).

3.5.3 Conclusions

Over the period 1987 to 2001, productivity converged across the NUTS–2 regions of the EU. There is some evidence associating this process of convergence with human knowledge factors, particularly high-tech specialisation in employment and high rates of investment in research and development, although the quality and quantity of data to not permit a statistically robust conclusion. There is also strong evidence of spatial clustering of productivity growth, with a number of effects distinguishable:

— A catching up process in the disadvantaged regions of southern Greece, southern Ireland and the eastern Länder of Germany, the targets of the Structural Fund and Cohesion policies for the last decade;

— Growth peaks in and around the capital cities of London and Paris associated with agglomerated concentrations of international financial and business services;

— Growth peaks in the northern border regions of France and Benelux, where the removal of trade barriers and investment in trans-European transport has been especially supportive to growth;

— Growth peaks in the south east of Sweden and southern Finland, and in southern Germany and Austria, where high-tech clustering and associated spatial spillover effects are supporting faster growth;

— Growth troughs in southern and eastern Spain and Portugal where periphery effects operate.

On the basis of the analysis of those regions displaying the strongest growth differentials over what would have been predicted since 1987 in terms of starting productivity values and measured

endowments of resource, the case study regions analysed in the next section have been selected.

3.6 Case Studies

The purpose of the regional case studies is to look at successful regions and investigate 'beyond the data' those additional factors which might help to explain competitive position. This may then yield additional measures supporting high productivity which could be adopted by other regions that are not as successful.

The regions used in the case studies were selected by use of the Barro regression methodology discussed in the previous section. The logic was to select outlying regions where, even when taking account of catching-up and the additional conditioning factors such as educational levels and R&D expenditure, productivity growth was still higher than expected. The evidence is that there is something in these regions that has given them a better performance, and the task of the case study analysis is to understand what this might be and assess whether this provides a general insight into factors that are driving competitiveness across all regions.

The following five regions were selected on the basis of this analysis:

— Oberbayern (de21)

— Darmstadt (de71)

— Sterea Ellada (gr24)

— Île de France (fr1)

— Niederösterreich (at12)

3.6.1 Regional characteristics

Graph 3.9 shows an outline NUTS-2 map of Europe with the case study regions marked. With the exception of Sterea Ellada, all the other regions lie within the high productivity area between Milan and London, containing Northern Italy, Southern Germany, South East France, the Ruhr area, Île de France, Belgium, the Netherlands and South East England. Three of the regions also contain sizeable urban areas (Oberbayern - Munich, Darmstadt, - Frankfurt, Île de France - Paris) while Niederösterreich has the Vienna region at its centre.

Table 3.8 shows the profiles of the various regions according to the indicators used in this chapter. All regions are above the EU average level of GDP per hour worked by the end of the sample period, and all have above-average growth rates for the period, with Île de France standing out as the strongest performer. In terms of urbanisation, Île de France again stands out as the most densely populated, followed by the German regions. Niederösterreich and Sterea Ellada are relatively sparsely populated.

Across those indicators representing the regional knowledge base and innovative activity, there are greater differences. The more densely populated regions (Oberbayern, Darmstadt and Île de France) have R&D expenditure of between 3-5 % of GDP, whereas in the smaller regions the proportion is much smaller[67]. A similar picture emerges for the tertiary student population, although lack of data prevents complete coverage. For specialisation in high-tech activities most of the regions have a location quotient above unity, indicating relative

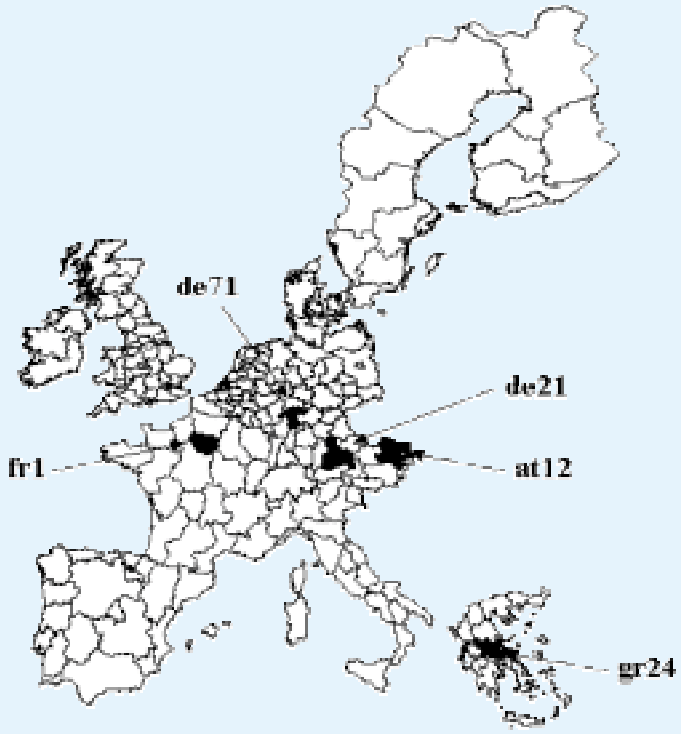
[67] It should be noted that R&D data are measured at the enterprise level so that there may be a bias in the data favouring large cities as the location of headquarters where accounts are collected.

Table 3.8: Key indicators for case study regions

	GDP per hour worked (PPS, EU=100)			GDP per hour worked (1995m euro, %pa)	High tech employment (LQ)	R&D intensity (%)	Per capita students in tertiary education (%)	Population density (per square km)
Region	1980	1990	2000	1980-2000	2000	1999	Various years	2000
Oberbayern	106.5	110.3	125.9	2.60	1.28	4.65	n/a	230
Darmstadt	101.0	113.6	119.2	2.59	1.15	3.03	4.49	500
Sterea Ellada	96.2	99.4	124.8	2.47	1.00	0.29	n/a	41
Île de France	132.3	146.5	159.0	3.15	1.13	3.37	4.80	918
Niederösterreich	123.3	120.7	134.3	2.26	1.06	0.62	0.16	80
EU Average	100.0	100.0	100.0	1.86	1.00	n/a	n/a	116

Source: Cambridge Econometrics European regional database (April 2003).

Graph 3.9: Case study regions



specialisation in the area when compared to the country average, although again the highest quotients are for the more densely populated areas.

3.6.2 Additional (qualitative) information

This section discusses some key features of the case study regions to help provide additional explanation for the 'unexpected' productivity performance. There are a number of factors which could contribute to the faster-than-expected productivity growth (that is, those which could not be captured in the Barro regressions) but which were identified as important in the literature review. These include:

— government policy (including regional innovation strategy);

— entrepreneurship culture;

— cluster activity;

— regional spillovers.

Oberbayern (de21)

The Oberbayern region is dominated by the city of München, which is among the wealthiest and economically most successful of German cities. The region has the highest purchasing power and retail turnover per capita in Germany and stands third in terms of public investment per capita. München itself accounts for about 18 % of Bayern's GDP and is the driving force of an economy that achieved the highest growth rate among all German Länder in 1998, and was second only to Baden-Württemberg in 2000. The region's international airport comes second only to Frankfurt in passenger numbers, more than 20 million per annum.

New jobs are almost exclusively in services. The rate of new firm creation is also well in excess of the rate of business closures. The very success of the economy has led in recent years to serious skills shortages and determined efforts are being made to recruit skilled personnel from abroad. Immigration from abroad is the main source of population growth, with particularly large flows from the Balkans over 1999-2000 as people fled the conflict in Yugoslavia. This process of immigration helps to revitalise the region's economy.

The kind of continued dynamic growth seen in Oberbayern requires and sustains a corresponding sectoral structure: very modern manufacturing and a rapidly expanding services sector. The city of

München is particularly strong in such services as legal, technical and business consultancy, banking and insurance and last, but by no means least, tourism. Tourism draws also on the region's established reputation in high culture and stimulates growth in other services. Manufacturing covers traditional machinery and car makers, but also new areas such as biotechnology and new materials. In spite of the predominance of services there is a policy of seeking to retain manufacturers in the city by the provision of specially-designed industrial sites. The financial sector is another source of strength, with some 12 % of all German insurance companies have their headquarters in the city, while other business services are also well-represented in the city, especially the advertising industry.

Economic policy has played an important role in Bayern's success. Accelerating growth was stimulated and sustained by the provision of adequate supplies of inexpensive energy, as well as transport infrastructure and educational facilities. Policy also helped to promote a deeper and more widespread awareness than in many other places of the problems of business and the potential of new technological developments. So it is no matter of chance that München has become Germany's leading centre for ICT, computing and electronics. In the recent past, receipts from the privatisation of state-owned companies were used to implement an industrial policy directed at establishing centres of excellence in a limited number of specific technological fields in the region. The rationale was that encouraging scientific/academic co-operation with business would help to create industrial clusters operating at the cutting edge of technology. Several clusters have grown around the region, and the most important are:

— ICT, grouped around Infineon, Siemens, Oracle and the Microsoft subsidiary: some 8,000 firms, including 2,500 in microelectronics and software;

— Media (long a strength of München's economy): from print to films and new media;

— Biotechnology: a more recent cluster, employing about 2,500 people, and centred mainly on the research institutes, innovation and start-up centres on the Großhadern-Martinsried Science Park in the south of the city.

The city of München is now ranked second only to London among European biotechnology centres and its resources are soon to be extended by a second science park in the north of the city.

Darmstadt (de71)

Darmstadt, containing the Frankfurt city-region, is the economic center of the Rhein-Main region, one of Europe's most productive regions in terms of manufacturing, banking & financial services, communications and data processing. The dynamism of the region's economy has long attracted people from other parts of Germany and beyond. Between 1987 and 2000, the population of Rhein-Main increased by about 470,000, that is almost 11 %, but the percentage of the population originating from outside Germany rose from 10 % to 14 %, which indicates the importance of immigration.

Not only is Frankfurt the leading financial center in continental Europe, but the whole region is a major European center of modern industries such as telecommunications and pharmaceuticals. According to a recent industry survey, Frankfurt ranks fourth after London, New York and Amsterdam among the top 50 Internet hub cities. The registration office for German internet addresses is located in Frankfurt and the Commercial Internet Exchange handles more than 85 % of German and 35 % of European internet traffic. The region's telecommunications infrastructure is first-rate and boasts a new, 700-km optical fibre network along with a rising number of data-interchanges.

There is a well-developed public transport system and very easy access to the national highway and railway systems, especially to the high-speed ICE links with Berlin, München and Hamburg. The Rhein-Main international airport is the major international gateway to Germany. Since the completion of the Rhein-Main-Donau Canal in 1992, Frankfurt also lies on the main water transport route from Rotterdam to the Black Sea. However, the high density of land use in the entire Rhein-Main conurbation poses serious congestion problems.

The presence of many leading pharmaceuticals companies and prestigious research institutes makes the region one of the top locations for life sciences. Aventis, Merck, Degussa, Fresenius and Boehringer Ingelheim have major research and production facilities in the Rhein-Main region. The region's research infrastructure includes some 70 biotech-oriented firms, five universities and more than 100 research institutes with a strong focus on biotech research and bio-informatics. The links between the pharmaceuticals industry, biotech companies, research institutes and venture capital are reinforced by the Frankfurt Biotech Alliance, which brings together all interested parties so as to stimulate new projects

and processes and promote the region abroad. Moreover, the city authorities have recently begun to plan a Frankfurt Innovation Centre for Biotechnology to facilitate co-operation between scientific research and life sciences businesses and start-ups.

In anticipation of the enlargement of the European Union, the public authorities have taken steps to strengthen its position of the region in continental Europe by promoting Frankfurt as the leading financial centre and as a leading internet hub city. Furthermore, new investors can find a skilled and, for the most part, multi-lingual workforce in and around the region.

Sterea Ellada (gr24)

The region borders Athens and has a pronounced dualistic economy with a strong emphasis on agriculture and mining matched by a dynamic service and manufacturing sector. In the last 15 years, the region's orientation, as a whole, has shifted towards the services. However, the agricultural sector remains dominant and employs more persons than the manufacturing sector and nearly as many as the service sector. The area has a large tourist industry given the presence of beaches, famous archaeological sites and ski resorts.

The company structure is somewhat polarised with the presence of large national manufacturing and mining companies and a significant concentration of economic activity in family owned SMEs. A concentration of large industrial companies along the "national road" north of Athens ensures that the region has one of the highest levels of R&D business expenditure of the Greek regions. However, a majority of companies in the region are small family run enterprises with limited emphasis on innovation. The district of Fthiotida has a significant industrial activity, especially in regard to food processing that has taken advantage of local produce.

The economy of Sterea Ellada has also a strong mining and quarrying sector. The district of Evia, Greece's second largest island after Crete, has intensive industrial activities linked to the mining sector (nickel, marbles, lignite, etc.). The neighbouring districts of Fokida and Viotia also have economies linked to mining. Viotia is also responsible for one third of Greece's aluminium production.

Three main centres of technological expertise are to be found in Sterea Ellada:

— the Technical Educational Institutes in Lamia and Chalkida are responsible for post-school vocational and technical courses in applied technologies (electrical-mechanical) and health;

— CERECO, a contract research organisation for ceramics, coatings, materials and cement industries;

— the Hellenic Aerospace Industry (EAB), a public company with advanced engineering skills in the aviation industry.

Three other organisations are also active in the innovation process. However, they are located in the neighbouring Athens and Thessaly regions: CLOTEFI (textile and clothing), ETAT (food) and EBETAM (metallurgy).

In terms of innovation initiatives, there is a lack of local support infrastructure due to the region's proximity to Athens, where many of the economic development agencies are located. Excluding the local Chambers of Commerce, which do not provide special support to local firms outside their membership, only three local organisations exist:

— General Secretariat of Research and Technology, which manages the EU operational programme of R&D (EPET II);

— Association of Industries in Thessaly and Central Greece, which offers commercial information, representation, training and promotes intra-firm co-operation activities;

— Evrytania S.A., a rural development company involved in several EU programmes (Integrated Mediterranean Programmes, Leader, Valoren, Now) with the aim of supporting all socio-economic needs such as infrastructure, raw materials, commercialisation of products and improvement of local production.

The region has developed a regional innovation strategy with an emphasis on:

— raising awareness amongst the local SME base in regard to issues relating to innovation and technology management;

— encouraging support organisation both in the region and located in Athens to work with more traditional and less innovative SMEs;

— increasing inter and intra regional networking between local companies and organisations.

Île de France (fr1)

The region of Île-de-France comprises Paris and the municipalities immediately surrounding it. The region accounts for nearly 30 % of France's GDP and is home to nearly 20 % of the population. Almost without exception large companies (more than 2,000 employees) in France have their headquarters in this region, preponderantly in Paris and Hauts-de-Seine. More than 90 % of all manufacturing employees in France work for companies with headquarters in Île-de-France. The city is at the centre of a star-shaped communications network of five motorways and a growing number of TGV rail lines. The region is served by the two largest airports in France, Roissy/Charles de Gaulle to the north and Orly to the south, which together are third in Europe for passenger, freight and postal traffic. Within the region itself, the urban transport network is comprehensive and well organized.

De-industrialisation started in Île-de-France in the early 1980s and over the last 20 years manufacturing employment has fallen to its present level of about 17 % of total employment in the region. Services have become the main motor of job creation and now account for 81 % of employment, compared to 74 % in the early 1990s. Despite the sharp fall in its share of employment manufacturing succeeded in raising its output steadily through constant improvements in productivity, outsourcing of the provision of services and a pronounced shift to high-tech industries supported by a network of research centres. Most high-tech R&D and manufacturing activity is located in clusters, situated in modern towns such as Cergy-Pontoise, Evry and, especially, Saint-Quentin-en-Yvelines where such leading companies as Dassault Electronique, Thales, Alcatel and Nortel GSM are based. At Saclay, to the south of Paris, there is the most important scientific and technological centre in the country, where about 10,000 people are employed, most of them in a growing number of high-tech SMEs and R&D subsidiaries of large biosciences companies such as Pfizer and GE Medical Systems, as well as electronics and engineering enterprises such as Cerberus Guinard and the Renault Technocentre.

Île-de-France is also the national leader in defence manufacturing in a wide range of sectors: armaments, military aeroplanes, nuclear weapons, aerospace and military satellites, embracing industries as diverse as plastics, mechanical engineering, metallurgical technologies, electronics and optical engineering. In an arc that runs from the north of Hauts-de-Seine to the edge of Val-de-Marne the large defence companies, Thales, Matra, Aérospatiale, Dassault and Snecma, are the core of a sector employing some 70,000 and containing as many as 900 smaller companies located throughout the whole Île-de-France region.

Some 10,700 foreign-owned companies are established in the region, with a particularly strong presence in pharmaceuticals, perfumes and chemicals & plastics. There are also many companies active in electronics, ICT and business consultancy.

Niederösterreich (at12)

The province is the largest of Austria's nine provinces and neighbours Vienna with a particular boost to its productivity in the 1980s onwards coming from the decentralisation of manufacturing out of Vienna. The area has a number of outdated industrial sectors and the agricultural base, although shrinking, remains significant. However, the region is successfully undergoing a process of economic expansion based on:

— building on existing sectoral strengths that are internationally competitive and investing in future technology sectors

— increased internationalisation of the regional economy (significant focus on Central and Eastern Europe)

— innovation and technological upgrading

— networking of economic actors and cluster development

A number of notable features distinguish the regional economy:

— the proximity and opening up of central and eastern Europe has placed significant cost pressures on labour intensive production forcing the region to move up the value chain;

— an advantageous position in central Europe with good communications and transport connections;

— internationally recognised and successful companies in the above-mentioned industries;

— closely linked to Vienna with its favourable international reputation as a high quality European urban location;

— strong concentration of knowledge infrastructure, such as research and technology centres

pertinent to local industries (hosts Austria's largest technology research centre covering a wide range of industrial research and three other centres pertaining to microsystem engineering, agribiotechnology and biotechnology), and industry technology centres;

— close co-operation and interaction with relevant educational and technological institutions in Vienna, especially in regard to the private sector accessing educational services and technology transfer/support organisations;

— high quality business infrastructure, such as business parks;

— a history of networked economic development governance and partnership.

By 2010 the region aims to be in the top 10 innovative regions in Europe. This is an aim that is shared by the public and private sector alike. Since 1997, a widely agreed Regional Innovation Strategy has been implemented. Current economic development priorities focus on further embedding the culture and processes of innovation in SMEs, technological advice, transfer and adoption, promoting co-operation amongst economic actors e.g. SMEs, research centres, chambers of commerce, education facilities and economic development agencies (although the region does not have a history of clusters, the culture of the region supports the current cluster development programme); increasing internationalisation with an emphasis on CEE; and increasing the number of business start-ups.

3.6.3 Conclusions

The case studies represent a varied mix, ranging from the urbanised Île-de-France region, the hub of the French economy, to the sparsely populated Greek region of Sterea Ellada. All the regions can be classed as being successful, having shown above-average productivity growth over the 1987-2000 period, and the reasons behind this success are numerous. Table 3.9 summarises the principle driving forces identified in the analysis.

3.7 Concluding remarks

This chapter considers aspects of regional competitiveness – defined as productivity, that is, GDP per hour worked – its measurement and its determinants. Apart from improving our understanding of what is at the background of differential productivity performance across EU regions, an important objective is to see whether it may be possible to replicate the higher level of performance in some regions in other, less competitive, regions.

Economic theory suggested several factors that distinguish the concepts of regional and national competitiveness. Foremost amongst these are the issues of localisation and specialisation that come from the field of New Economic Geography. A number of studies (e.g.. Audretsch and Feldman, 1998) link spillover effects, in particular knowledge spillovers, with productivity gains providing a bridge to the ideas of new growth theory where such effects are regarded as important sources of externalities.

A review of data availability suggested a limited number of indicators available, both across regions and across time, with which to undertake empirical analysis. However, sufficient indicators were available to measure productivity by 15 sectors across the NUTS-2 regions over 1980-2000, and to identify a selection of knowledge-based proxies such as R&D expenditure, and students enrolled in higher education.

Correlation analysis of productivity with the available indicators suggested positive associations with R&D intensity, specialisation in high-tech activities, and proportionate student numbers in tertiary education, while a negative relationship was apparent between productivity growth and its starting level, providing support for (unconditional) regional convergence. Investigation for spillover effects revealed that they were likely to be present.

Econometric results using Barro regressions support the hypothesis for unconditional and conditional convergence across the EU NUTS-2 regions, and provide some support for the hypothesis that knowledge-based factors such as R&D expenditure and workforce skills do make a contribution to regional productivity growth. Indeed, evidence of spatial autocorrelation is likely to have been caused by unmeasured spillover effects.

Additional case study work was performed on selected regions which had produced a 'better than expected' productivity performance once taking account of possible catch-up effects and contributions from R&D expenditure and other knowledge-based indicators. Analysis of the regions' characteristics revealed a range of factors which could not be captured in the empirical work, but which was likely

to have contributed to a superior productivity performance. These included:

— Good links for all major forms of transport, but particularly access to international airport, and a modern telecommunications network;

— A strong entrepreneurial culture that provided a bridge between research undertaken in universities and innovation activity in business;

— The presence of high-tech clusters in areas such as bio-technology;

— An active public authority which both provides links between the academic and business communities, and promotes the region in the face of forthcoming challenges, e.g. EU enlargement;

— Spillover effects caused by networking and common vision among regional stakeholders.

Table 3.9: Key factors of success for case study regions

Region	Factors for Success
Oberbayern	Good transport links, particularly the airport
	High level of firm creation, linked to strong entrepreneurial culture
	Immigration supplying skilled labour to support growth in high-tech areas
	Very modern manufacturing base and a rapidly expanding services sector
	Policy to retain manufacturing through provision of specially-designed industrial sites
	Strong public support through energy supply, transport infrastructure and educational facilities
	Clusters in ICT, Media and biotechnology likely to lead to large spillover effects
Darmstadt	Immigration of skilled, multi-lingual workforce, from within and outside the country, to support growth in employment
	Leading financial centre, together with strength in telecommunications and pharmaceuticals
	Well developed public transport system (road, rail water, and air) and modern telecommunications structure
	Cluster of life science research institutes
	Strong links between university and business reinforced by public authority support
	Active policy to promote the region and city in an enlarging Europe
Sterea Ellada	Presence of large, high productivity companies with high levels of innovation created via high R&D spend
	Agencies and institutions supporting innovation and technology transfer in medium sized and large companies
	A regional innovation system in part supported by European funding
	Vocational training in relevant applied technologies
	Proximity to the capital city and good communications
Île de France	Cultural hub of French economy – history of centralist policy-making
	Centre of national transport network – well served by TGV and regional train lines, motorways and international airports
	Shift to high-tech industries supported by network of research centres offset helped problems of de-industrialisation in the early-80s
	Policy to locate clusters (particularly bio-tech, electronics and engineering) in modern towns outside the central city-region
	National leader in defence manufacturing, with resulting network of support companies
	Strong presence of foreign-owned companies, particularly in pharmaceuticals, chemicals and plastics
Niederösterreich	A critical mass of untraded interdependencies (networking, common vision) and spillovers
	Economic development governance and the presence of a regional innovation system
	An emphasis on internationalisation
	An economically embedded and networked research and educational base with an emphasis on industrial collaboration
	Innovation and technology upgrading being seen as the solution to labour cost pressures
	Geographic position, proximity to the capital city, good communications, proximity to Central and Eastern Europe

3.8 Policy conclusions

While the analysis of the overall pattern of regional competitiveness supports a view that productivity differences across the regions of the EU are diminishing over time, the disparities remain substantial and the pace of convergence remains very slow. This justifies an active policy stance.

The evidence is that the fastest-growing regions have firms that have most successfully integrated into the international competitive system. This allows them to harness the human knowledge resources of their regions and raise their competitive edge. The role of public policy has been subtle but critical in the success of these regions, providing a policy infrastructure that supports business innovation. It appears that an active policy stance will be partly based on the manner in which policy successfully operates in those regions with the highest existing rates of productivity growth. The evidence suggests that policies that remove barriers to trade and open up regions to competition across the single EU market are crucial. However, idiosyncratic problems of peripheral regions need to be specifically addressed through improved transport and communications, especially telecommunications, and policy everywhere needs to address human capital requirements. The case studies report these as important influences in those regions that have generated a better productivity performance. These remain as underlying conditions for the improvement of productivity in the most disadvantaged regions of the EU.

The evidence for the importance of human knowledge in boosting regional competitiveness is varied, often difficult to tie down but ultimately compelling in its message. The fastest-growing regions are those with firms who are better at harnessing human knowledge. This is supported in both the cross-regional statistical analysis and the case study analysis. The significance of the evidence for the success of clustering in the high technology and especially biotechnology areas is that it indicates a particularly strong role for human knowledge factors. Clusters not only confer advantages through common access to knowledge resources – such as the science and research base of higher education – or indeed capital resources, but also facilitate inter-firm communication and entrepreneurial activity in those sectors that generate the highest value-added outcomes. The message for policy is that it should actively support the agglomeration forces generating such human resourcefulness and encourage the processes that build such human capital.

The implications to be drawn are that active public support for improved competitiveness will come from concerted programmes operating at different levels, such as those co-financed by structural and cohesion funds, pan-European through to regional, and covering associated physical and non-physical infrastructure requirements. This will support better transport and communications infrastructure and better support the regional entrepreneurial culture that allows businesses to build close links with well-funded and well-organised networks of, especially science-based, higher education institutions. Policy support at regional level appears critical in the better-performing regions and this corresponds to regional stakeholders subscribing to a common vision, facilitated by public-private partnerships to take this vision forward.

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APPENDIX 3

Appendix 3.1: NUTS-2 regional codes and NACE sectoral codes

Table A.3.1: Sectoral links between NACE-CLIO and ESA95

Sector Heading	ESA95 Sections	ESA79 Codes
Agriculture, hunting, forestry and fishing	A + B	B01
Energy and Manufacturing	C + D + E	
Mining and quarrying + Electricity, gas and water supply	C + E	B06
Manufacture of food products, beverages and tobacco	DA	B36
Manufacture of textiles and textile products + Manufacture of leather and leather products	DB + DC	B42
Manufacture of coke, refined petroleum products and nuclear fuel + Manufacture of chemicals, chemical products and man-made fibres + Manufacture of rubber and plastic products	DF + DG + DH	B13 + B17 + B50 (part)
Manufacture of electrical and optical equipment	DL	B24 (part)
Manufacture of transport equipment	DM	B28
Other Manufacturing (Manufacture of wood and wood products + Manufacture of pulp, paper and paper products; publishing and printing + Manufacture of other non-metallic mineral products + Manufacture of basic metals and fabricated metal products + Manufacture of machinery and equipment n.e.c. + Manufacturing n.e.c.)	DD + DE + DN + DI + DJ + DK	B15 + B24 (part) + B47 + B50 (part)
Construction	F	B53
Market Services	G + H + I + J + K	B 68
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	G	B58 (part)
Hotels and restaurants	H	B58 (part)
Transport, storage and communication	I	B60
Financial intermediation	J	B69
Real estate, renting and business activities	K	B74
Non-market services (Public administration and defence; compulsory social security + Education + Health and social work + Other community, social and personal service activities + Private households with employed persons + Extra-territorial organisations and bodies)	L + M + N + O + P	B86

Appendix 3.2: A note on Barro regressions

Methodology

The general estimating equation in a Barro regression is as follows:

$$(1/T)\ln\left(Y_r^t / Y_r^0\right) = \beta_0 - \left[\left(1-e^{-\beta T}\right)/T\right]\ln Y_r^0 + \lambda X$$

where the average annual growth rate of productivity[68] in region r from year 0 to t is related to the initial level of productivity and a set of conditioning variables (vector X). The Barro-test for convergence is that $\beta > 0$, i.e. the lower the initial level of productivity, the higher the growth rate[69]. The estimate of coefficient β and the expression in brackets multiplying the log of Y^0 can be used to solve for the rate of β-convergence per year. Thus, poorer regions on average grow faster than rich ones and, as a consequence, productivity levels are expected to converge. This property is consistent with the neo-classical approach to convergence whereby trade provides efficiency advantages for all regional participants through specialisation, with factor-price equalisation then bringing ultimate convergence in productivity.

Conditioning variables

Subsequent work in this area (see Durlauf and Quah, 1998, Table 2 for a comprehensive listing) has expanded the range of conditioning indicators in country studies to include knowledge-based factors alongside others reflecting more traditional explanations such as trade, investment, and population growth as well as a range of socio-political factors. The variety of productivity-related drivers linked to deepening human knowledge are suggested by the earlier associative analysis, although both population activity rates and cost of living measurements may themselves mean that measured real productivity differences across regions can display somewhat anomalous outcomes.

The estimation work undertaken with the regional database concentrates on assessing the evidence for knowledge factors in regional competitiveness using a Barro-type approach.

The literature indicates that the determinants of regional growth, apart from capital and population, are human capital accumulation (innovation) and the diffusion of technology from leading regions. In the endogenous growth literature two major frameworks are distinguished, the Lucas (1988) approach and the Nelson-Phelps (1966) approach. In both of these, inputs of knowledge factors come in the form of growth, educational attainment and R&D interdependencies. Diffusion of technology in particular is emphasised by Nelson-Phelps, with education speeding the process of catch-up by facilitating the high rates and levels of trade in ICT products. This suggests increases in educational attainment would be the most clearly specified determinant.

For regional econometric analysis of the role of knowledge factors, the growth accounting approach is felt to be over-demanding and the chosen approach rather seeks to assess competitiveness and convergence associations with knowledge factors based on the substantial literature (see Durlauf and Quah, 1998 for a literature review) derived from the work of Barro and Sala-i-Martin (1995). This builds on earlier work by Baumol (1986), with the empirical formulation having a number of features that make it attractive for use. The primary unconditional regression equation is based on a neo-classical view but the conditional regression can be thought of as a reduced form for a number of alternative models. Its principal practical advantage in regional analysis is that it requires little substantial variable measurement apart from productivity at two points in time and knowledge input factor proxies. It therefore provides a simple opportunity to test for convergence, both unconditional and conditioned by knowledge factors. It also provides a basis for classifying regions by the residuals from such regressions in relation to other possible explanatory inputs, including the population and technology diffusion determinants associated with knowledge factors. The OLS estimation of Barro regressions is also generally considered to be robust to mis-specification.

The simplest β-convergence Barro regression has been used to exploit more fully the cross-section and time series information in available datasets (e.g. a panel data approach can be used to deal with temporal and spatial correlations) but a basic finding of their analysis has generally been shown to hold true. This is that absolute convergence tends to exist for homogenous regions (particularly in regional studies the states of the US and in country studies the OECD) but not for the world as a whole. Convergence for the heterogeneous sets of

[68] Traditionally the indicator of interest has been GDP per capita, but as productivity (GDP per hour worked) is the chosen measure of competitiveness, this has been chosen as the dependent variable in the Barro equation.

[69] Testing, without any other explanatory variables, for whether higher productivity growth rates are associated with lower initial productivity levels would correspond to the simplest type of 'unconditional beta' convergence testing.

countries is only apparent when one controls for other variables (conditional convergence).

Additional complications

(i) Outliers

Temple (1999) has drawn attention to the sensitivity of cross-country regressions to influential outliers. The empirical work at EU regional level inevitably has to deal with higher residual variance from Barro regressions as regions themselves are more heterogeneous than in say OECD country studies, although the EU member states are more homogeneous than the OECD countries as a whole. With larger average residuals the use of outlier analysis is therefore more important. In order to assess both the robustness of results and test for influential effects of data measurement at regional level, outlier analysis is essential. It also provides the methodological approach at regional level for classifying regions and for assessing possible additional explanatory factors. Tests for spatial autocorrelation and heterogeneity in residuals are also more appropriate in regional analysis, with theory suggesting that spatial proximity may boost trade, associated technology diffusion and hence accelerate growth so that outliers associated with missing variables are likely to be correlated in space.

(ii) Spillover effects

Specification of the manner and route through which the spillover effects associated with such knowledge factors operate is problematic at regional level. This is principally because of the general absence of regional trade information and missing or poor quality information on the critical knowledge inputs. One expected outcome from missing such effects will be spatial correlation in growth regression residuals. These were indeed found and discussed in the main text.

(iii) Spatial autocorrelation

Both cluster theory and endogenous growth theory suggest that missing factor effects and any economic shocks over time are likely to be correlated between adjacent regions. This may reflect regional club effects with regionally contiguous groups seeing their productivity performance moving together. Correlations in shocks may also reflect the common external trade experience of such regional clubs and stronger links to leading regions, but may also be associated with nationally-based economic interdependencies, such as the economic links to a capital city region or the influence of concerted national policy across all regions, such as changes in a tax regime.

(iv) Heterogeneity

Specification both of the form of the regression equation and the nature of residual shocks at regional level will also potentially mean that possible variable parameters associated with size and heteroscedastic residual effects will be associated with both the level of starting productivity and the duration of the time period measured. While a logarithmic form of regression will help to accommodate such heterogeneity, the effect within the EU data set is in any case likely to be less problematic than in more broadly based comparisons across very different regions or countries.

Estimation sequence

To begin with, a general equation was estimated covering all regions where data were available. The time period for productivity growth was 1987-2001, with unconditional Barro equations estimated for some 200 NUTS-2 regions in the EU. In the event only the following variables could be used due to lack of data availability: R&D expenditure in share of GDP, high tech share of total employment, and the number of enrolments in tertiary education.

Unconditional Barro regression

Equation parameters and diagnostics

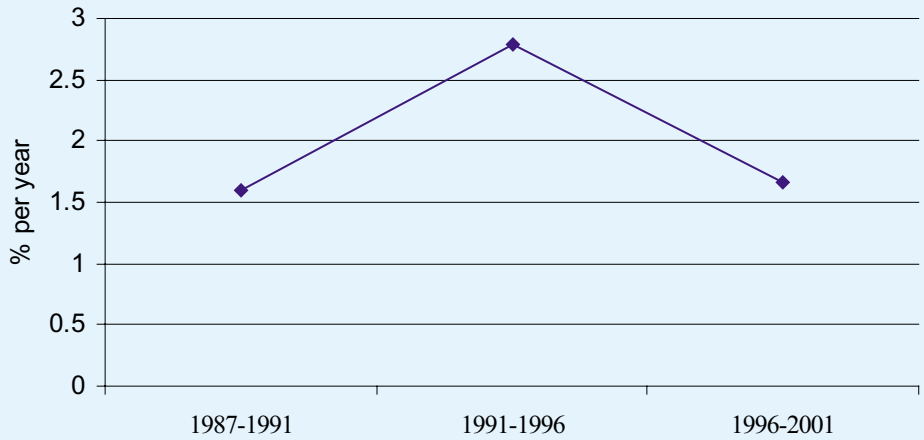
Results for the unconditional Barro regression are presented in Table 3.6 and show a highly significant β-convergence over the regional space, with the hypothesised negative coefficient on the starting level productivity indicating convergence over the period. The overall fit is relatively poor as expected and residual diagnostics show considerable information content is left in the residuals, which give evidence of misspecification, non-normality and show serial dependency for the country-based ordering of the regions in the regression analysis. Graph A.3.1 presents evidence that there is systematic variation in β-convergence rates over three selected time periods and this is inversely associated with the speed of growth of the EU economy. This is consistent with the view that short-term faster growth is driven by international macro-economic conditions that impact first on the highest productivity regions before spilling over into the rest. Graph A.3.2 reports in more detail on this, showing the consistent decline in dispersion as measured by σ-convergence over the period, especially for the most disadvantaged regions.

σ-convergence

The significant evidence for unconditional β-convergence across the whole of the 1987-2001 period means that there is a justification for exploring σ-convergence, the changing dispersion of measured productivity across regions, and this is also amenable to decomposition into particular regional groupings relevant to policy.

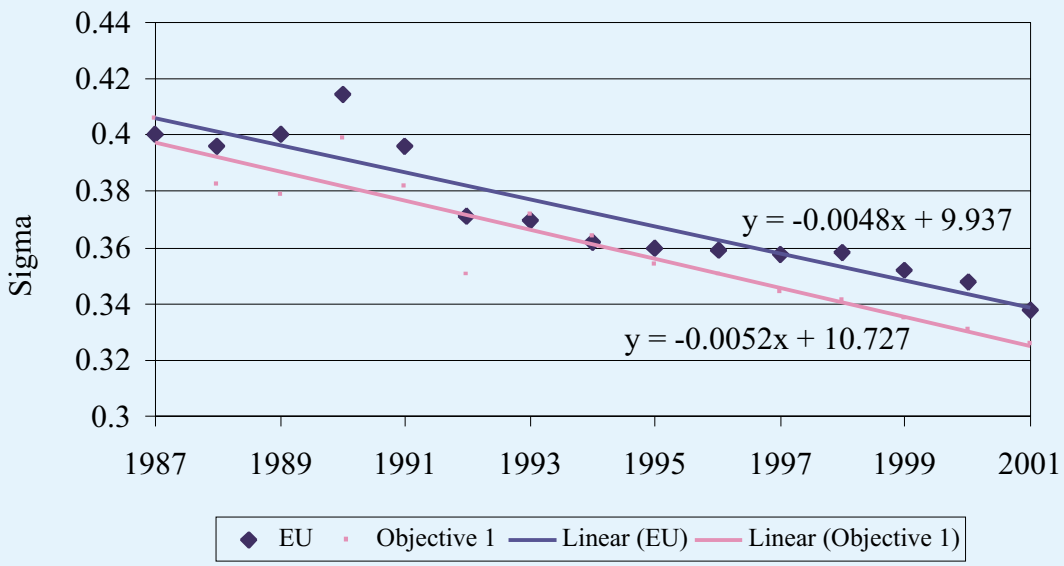
Graph A.3.2 plots σ-convergence in productivity across the 207 EU NUTS-2 over the period and for the subgroup of Objective 1 regions. The plot relies upon the evidence of the Barro regressions and indicates more clearly that convergence in regional productivity has systematically occurred over the whole period 1987-2001 but that during the periods of fastest growth in the EU, particularly in the buoyant years up to 1989, there had been an associated widening of the dispersion between regions. More recent convergence, on this measure, has taken place during the more modest growth (1996-2001) period across the EU.

Graph A.3.1: β-convergence rates over time - Unconditional model



Source: Cambridge Econometrics European Regional database (April 2003).

Graph A.3.2: σ- convergence rates over time - Unconditional model



Source: Cambridge Econometrics European regional database (April 2003).

The Moran scatter plot[70] of Graph A.3.3 shows clear and statistically significant spatial dependency in the residuals.

Conditional Barro regression

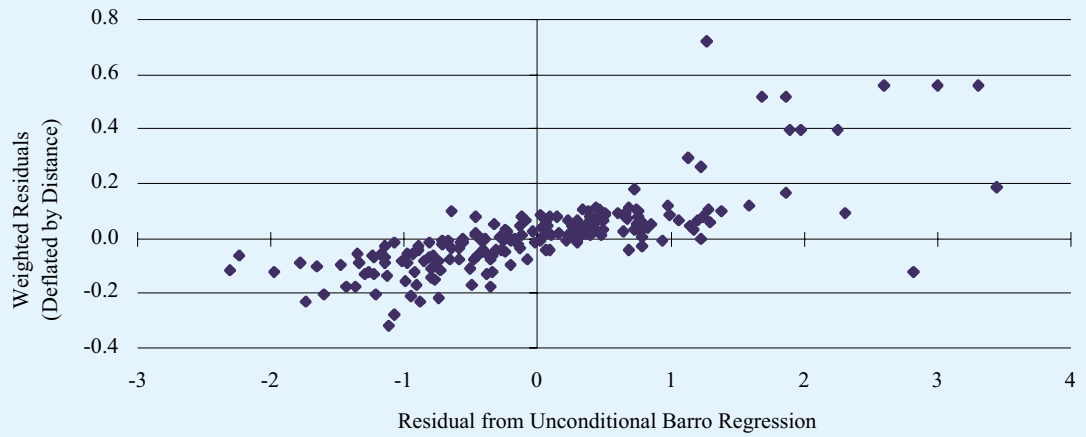
Equation parameters and diagnostics

The β-convergence results remain significant in the reported conditional Barro regression of Table 3.7 with the additional coefficients positive, as hypothesised, on the conditioning variables of R&D expenditure relative to GDP and the high tech specialisation of employment. The coefficient on enrolment in tertiary education was negative and insignificant in associated regressions. While suggestive, these estimates are not statistically robust at the 5 % level, although the diagnostic results show the residuals to be much better behaved than in the unconditional regression with for example the Ramsey RESET test for mis-specification not significant.

The conditional Moran scatter plot is shown in Graph A.3.4 providing supporting evidence of continuing serial correlation but with the effect of large blocks of missing data affecting the reported conditional Moran's I value which is also not significant at the 5 % level.

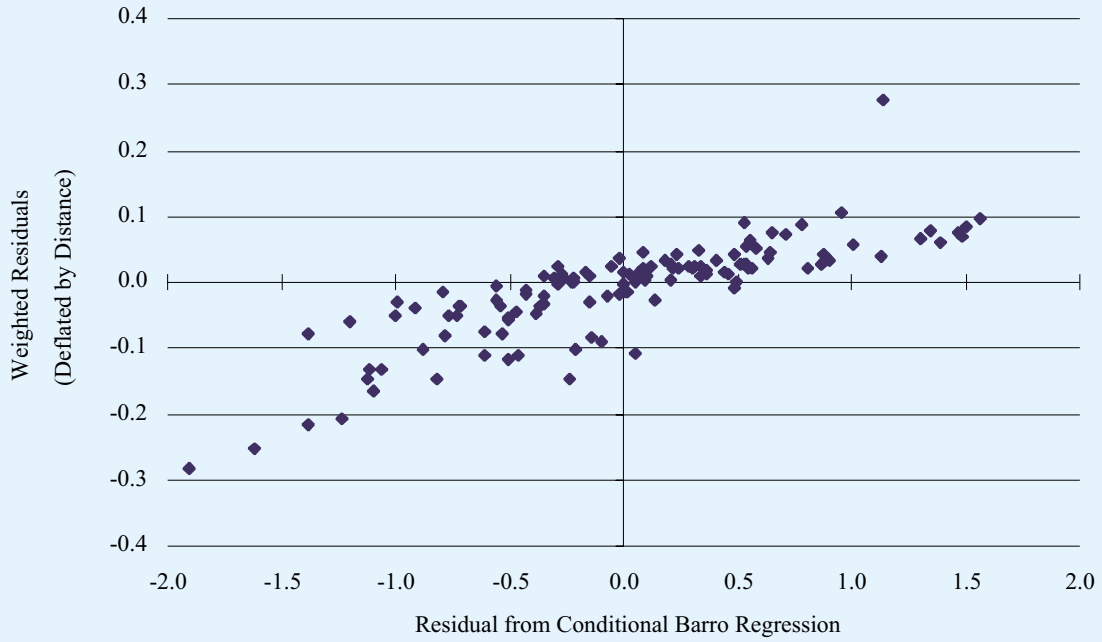
[70] See Moran, P. (1948). The measure looks at spatial correlations in the residuals, an aggregate measure associating in turn each region's residual with the size of residuals in adjacent and more distant regions, with weights varying inversely with distance away. The I value can be interpreted in the same manner as a correlation coefficient, varying between -1 and +1, with zero indicating no association.

Graph A.3.3: Residual spillover effects - unconditional model



Source: Cambridge Econometrics European regional database (April 2003).

Graph A.3.4: Residual spillover effects - conditional model



Source: Cambridge Econometrics European regional database (April 2003).

Chapter 4: EU enlargement and competitiveness of manufacturing

4.1 Introduction

On 1 May 2004, ten new Member States will accede to the EU: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic and Slovenia. The enlargement will create a larger internal market and lead to changes in the economic structures of the enlarged Union.

While economic developments in Cyprus and Malta have been generally stable, the Central and East European countries have undergone dramatic structural changes during the 1990s. Their production structures have changed, and their relations with the EU – including trade and foreign direct investment – have intensified. A catch-up process of these countries towards the living standards of the present EU-15 has started, although progress has been uneven among the group.

This chapter seeks to outline the main features of the changing economic landscape of the EU and to analyse the competitive position of the acceding countries within the enlarged Union. Section 2 gives a broad overview of the macroeconomic performance of the acceding countries as well as the other two Central and East European countries, Bulgaria and Romania since 1990. Section 3 looks at the changing economic structures in these countries, including changes in the business environment, the role of the main economic sectors, and changes in the manufacturing sector during the 1990s.

Sections 4 and 5 discuss the competitiveness of the manufacturing industry in the acceding and candidate countries: the former on productivity and labour costs, the latter on trade competitiveness. Due to lack of detailed data on the manufacturing sector in Cyprus and Malta, these countries could not be covered. Instead, where possible, the data for the eight Central and East European countries acceding in May 2004 is accompanied by an analysis of the other two East European candidate countries Bulgaria and Romania. Section 6 concludes.

Unless otherwise indicated, the country groupings and acronyms used in this chapter refer to the following countries:

CEEC-8: Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Poland (PL), the Slovak Republic (SK) and Slovenia (SI)

AC-10: the 10 countries acceding in May 2004, i.e. CEEC-8 as defined above, Cyprus (CY) and Malta (MT)[71]

CEEC-10: the 10 acceding and candidate countries: CEEC-8 as described above, together with candidate countries Bulgaria (BG) and Romania (RO)

EU-25: EU after the next enlargement round, i.e. the present 15 EU members and AC-10 as described above.

4.2 Macroeconomic performance in the acceding countries after 1990

Accession of the ten new Member States will add some nine per cent to EU's GDP and close to twenty per cent to EU's population (Table 4.1). Given the lower employment rates in the acceding countries, total employment will increase by less than total population, by some eighteen per cent.

Average GDP per capita in the ten countries acceding in May 2004 (measured at purchasing power stan-

[71] Within the AC-10 group, the eight Central and East European countries (CEEC-8) account for 98 % of total GDP (2002), Cyprus and Malta for the remaining 2 %.

dards, which correct for the undervaluation of the currencies in many acceding countries) is less than half of that in the present EU-15, and average labour productivity just above half of the level in EU-15.

Table 4.1 Economic indicators for the countries acceding in May 2004 in comparison to the present EU-15

	% of the level in EU-15
GDP (in PPS, 2002)	9.0
Population (2002)	19.7
Total employment (2001)	17.7
GDP per head (in PPP, 2002)	46.4
Labour productivity (GDP per employed person in PPS, 2001)	52.2

Notes: The ten countries acceding in May 2004 are Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic and Slovenia. PPP and PPS: Purchasing Power Parities / Standards.

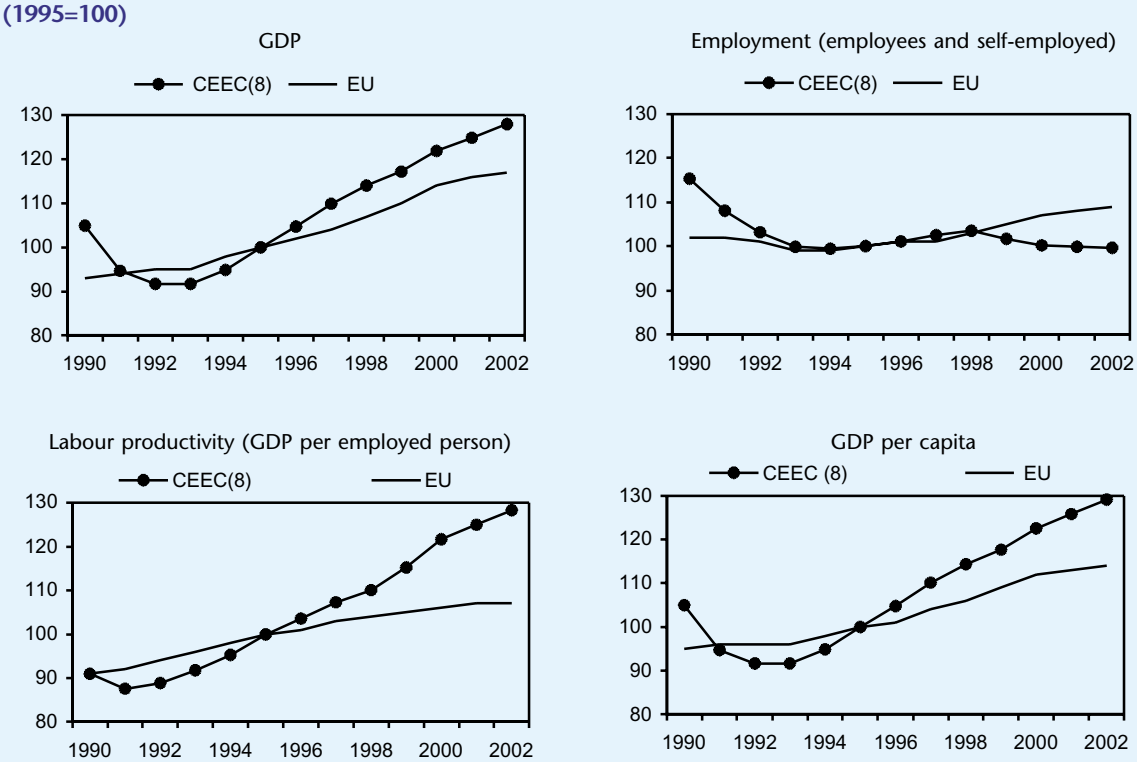
Source: Commission services, using national statistics and Eurostat.

During the early 1990s, the acceding countries in Central and Eastern Europe went through a first phase of the transition process which was characterised by dramatic declines in *GDP* (Graph 4.1). The negative growth resulted from both supply and demand shocks, caused by the loss of traditional export markets, the break-up of existing supply chains and decision-making structures, rapid trade liberalisation and restrictive macroeconomic policies.

From 1994 onwards, economic recovery gained momentum in the acceding countries and growth has since exceeded that in the EU. Bulgaria and Romania, the two Central and East European candidate countries, have lagged behind the acceding countries in this recovery: average GDP growth in these two countries since 1995 has remained below 1 % per year (Table 4.2).

Employment in the Central and East European acceding countries declined even more strongly than GDP in the first years of transition (-2.8 % per year between 1990-1995). After a modest recovery, employment has declined again since 1999. The cumulated decline in total employment in CEEC-8 over the period 1990-2002 amounted to 13.5 %. Low levels of employment are a major concern in the acceding countries. Among the acceding countries, Cyprus, the Czech Republic and Slovenia have the highest employment rates, all being close to the present EU-15 average of 64 % (Table 4.2).

Graph 4.1 Growth of GDP, employment and productivity in CEEC-8 compared to EU-15, 1990-2002 (1995=100)



Source: WIIW Database incorporating national statistics, WIFO and WIIW calculations using AMECO.

Average labour *productivity* increased at a rapid pace in the acceding countries throughout the past decade (2.9 % per year during 1990-2002 in CEEC-8, which compares to 1.4 % in EU-15). However, to the extent that the productivity gains were the result of labour shedding, they reflected the painful adjustment processes going on in these countries rather than a successful modernisation of their economies. In the second half of the 1990s, productivity gains were to the main extent related to gains in output, while employment shedding remained on a lesser scale than in the first half of the decade.

Growth of *GDP per capita* in the acceding countries has mirrored that of overall GDP; given the lower employment levels in the acceding countries, the gap vis-à-vis the present EU-15 is larger in terms of GDP per capita than in terms of average productivity per employed person.

4.3 Changing economic structures

4.3.1 Business environment

Economic transition since the early 1990s has implied major changes in the economic structures of the acceding and candidate countries in Central and Eastern Europe. However, progress towards modernisation of the economies has been uneven across countries and across policy areas.

The European Bank for Reconstruction and Development (EBRD) publishes annually a set of transition indicators, which measure progress in a wide range of areas.[72] By 2002, all the eight Central and East European countries acceding in May 2004 were considered to have reached the level of an advanced market economy with respect to trade and foreign exchange systems as well as regarding small scale privatisation. On the other hand, despite the impressive progress of the past years, problems remain in several countries with regard to governance and enterprise restructuring (soft budget constraints, bankruptcy legislation etc.) and competition policy (abuse of market power and barriers to entry).

Furthermore, progress in financial sector reforms is considered to be lagging behind in some countries (Poland, the Slovak Republic and Slovenia), which generally implies higher financing costs for enter-

[72] For the 2002 transition indicators, see the EBRD (2002). The reader is also referred to the forthcoming report by the European Commission on the progress towards accession in the candidate countries as well as the monitoring reports on the acceding countries.

Table 4.2 Economic indicators for individual acceding and candidate countries and EU-15

	GDP growth in 1995-2002, % p.a.	Employment growth in 1995-2002, % p.a.	Labour productivity growth in 1995-2000, % p.a.	Population in 2002 (EU-25=100) (EU-25: 456 mio.)	Employment rate in 2001, % of 15-64-year old population	GDP per capita (at PPP) in 2001 (EU-15=100)	GDP (at PPS) in 2002 (EU-25=100)
Czech Republic	1.7	-0.5	2.2	2.2	65.1	60	1.4
Estonia	5.0	-1.1	6.2	0.3	61.3	41	0.1
Hungary	3.9	0.7	3.1	2.2	56.5	57	1.4
Latvia	5.2	0.2	5.0	0.5	58.7	35	0.2
Lithuania	4.0	-2.2	6.4	0.8	60.1	39	0.3
Poland	4.0	0.2	3.8	8.5	55.0	39	3.6
Slovak Republic	3.8	-0.1	3.9	1.2	56.8	47	0.6
Slovenia	3.9	0.7	3.2	0.4	63.8	74	0.3
CEEC-8	**3.6**	**0.0**	**3.6**	**16.1**	..	..	**7.9**
Cyprus	3.6	1.2	2.4	0.2	65.9	74	0.1
Malta	3.3	0.6	2.7	0.1	54.2	55	0.1
AC-10	**3.6**	**0.0**	**3.6**	**16.4**	**56.7**	**46**	**8.1**
Bulgaria	0.6	-1.3	1.9	1.7	49.6	25	0.5
Romania	0.4	-1.8	2.2	4.9	62.4	25	1.3
AC-10, BG and RO	**3.0**	**-0.5**	**3.6**	**23.0**	**57.4**	**40**	**9.9**
EU-15	**2.2**	**1.2**	**1.0**	**83.6**	**64.1**	**100**	**90.1**

Notes: Labour productivity refers to GDP per employed person (at purchasing power parities, or PPP). PPS: purchasing power standards (Eurostat). Employment rates for Cyprus, Lithuania and Poland are for 2000. GDP levels for Malta in comparison to the EU are for 1999.

Sources: WIIW database incorporating national statistics; WIFO and WIIW calculations using AMECO; Eurostat.

prises in these countries. There are also delays in infrastructure reforms, in particular with regard to the quality of roads and telecommunications; in this area, Slovakia lags significantly behind.

A joint EBRD and World Bank survey (EBRD, 2002) suggests that significant improvements took place in the business environment of the Central and East European acceding and candidate countries between 1999 and 2002. This 2002 *Business Environment and Enterprise Performance Survey* asked 6000 enterprises to evaluate economic governance and state institutions and to assess the extent to which the business environment creates obstacles to the operation and growth of their businesses. The Czech Republic, Estonia, Hungary and Slovenia had the best scores in the general assessment of the business environment. The obstacles to doing business were still regarded as considerable in Latvia, Lithuania, Bulgaria and Romania.

Overall, *financing* and *taxation* were considered to be the largest obstacles for doing business (EBRD, 2002). In contrast, problems with *infrastructure* and *crime* were considered as minor obstacles to business in most acceding countries in the 2002 survey, representing a major improvement on the results of the survey three years earlier. Also *regulation*, or the extent of bureaucratic hurdles on business, is considered as a relatively small obstacle, but its importance is increasing again in several countries, in particular in the Baltic States.

The *judiciary*, laws and their enforcement, is considered as a major obstacle in Lithuania, Slovakia and Romania. *Corruption*, which is generally quoted as a medium-sized obstacle in the acceding and candidate countries, is relatively more important in Latvia, Lithuania, Slovakia, Bulgaria and Romania. However, comparison with the results of the 2000 *World Business Environment Survey* of the World Bank, which covers a sub-set of EU-15 Member States, suggests that the frequency of bribes in most of the Central and East European acceding and candidate countries be lower than for instance in France and Germany.[73]

The modernisation of existing assets and the training of people in skills such as managerial know-how require extensive efforts and large financial resources. *Foreign direct investment* (FDI) has been one of the driving forces behind the restructuring and upgrading of human and physical capital. FDI can enhance productivity growth and export expansion by bringing in additional capital, technology and managerial know-how, as well as easing the access to markets.

Havlik (2003) presents robust statistical evidence of the positive impacts of FDI penetration on productivity and unit labour costs at branch level. Hunya (2002) shows that enterprises with foreign investment participation have labour productivity levels on average twice as high as domestically owned enterprises; the former are also more export-oriented. Damian et al. (2003), using a panel data set covering more than 8000 firms in acceding countries, investigate the channels of technology transfer through FDI and the impact of FDI on productivity growth. In contrast to the findings of others, they conclude that total factor productivity growth in foreign affiliates is much faster than that in locally owned firms only in some acceding countries (Estonia, Hungary and Slovenia).

Among the eight Central and East European countries acceding in May 2004, Poland and the Czech Republic have attracted the largest stocks of foreign direct investment (FDI) both in absolute terms and relative to GDP (Table 4.3). Roughly forty per cent of the total inward FDI stock is in the manufacturing sector in five of these countries; the Baltic States are an exception, as manufacturing accounts for a smaller part of their total inward FDI.

FDI data by manufacturing industry reveal an uneven distribution of FDI among the industries. This reflects not only the varying degree of attractiveness of individual industries but also cross-country differences in privatisation policies. Large FDI inflows have been recorded in both domestically oriented industries such as food and beverages (important in all acceding countries except Slovenia) and predominantly export-oriented industries such as electrical and optical equipment or transport equipment. In the Baltic States, FDI plays a major role in textiles and wood.

Accession to the EU will imply a further reduction in trade barriers and hopefully a still deeper integration of the new members into the cross-border production networks. EU membership also involves the adoption of the existing EU legislation, or the *"acquis communautaire"*.

Compliance with EU standards and safety requirements will in many cases lead to quality improvements and constitute a competitive advantage. Exported products will be subject to one conformity assessment procedure only, which will in many cases reduce production costs considerably. However, in the short run the adoption of the EU rules may require substantial investments in some sectors, and

[73] Comparison of EBRD (2002, Table 2.2) with the World Business Environment Survey (WBES) Interactive Dataset on the World Bank's homepage http://info.worldbank.org/governance/wbes/front.htm.

Table 4.3 Foreign direct investment (FDI) stocks1) in manufacturing industry, 2001

		Czech Republic	Estonia[2)]	Hungary[2)]	Latvia	Lithuania[2)]	Poland	Slovak Republic	Slovenia
Total FDI stock in the country (mio euro)		30717	2843	11080	2521	2509	60311	5313	3637
- of which, in manufacturing (mio euro)		11540	613	4079	429	722	24829	2328	1317
Manufacturing FDI stock % of GDP		18.2	11.0	8.1	5.1	5.9	12.2	10.2	6.3
		FDI stocks per employee (1000 euro)							
D	Manufacturing total	10.7	5.2	5.4	2.9	3.0	10.6	6.1	5.8
DA	Food products; beverages and tobacco	11.3	6.9	8.1	3.5	5.1	14.1	7.1	3.3
DB	Textiles and textile products	3.8	3.8	1.5	2.2	2.0	1.0	0.6	1.2
DC	Leather and leather products	0.7	.	1.1	2.4	0.1	0.4	1.1	.
DD	Wood and wood products	5.4	7.2	1.9	2.2	1.7	12.7	2.2	0.5
DE	Pulp, paper and paper products; publishing and printing	20.5	.	5.0	2.3	2.0	15.1	7.2	16.0
DF	Coke, refined petroleum products and nuclear fuel	71.4	.	25.8	.	12.8	.	37.0	.
DG	Chemicals, chemical products and man-made fibres	18.6	17.1	6.3	9.6	.	14.0	8.5	18.5
DH	Rubber and plastic products	14.4	2.4	6.1	5.9	5.5	6.4	3.0	12.7
DI	Other non-metallic mineral products	22.8	.	8.3	7.1	3.5	23.2	5.2	8.0
DJ	Basic metals and fabricated metal products	5.8	2.9	3.3	5.1	1.3	1.9	16.7	3.0
DK	Machinery and equipment n.e.c.	3.7	4.0	3.7	4.2	0.7	1.5	2.0	7.1
DL	Electrical and optical equipment	12.6	1.6	5.8	2.0	3.0	11.8	2.4	5.0
DM	Transport equipment	22.7	10.7	9.7	0.3	8.3	36.9	5.4	13.1
DN	Manufacturing n.e.c.	1.9	.	1.5	1.1	0.6	3.4	1.2	0.3

[1)] FDI coverage by country is as follows: Czech Republic: equity capital, reinvested earnings, loans; Estonia: equity capital, reinvested earnings, loans; Hungary: nominal capital based on corporation-tax declarations; Latvia: equity capital, reinvested earnings, loans; Lithuania: equity capital, reinvested earnings, loans; Poland: equity capital, reinvested earnings gross; projects over USD 1 million capital based on PAIZ (the Polish Foreign Investment Agency) data; Slovak Republic: equity capital, reinvested earnings - in the corporate sector; Slovenia: equity capital, reinvested earnings, loans.
[2)] Data for 2000.

Source: WIIW-WIFO FDI database, national statistics.

these are likely to crowd out other types of investment. European Commission (2001, 2003) estimates that the total investment needs in the acceding countries amount to some EUR 80 to 100 billion.

In most sectors, the largest investments are those required in order to comply with environmental regulations. Also requirements arising from occupational health and safety regulations, employment legislation, as well as product-specific standards will impose costs on many industries. The sectors most affected by the *acquis* include the chemical and pharmaceutical sector, basic metals and fabricated metal products, food industries, and the transport equipment sector – all important industries in the acceding countries.

In some cases, transition periods have been granted to the acceding countries for the implementation of the full *acquis*.

Many industries in the acceding countries have already undergone restructuring and modernisation and are well prepared for the adoption of EU legislation. However, there is a dichotomy between modern, foreign-dominated industries and domestically owned enterprises (see Hunya, 2002). Industries with EU-oriented production, high levels of foreign direct investment, solid investment growth rates and a domination of large-size enterprises are generally best prepared for the obligations of EU membership. Small companies and companies operating only on the domestic market are generally less well prepared. A recent Eurochambres survey indicated that only half of the companies in the acceding countries had started preparations for the Single Market, and less than ten per cent felt they were fully informed of the existing EU legislation (Eurochambres, 2003).

4.3.2 Main sectoral changes in the acceding countries, Bulgaria and Romania, since 1990

The economic transition in the Central and East European acceding and candidate countries has involved large shifts in the sectoral composition of GDP and employment. The changes have brought their overall economic structures closer to those in EU-15. At the beginning of the transition, the acceding countries had larger agricultural and industrial sectors, and a smaller services sector than the EU-15 average (see Graphs 4.2 and 4.3)[74]. In the course of the 1990s, the general trend has been towards an increasing share of services at the cost of agriculture and industry, although in a few countries the shares of agriculture or industry have increased as well. In Cyprus and Malta, the sectoral shifts during the 1990s were less pronounced.

In the period 1990-2001, the share of *agriculture* in GDP and in employment fell dramatically in each of the Central and East European acceding countries. Even in absolute terms, agricultural employment declined. In contrast, in Bulgaria and Romania, the share of agriculture in total employment increased. This was essentially the result of a dramatic decline in industrial employment and the limited absorption capacity of the services sector. Nonetheless, in Romania agricultural employment increased also in absolute terms.

Agriculture still accounts for a larger share of total value added in the acceding countries than in the present EU-15. However, in terms of agricultural employment the difference between the acceding countries and the present EU is yet even more significant than in terms of value added, reflecting the low average labour productivity in agriculture in the accession countries. After EU accession, competitive pressures and modernisation are likely to increase labour productivity in agricultural production in the new Member States, which could imply further steep declines in agricultural employment in those countries.

In all the Central and East European countries, the share of *industry* (comprising manufacturing, mining, water and electricity supply, and construction) declined in terms of both value added and employment between 1990 and 2001. The decline was more pronounced in the first years of transition and levelled off after 1995. In several countries, industrial employment declined sharply even in absolute terms. In terms of gross value added, the share of industry in most acceding countries is now similar to that in the EU; as an employer, industry continues to have a larger role in particular in the Czech Republic, Slovenia, the Slovak Republic and Hungary.

The Hungarian experience, a renewed increase in industrial employment after a significant decline, suggests that also some other acceding countries might experience a "re-industrialisation" in the future. Factors such as low labour costs and availability of skilled labour may attract more export-oriented industrial production, as has happened in several South-East Asian economies.[75]

[74] Under the previous regime, industry was emphasised at the expense of services. Furthermore, service activities were often supplied within big industrial combines and were consequently classified under "industry" and to some extent "agriculture" as well. Most services were considered "unproductive labour" and their contribution to the efficient functioning of the economy was neglected (Stare and Zupancic, 2000). Also, many modern services that play an important role in market economies (such as marketing, financial services, real estate and other business services) were not needed under socialism. (Soubbotina and Sheram, 2000).

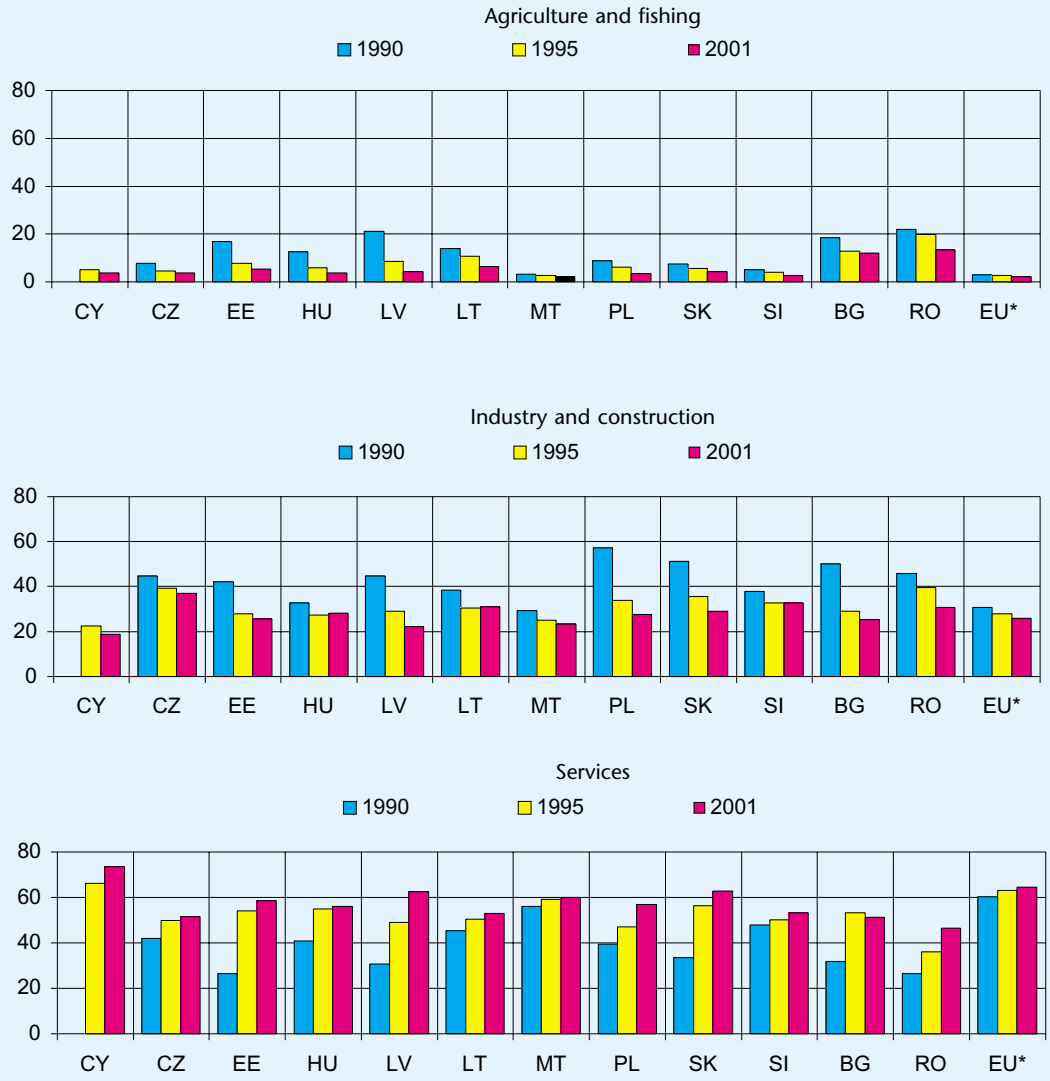
[75] Urban (2001).

As the role of agriculture and industry declines, *services* have increased their share in both value added and employment in each of the ten Central and East European acceding and candidate countries. However, at the beginning of the transition, the rising share of services essentially reflected less pronounced employment losses relative to industry and agriculture. Only when growth gained momentum in the total economy, employment in services started to rise in absolute terms.

The increasing share of services in the Central and East European countries reflects a 'catch-up' of the tertiary sector, which still accounts for a distinctly lower share of total value added and employment than is the case in the present EU-15. The gap vis-à-vis EU-15 is largest in the field of financial and other business services (marketing, consulting, auditing etc.)[76]. Given the large scope for catch-up, the services sector can be expected to continue to grow and account for the main part of employment

[76] For a more extensive analysis of the development of the services sector in the accession countries, see Vidovic (2002).

Graph 4.2 Sectoral composition of value added in the acceding countries, Bulgaria and Romania in comparison to EU-15 in 1990, 1995 and 2001 (% of GDP)

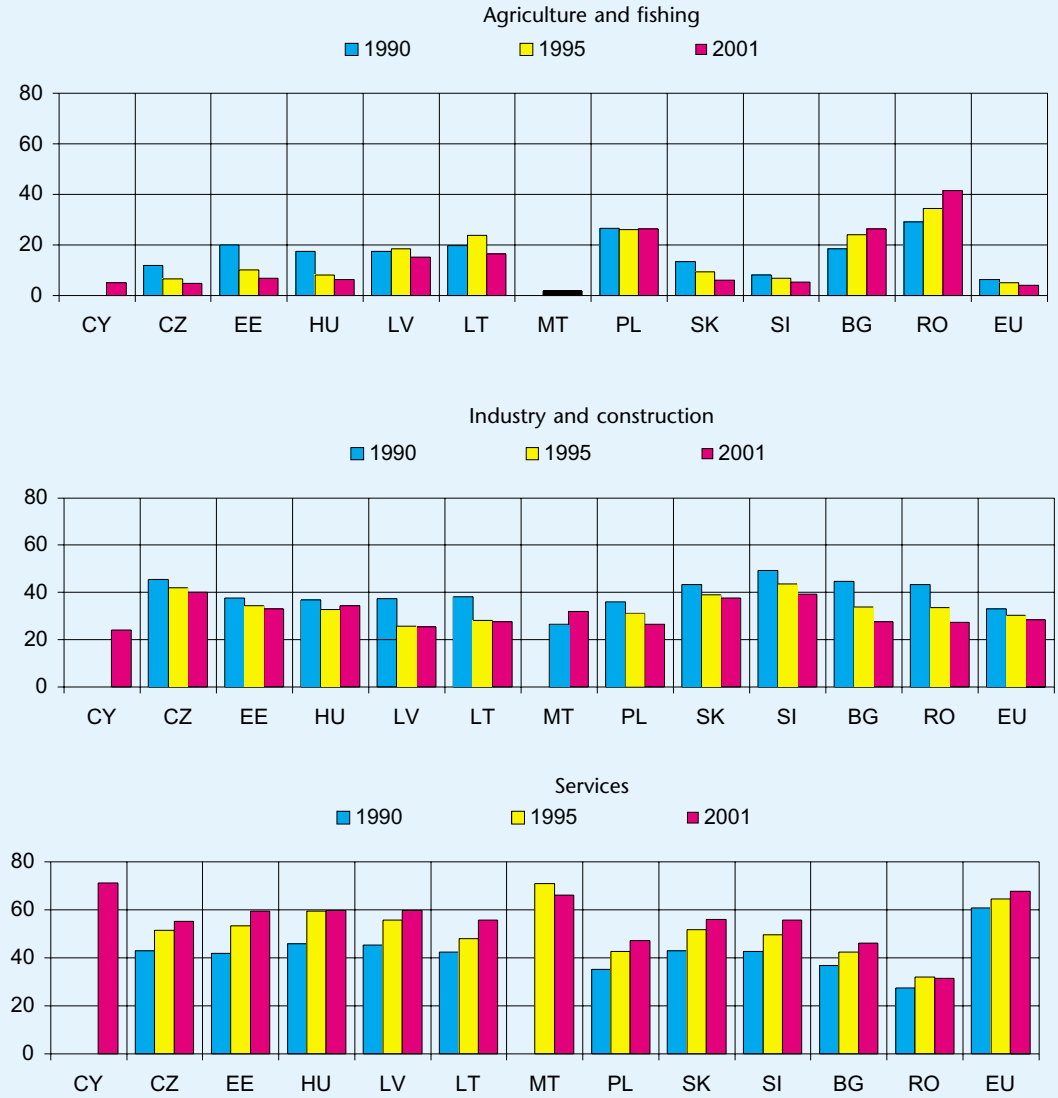


* Year 2000.

Note: Sector shares are defined as gross value added (GVA) in each sector relative to gross domestic product (GDP). Because of the so-called 'Financial intermediation services indirectly measured' (FISIM), which are included in GDP but not in gross value added, the shares of the three sectors will not add up to 100 %.

Sources: WIIW Database incorporating national statistics; WIFO and WIIW calculations using AMECO.

Graph 4.3 Sectoral composition of employment in the acceding countries, Bulgaria and Romania in comparison to EU-15 in 1990, 1995 and 2001 (% of total employment)



Sources: WIIW Database incorporating national statistics; WIFO and WIIW calculations using AMECO.

growth in the Central and East European acceding and candidate countries.

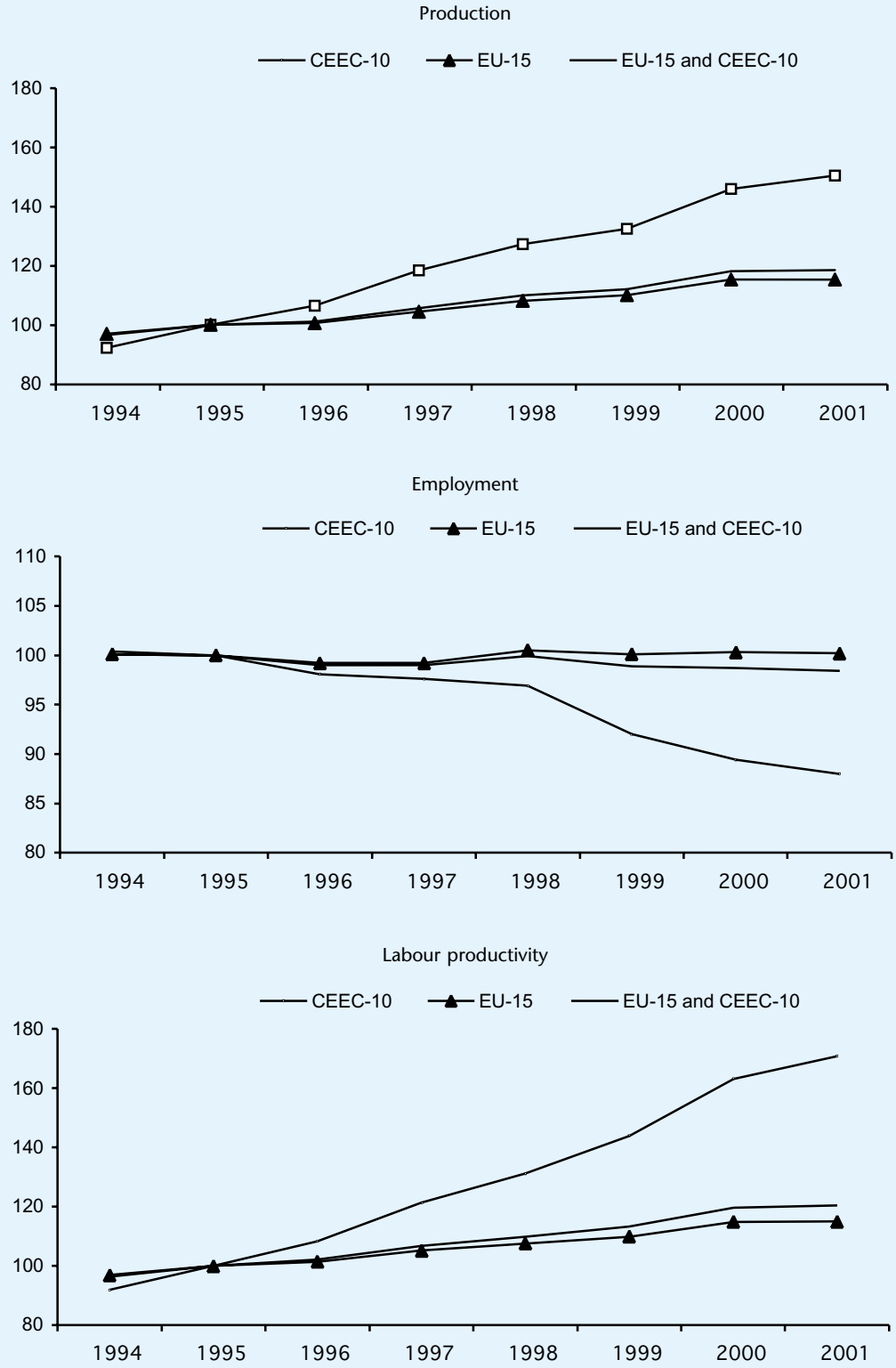
In Cyprus and Malta, where tourism is of key importance for the economy, the services sector has traditionally been large and the changes during the 1990s were less dramatic.

4.3.3 The manufacturing sector in Central and Eastern Europe

The remainder of this chapter will focus on the competitiveness of the manufacturing industries in the ten Central and East European acceding and candidate countries. The present sub-section outlines the main trends in the manufacturing sector of the ten acceding countries, trends which are not dissimilar from those in the total economy described above.[77] Manufacturing production increased strongly during the 1990s, while manufacturing employment declined significantly (Graph 4.4). Against the major reductions in employment, labour productivity in manufacturing increased at a dramatic speed, significantly exceeding productivity growth in the total economy.

[77] Appendix 4.A.5 outlines the trends in manufacturing specialisation and concentration in the enlarging area, defined as EU-15 and the ten Central and East European acceding and candidate countries.

Graph 4.4 Developments in the manufacturing sector in Central and Eastern Europe and EU-15 in 1994-2001 (1995=100)



Notes: In this graph, CEEC-10 refers to the eight Central and East European countries acceding in May 2004 together with Bulgaria and Romania. Labour productivity refers to output per employed person.

Sources: WIIW database and AMECO.

After a decade of downsizing and re-structuring, most Central and East European acceding and candidate countries now have an industrial structure somewhere between that of "EU-South" (here defined as Greece, Portugal and Spain) and "EU-North" countries (here covering Belgium, Germany, France, Italy and the United Kingdom). In particular, production structures in Czech, Hungarian, Slovenian, and Slovak manufacturing are very close to the EU-15 average and those in Poland slightly different, while the Baltic states, Bulgaria and Romania differ significantly from the average production structures of the present EU-15.

In general, the most important manufacturing sectors in the Central and East European countries are food, beverages and tobacco, transport equipment, as well as basic metals and fabricated metal products (Table 4.4). In the Baltic countries, textiles and wood products have a large weight. In comparison to the present EU-15, the acceding countries have lower production shares in paper and printing, chemicals, machinery and equipment and – with the notable exception of Hungary – in electrical and optical equipment.

The acceding countries will have a relatively small weight in total *manufacturing production* in the enlarged EU. Measured at current exchange rates in 2000, the eight Central and East European countries acceding in May 2004 accounted for 4.4 % of total manufacturing production in an enlarged EU (comprising themselves and the present EU-15). However, if expressed in terms of purchasing power parities, which correct for the undervaluation of the currencies in some of the acceding countries, their share would double to 9.0 %. If Bulgaria and Romania were added to the group acceding in May 2004, the total weight of the ten Central and East European acceding and candidate countries in the larger EU, measured at purchasing power parities, would rise to 10.7 % (Table 4.4).

The relative size of the acceding countries in terms of *manufacturing employment* is significantly higher than their share in total manufacturing production, reflecting the lower level of labour productivity relative to the present EU-15. In 2000, the eight Central and East European countries acceding in May 2004 accounted for 15.0 % of manufacturing employment in an enlarged EU. Adding Bulgaria and Romania increases the weight of the Central and East European group to 20.9 % (Table 4.4). The acceding countries have particularly high employment shares in textiles, leather, wood, coke and refined petroleum (coke and refined petroleum is an important employer in particular in Romania).

Changes in the structure of manufacturing in the eight Central and East European acceding countries after the mid-1990s have been similar to those in the present EU-15 (Graph 4.5). The fastest growing industries in both country groups were transport equipment, and electrical and optical equipment. The main loser – again in both country groups – was the food, beverages and tobacco industry.

4.4 Manufacturing cost competitiveness of the acceding countries

4.4.1 Labour productivity

Labour productivity measures the average amount of output per employee. Productivity is determined by factors such as the capital-intensity of production, labour skills or the efficiency of management, and is an important indicator of competitiveness. This section analyses first the relative levels of labour productivity in the manufacturing sector of the Central and East European acceding and candidate countries, then reviews average labour costs in the same industries and countries. Finally, a comparison of unit labour costs, the joint outcome of productivity and labour costs, is presented at the end of the section.

In the eight Central and East European countries acceding in May 2004 (CEEC-8), average labour productivity in manufacturing rose by an impressive 8.7 % per year in the period 1995-2002. Average annual growth rates over this period varied from 3 % in Slovenia to 13 % in Hungary. These compare to average annual productivity growth of 2.2 % in EU-15 over the same period. The rapid productivity growth in the eight Central and East European acceding countries was partly the result of labour shedding: employment declined by an annual average of 2.1 % in 1995-2002.

Despite the catch-up, *levels* of labour productivity in Central and Eastern Europe are significantly lower than in the present EU-15. Average labour productivity in manufacturing in the ten Central and East European acceding and candidate countries varies between 25 % (Latvia) and 71 % (Hungary) of the EU-15 level (productivity is defined as output per person using PPPs for total GDP, see Table 4.5). There is a clear gap between a more advanced group – Hungary, the Czech Republic, Slovenia, the Slovak Republic and Poland – which are in the range of 48-71 % of the EU level, and a less advanced group – Latvia, Lithuania, Estonia,

Table 4.4 Structure and size of the manufacturing sector in Central and Eastern Europe in comparison to EU-15, 2000

		Industry share in manufacturing total[1], %		Production share[2] of CEEC-10 in an enlarged EU[3], %		Employment share of CEEC-10 in an enlarged EU[3], %
		CEEC-10	EU-15	Using exchange rates	Using PPPs	
D	Total manufacturing	100.0	100.0	5.0	10.7	20.9
DA	Food products; beverages and tobacco	19.1	13.7	6.8	14.3	24.2
DB	Textiles and textile products	4.9	3.9	6.3	13.5	36.9
DC	Leather and leather products	0.9	0.9	5.0	10.9	32.6
DD	Wood and wood products	3.2	1.9	7.9	16.0	28.4
DE	Pulp, paper & paper products; publishing & printing	5.5	7.6	3.6	7.7	11.8
DF	Coke, refined petroleum products & nuclear fuel	7.1	6.0	5.8	13.2	36.6
DG	Chemicals, chemical products and man-made fibres	7.2	10.1	3.6	8.0	16.7
DH	Rubber and plastic products	3.9	3.8	5.1	10.6	16.0
DI	Other non-metallic mineral products	4.8	3.4	6.8	14.3	24.8
DJ	Basic metals and fabricated metal products	12.5	11.1	5.5	12.2	17.5
DK	Machinery and equipment n.e.c.	5.7	8.9	3.2	7.1	19.1
DL	Electrical and optical equipment	10.2	12.0	4.2	9.1	16.2
DM	Transport equipment	11.3	13.6	4.2	9.0	16.0
DN	Manufacturing n.e.c.	3.7	2.9	6.2	12.9	23.3

[1] Shares in total manufacturing production (in nominal terms, converted using exchange rates).

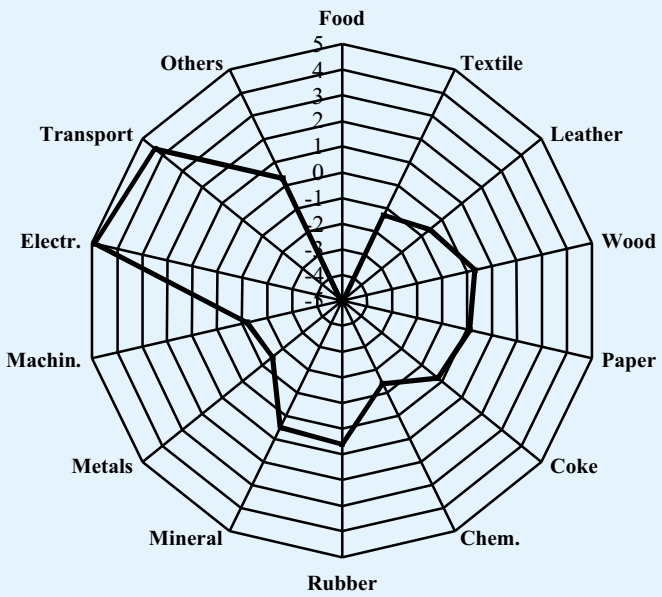
[2] Production values in the year 2000 converted using current exchange rates and using purchasing power parities (PPP) for 1999.

[3] In this table, "enlarged EU" refers to the sum of the present EU-15 and CEEC-10. CEEC-10 refers to the eight Central and East European countries acceding in May 2004, Bulgaria and Romania.

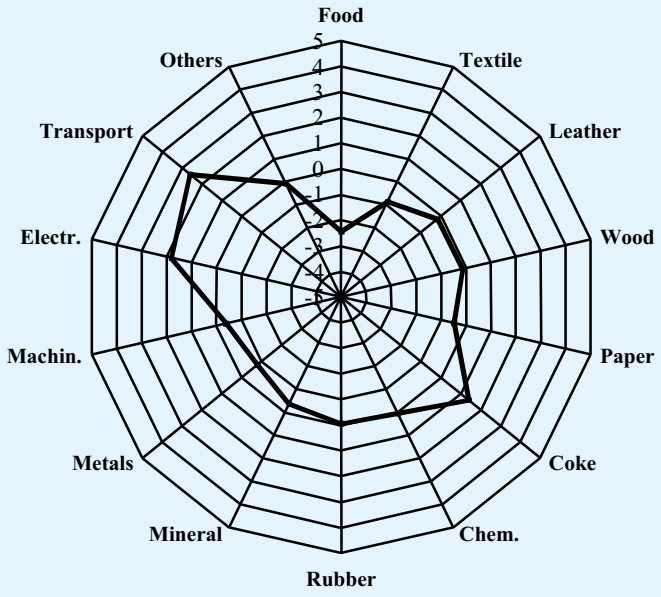
Sources: Shares in total manufacturing: WIIW database incorporating national statistics, WIFO and WIIW calculations using SBS; shares in enlarged EU: WIIW and WIFO estimates based on national statistics and AMECO.

Graph 4.5 Structural changes in manufacturing production in CEEC-8 and EU-15, 1995-20001

CEEC-8



EU-15



[1] Change in the share of each industry in total manufacturing production between 1995 and 2000, percentage points.

Sources: CEEC-8: WIIW calculations using national statistics; EU-15: WIFO calculations using SBS.

Bulgaria and Romania – where labour productivity is between 25-30 % of that in EU-15.[78]

Productivity differences across manufacturing industries (Table 4.5) tend to follow a similar pattern in all the countries. Labour-intensive industries, most significantly textiles and leather, show productivity levels significantly below other industries. In general, highest productivity levels are found for coke, refined petroleum and nuclear fuel, for chemicals and for transport equipment.

Data on productivity growth by industry point to a faster catch-up towards productivity levels of EU-15 in medium- and high-technology sectors, while catch-up is slower in the more labour-intensive sectors such as textiles and leather, where the gap against EU productivity levels is larger. In most of the ten Central and East European acceding or candidate countries, the fastest productivity growth rates during 1995-2001 were registered in the production of electrical and optical equipment, and transport equipment.[79] In general, the lowest productivity growth rates were recorded in the food and beverages industry, textiles and leather as well as in the production of coke, refined petroleum and nuclear fuel.

4.4.2 Labour costs

Price competitiveness improves if wage increases are below those of competitors, or if the average output per employee (productivity) increases. Similarly, cost competitiveness remains unchanged if wage increases are compensated by corresponding improvements in productivity. The evolution of unit labour costs measures the joint effect of these two (Box 4.1). In the following, wage developments in the Central and East European acceding and candidate countries will be reviewed, followed by an overview of unit labour costs by industry.

[78] International comparisons of productivity levels are hampered by the conversion of output data from national currencies into a common currency. The use of market exchange rates is not appropriate for this purpose (in particular not for the accession countries, the currencies of which may still be grossly undervalued and which experience wide currency fluctuations). Alternative converters are purchasing power parities (PPPs), or – preferably – branch-specific unit value ratios (UVR) which compare prices of representative products. UVR estimates for the year 1996 are available for the Czech Republic, Hungary and Poland relative to Germany from a recent research project jointly conducted by the WIIW and the University of Groningen [see Monnikhof and van Ark (2002)]. This study estimated labour productivity in the Hungarian manufacturing industry in 1996 to be just below 40 %, that in the Czech Republic 35 % and in Poland 25 % of the German level.

[79] Details by country and by industry are given in Appendix 4.A.1.

Box 4.1 Decomposition of Unit Labour Costs (ULCs)

Unit labour costs (ULC) are defined as labour costs per unit of gross manufacturing output (OUT). Labour costs are average gross wages plus indirect wage costs per person (W) multiplied by the number of persons employed (EMP).

ULC = (W * EMP) / OUT

Labour productivity (LP) is defined as output per employed person:

LP = OUT / EMP

Changes in labour productivity (dLP) can be approximated as:

dLP = dOUT – dEMP

Thus, unit labour costs may be rewritten:

ULC = W / (OUT / EMP) = W / LP

Accordingly, any change in unit labour costs (dULC) can be decomposed in the following way:

dULC = dW – dLP = dW – dOUT + dEMP

ULC will rise (and cost competitiveness decline) when the increase in labour costs is higher than the increase in productivity, and vice versa. Productivity changes are determined by the relative growth rates of output and employment: labour productivity will increase (decrease) if output growth is faster (slower) than employment growth. At given labour costs, increased productivity will reduce unit labour costs and increase cost competitiveness.

For cross-country comparisons, labour costs in national currency are converted into a common currency (in the analysis of this chapter, into the euro, using current exchange rates). Thus, also variations of the exchange rate will have an impact on manufacturing ULC. Currency appreciation (depreciation) will push up (reduce) ULC expressed in euros.

Table 4.5 Labour productivity levels in manufacturing in 2001 and average growth in 1995-2001 (%)

		Czech Republic	Estonia (year 2000)	Hungary	Latvia	Lithuania (year 2000)	Poland	Slovak Republic	Slovenia	Bulgaria	Romania
	% of EU-15 level in 2000, using 1999 PPPs for gross fixed capital formation										
D	Manufacturing total	40.6	17.4	47.9	14.9	16.5	36.2	36.5	40.4	18.6	19.3
	% of EU-15 level in 2000, using 1999 PPPs for total GDP										
D	Manufacturing total	58.6	29.8	71.3	24.5	28.9	48.5	62.1	47.5	29.2	27.1
	Comparison to the national average for total manufacturing										
D	Manufacturing total	100	100	100	100	100	100	100	100	100	100
DA	Food products; beverages and tobacco	132	129	88	126	[1] 114 [1]	118	106	160	133	215
DB	Textiles and textile products	48	65	26	54	69	37	25	49	33	35
DC	Leather and leather products	30	68	20	39	97	44	31	45	34	29
DD	Wood and wood products	106	113	41	101	70	78	53	54	83	79
DE	Pulp, paper & paper products; publishing & printing	116	142	96	105	98	128	135	103	95	143
DF	Coke, refined petroleum products & nuclear fuel	1103	.	245	.	692	614	599	31	841	751
DG	Chemicals, chemical products and man-made fibres	166	164	130	96	274	158	129	211	183	180
DH	Rubber and plastic products	104	107	85	160	147	106	111	90	77	118
DI	Other non-metallic mineral products	90	129	68	129	68	87	72	88	120	78
DJ	Basic metals and fabricated metal products	88	89	77	79	[2] 68	99	106	79	132	165
DK	Machinery and equipment n.e.c.	76	79	58	74	45	67	64	114	64	68
DL	Electrical and optical equipment	80	80	163	113	[3] 109	114	69	80	79	70
DM	Transport equipment	159	113	280	71	85	135	296	237	59	71
DN	Manufacturing n.e.c.	72	67	[4] 37	78	61	69	77	86	47	53
	Other				210	[5]					
	Average growth of labour productivity in 1995-2001, % p.a.										
D	Manufacturing total	7.2	10.6	12.7	7.5	6.4	9.6	8.2	3.6	2.2	5.4

Notes: 1) Without ISIC 16: Tobacco products. 2) Without ISIC 27: Basic metals. 3) Without ISIC 30: Office, accounting and computing machinery and ISIC 33: Medical, precision and optical instruments, watches and clocks. 4) DF+DN. 5) ISIC groups 16, 23, 27, 30 and 33.

Methodological note: Productivity is defined as gross production per employee.

For a cross-country comparison, data in national currencies were converted with purchasing power parities (PPPs). PPPs were adopted from the European Comparison Programme 1999 – see Eurostat (2001). The first set of estimates above is based on a conversion of national productivity figures using 1999 PPPs for gross fixed capital formation. Given their close correspondence to the theoretically superior unit value ratio (UVR)-based productivity data (see footnote 78) for the Czech Republic, Hungary and Poland (UVRs are not available for other ACs), and assuming that a similar correspondence between UVR and PPPs for gross fixed capital formation exists for other acceding countries as well, productivity levels expressed at PPPs for gross fixed capital formation should be closer to reality – at least for the manufacturing industry as a whole. However, for reasons of consistency with the presentation of average labour costs in Table 4.5, the above presentation by industry is based on 1999 PPPs for total GDP. These give higher estimates of relative productivity levels in the acceding countries (prices of fixed capital in the Central and East European countries are relatively high, presumably due to imports of machinery and equipment).

Sources: WIIW estimates based on national statistics, OECD, EUROSTAT and UNIDO.

Average *monthly labour costs* in manufacturing in the ten Central and East European acceding and candidate countries are significantly below those in EU-15. If average monthly labour costs in manufacturing are converted into euros using current exchange rates, the acceding and candidate countries fall between 5 (Bulgaria) and 34 (Slovenia) % of the EU level (Table 4.6). Given the lower overall price levels, the purchasing power of wages in these acceding and candidate countries is higher: when converted using purchasing power parities for total GDP, labour costs in the acceding and candidate countries are between 16-53 % of the EU level.

The higher-productivity acceding or candidate countries also pay higher wages than the lower-productivity group. In Slovenia, Hungary, the Czech Republic, Poland and the Slovak Republic, average labour costs per employee are in the range of 14-34 % of those in EU-15 (using current exchange rates). In the lower-productivity group – the Baltic States, Bulgaria and Romania – average labour costs per employee vary between 5-9 % those in EU-15.

Comparisons at the level of individual manufacturing industries similarly show a link between productivity and wages: wages tend to be higher in the higher-productivity industries. Nonetheless, productivity differences across industries are much wider than wage differences. Furthermore, the differences in wage growth across manufacturing industries have been small in comparison to differences in productivity growth, implying that the differences in cost competitiveness across industries continue to increase.

Since 1995, real wage growth – expressed in national currencies – in the Central and East European acceding and candidate countries has varied between an annual –2 % (Bulgaria) and +6 % (Poland; see Table 4.6). However, given the appreciation of the currencies of these countries, labour costs expressed in euros – converted using current exchange rates – have risen clearly faster (between 8 and 21 % per year in nominal terms, except in Slovenia where growth averaged 3 %).

Average manufacturing productivity in the Central and East European acceding and candidate countries is lower than in EU-15. However, their lower wages more than compensate for the competitive disadvantage on the productivity side. Average *labour costs per unit of output* in total manufacturing range from 17 % (Bulgaria) to 72 % (Slovenia) of those in EU-15 (Table 4.7). More detailed comparisons with Austria (data to allow comparisons with EU-15 were not available) show that in some industries – leather and wood – the price competitiveness of Slovenia is actually inferior to that of Austria. Of the ten Central and East European acceding and candidate countries, Slovenia has the second highest labour productivity after Hungary, while labour costs – though far below those in EU-15 – are higher than in the other countries, which reduces the relative cost competitiveness of Slovenia.

In all the other Central and East European acceding and candidate countries, unit labour costs are less than half of those in EU-15. The cost competitiveness of Hungary, the Slovak Republic, the Czech Republic and Poland is based mainly on their relatively high labour productivity, while the competitive advantage of Bulgaria, Romania and the Baltic States lies essentially in the low level of labour costs.

Over the period 1995-2001, unit labour costs in manufacturing increased in all countries except Hungary, where they declined at an average rate of just above 1 per cent (Table 4.7). Differences in the growth of unit labour costs across individual industries are determined mainly by differences in labour productivity growth (differences in wage growth across industries are typically much smaller, while exchange rate movements have the same impact on all domestic industries). Industry data confirm that industries with higher productivity growth have improved their price competitiveness faster than others.[80] In general, competitiveness gains in terms of unit labour costs have been strongest in the technologically more sophisticated industries such as electrical and optical equipment, and transport equipment, but also in the residual group "manufacturing n.e.c." in which the manufacture of furniture accounts for a large part. Industries with a weaker performance in terms of cost competitiveness include in most acceding countries the food and beverages industry, textiles, leather, wood, paper and printing, coke and petroleum products and chemicals.

Data presented in this section have shown that productivity catch-up towards the levels in the present EU-15 is underway. However, a full catch-up will be a long process which will take place over a number of years. If wage levels converge before productivity levels, price competitiveness will suffer a serious setback. Moreover, exchange rate movements may have significant effects on price competitiveness - the currencies of many acceding countries are currently undervalued, and their appreciation would have adverse effects on price competi-

[80] Appendix 4.A.2 gives the details on the evolution of unit labour costs in 1995-2001 in individual industries relative to the national manufacturing average.

Table 4.6 Average monthly labour costs per employee in manufacturing in 2001 and average growth in 1995-2001 (%)

		Czech Republic	Estonia[1] (year 2000)		Hungary	Latvia [1] (year 2000)		Lithuania[1]		Poland	Slovak Republic	Slovenia	Bulgaria		Romania
		% of EU-15 level in 2000, using current exchange rates													
D	Manufacturing total	17.7	9.3		20.5	8.0		7.2		22.2	13.6	34.0	5.1		6.8
p.m.	*Manufacturing total (euro)*	*581*	*305*		*673*	*263*		*235*		*729*	*446*	*1117*	*167*		*222*
		% of EU-15 level in 2000, using 1999 PPPs for total GDP													
D	Manufacturing total	40.1	19.9		42.8	16.5		16.1		39.5	37	52.7	18.9		19.3
		Comparison to the national average for total manufacturing													
D	Manufacturing total	100	100		100	100		100		100	100	100	100		100
DA	Food products; beverages and tobacco	96	100		98	104	[4]	97	[4]	94	92	110	100		88
DB	Textiles and textile products	70	81		60	91		88		63	66	75	70		66
DC	Leather and leather products	64	80		59	68		81		65	69	78	65		65
DD	Wood and wood products	78	100		63	87		66		72	75	84	71		63
DE	Pulp, paper & paper products; publishing & printing	115	165		109	143		136		128	118	118	107		130
DF	Coke, refined petroleum products & nuclear fuel	155	103	[5]	231	.		.		202	166	109	247		233
DG	Chemicals, chemical products and man-made fibres	124	.		160	123		172		150	118	160	144		164
DH	Rubber and plastic products	102	99		103	80		97		97	115	101	88		106
DI	Other non-metallic mineral products	106	135		105	101		103		104	108	100	120		103
DJ	Basic metals and fabricated metal products	105	116		90	93	[6]	96		107	120	99	131		134
DK	Machinery and equipment n.e.c.	105	104		100	95		105		108	99	97	108		119
DL	Electrical and optical equipment	100	113		107	100	[7]	132		120	92	101	102		122
DM	Transport equipment	121	121		129	107		150		121	127	110	111		130
DN	Manufacturing n.e.c.	84	92		66	87		86		77	85	85	70		71
		Average growth in 1995-2001, % p.a.													
—	nominal growth, in national currency	10.2	14.5	[2]	16.5	8.2		13.1	[2]	18.5	11.2	9.5	72.1	[3]	58.3
—	real growth, in national currency (deflated by national CPI)	3.5	4.4	[3]	2.1	1.9		5.0	[2]	6.3	2.9	1.1	-2.0	[3]	-0.4
—	nominal growth, in euro (current exchange rates)	10.3	13.3	[2]	7.9	11.8		20.9	[2]	15.4	9.0	3.3	8.1	[3]	8.0

Notes: 1) Monthly labour costs are approximated by monthly gross wages. 2) 1995-2000. 3) 1996-2001. 4) Without ISIC 16: Tobacco products. 5) DF+DG. 6) Without ISIC 27: Basic metals. 7) Without ISIC 30: Office, accounting and computing machinery and ISIC 33: Medical, precision and optical instruments, watches and clocks.

Methodological notes: Labour costs refer to average gross wages, including indirect labour costs, per manufacturing employee per month. PPPs are purchasing power parities for total GDP.

Sources: WIIW estimates based on national statistics and Eurostat.

Table 4.7 Unit labour costs in manufacturing in 2001 and average growth in 1995-2001 (%)

		Czech Republic	Estonia[1)] (year 2000)	Hungary	Latvia[1)]	Lithuania[1)] (year 2000)	Poland	Slovak	Slovenia	Bulgaria Republic	Romania
% of EU-15 level in 2000											
D	Manufacturing total	30	31	29	33	25	46	22	72	17	25
% of Austrian level in 2001											
D	Manufacturing total	28	40	26	42	32	42	20	66	16	23
DA	Food products; beverages and tobacco	24	37	34	42	34	39	20	53	14	12
DB	Textiles and textile products	31	38	48	54	32	56	41	78	27	34
DC	Leather and leather products	74	58	96	89	35	78	55	144	39	65
DD	Wood and wood products	23	39	46	40	36	44	32	113	15	20
DE	Pulp, paper & paper products; publishing & printing	27	45	30	56	40	41	17	74	18	20
DF	Coke, refined petroleum products & nuclear fuel	21	.	135	.	.	75	30	.	26	41
DG	Chemicals, chemical products and man-made fibres	26	.	40	69	25	49	23	62	16	24
DH	Rubber and plastic products	22	31	26	17	18	31	17	60	15	17
DI	Other non-metallic mineral products	25	32	30	25	38	38	22	56	12	24
DJ	Basic metals and fabricated metal products	29	44	26	41	36	39	19	70	14	16
DK	Machinery and equipment n.e.c.	33	44	39	45	63	58	27	48	23	33
DL	Electrical and optical equipment	32	52	16	34	34	40	24	76	19	35
DM	Transport equipment	30	60	17	88	82	53	12	43	43	59
DN	Manufacturing n.e.c.	25	.	37	37	37	37	18	52	19	26
Average growth in 1995-2001, % p.a.											
D	Manufacturing total	3.3	2.4	-7.8	6.0	13.8	3.0	1.5	3.6	4.7	0.0

Footnote: 1) Calculated using gross wages.

Methodological notes: Unit labour costs were calculated using 1999 purchasing power parities (PPPs) for total GDP from Eurostat (2001) to convert the value of output (productivity) into euros, while labour costs were converted into euros using current exchange rates. In other words, output comparisons across countries are based on the real value of production ("physical units"), while labour costs are compared in nominal terms. Labour is seen as immobile, while output is considered a tradable good (the last should be a reasonable assumption for the manufacturing sector).

Because of delays in the release of data for many EU countries and problems of consistency at the level of individual industries, Austria was used as the benchmark for the comparisons of individual industries.

Average growth of unit labour costs is defined as the growth of nominal labour costs (in euros, converted using current exchange rates) divided by the growth rate of labour productivity (output measured in national currency at constant 1999 prices).

Sources: WIIW estimates based on national statistics and Eurostat.

tiveness. These considerations emphasise the need for further rapid advances in terms of productivity in the acceding countries.

4.5 Manufacturing trade performance of the acceding countries

4.5.1 Market shares and trade balances

Following the liberalisation at the beginning of the 1990s, trade between EU-15 and the Central and East European countries has increased rapidly. The EU has become the most important trading partner for all Central and East European acceding and candidate countries: now between 50-55 % (Lithuania and Bulgaria) and 75 % (Hungary) of their total exports go to the EU – shares which are higher than those of several current EU-15 members. The share of EU-15 in the total imports of these acceding and candidate countries tends to be lower than its share in their exports, largely because they import energy and raw materials from other sources (mainly from the CIS).

This section discusses developments in trade in manufactured goods, which represents more than 90 % of the total trade of the Central and East European acceding and candidate countries with EU-15. After a short introduction on the changes in market shares and trade balances, exports of the Central and East European acceding and candidate countries to EU-15 are analysed by looking at the role of different types of industries: technology-intensive industries are contrasted with labour-intensive, and the performance of high-skill industries is compared to that of low-skill industries. Finally, some observations are made regarding the importance of intra-industry trade and evidence on quality differentials in the trade between these countries and EU-15.

Over the period 1995-2001, the share of the ten Central and East European acceding and candidate countries in total manufacturing imports into EU-15 (including intra- and extra-EU trade) increased by 1.8 percentage points to 5 %. Preliminary data from national statistics indicate a further improvement of trade balances and additional market share gains in the EU in 2002 [see Podkaminer et.al. (2003), UN ECE (2003)].

Not only the acceding and candidate countries, but also China recorded a significant increase – 1.5 percentage points – in its share of manufacturing imports into EU (Graph 4.6). China's largest gains were partly in the same industries where also the acceding and candidate countries increased their market share: textiles, electrical engineering and in the residual category manufacturing n.e.c. In addition, China recorded large gains in leather industry. The market share of US exporters in EU-15 manufacturing imports rose by 1.2 percentage points, with particularly large gains in transport equipment and chemicals.

The increasing share of several third countries in total EU-15 manufacturing imports coincided with a decline in the relative importance of imports from other EU-15 countries: the share of intra-EU imports in the total declined by 4.6 percentage points. Also Japanese exporters experienced a loss in their EU-15 market share, equal to 0.7 percentage points; their losses were particularly large in the electrical engineering industry.

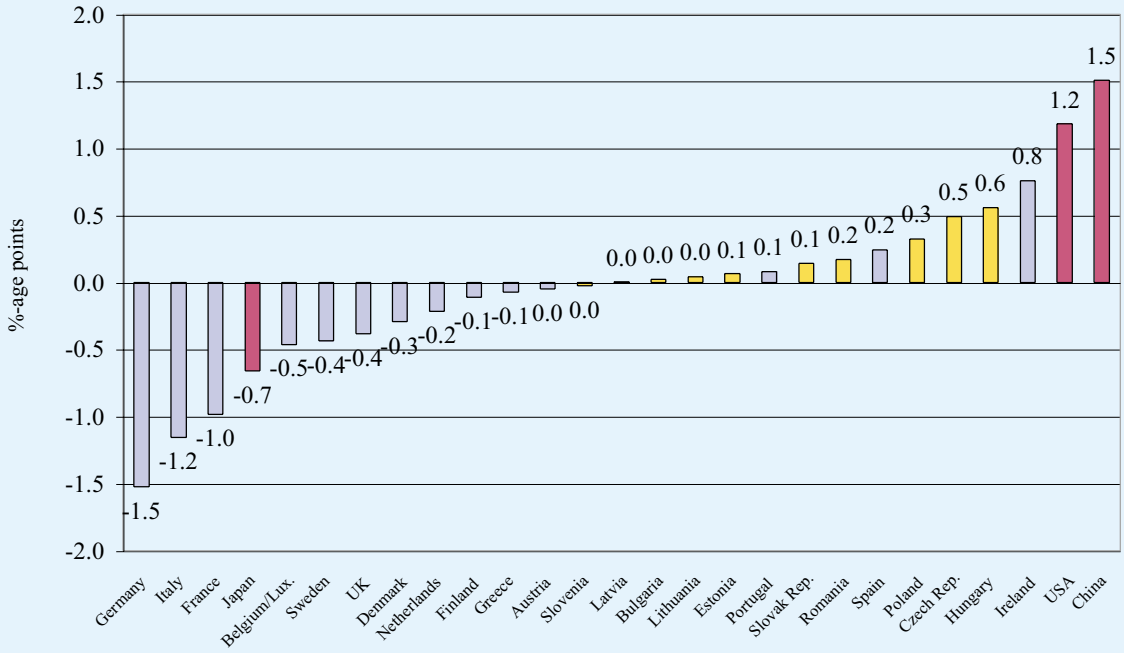
Among the individual acceding and candidate countries, Hungary, the Czech Republic and Poland recorded the largest gains. The main losers in terms of market shares were Italy, Germany, France and Sweden.

Looking at individual manufacturing industries, the market share gains of the acceding and candidate countries after 1995 were largest in wood and wood products, transport equipment, rubber and plastic, textiles, electrical engineering and manufacturing n.e.c (mainly furniture). In these industries, the market shares of the ten Central and East European acceding and candidate countries increased by 3-4 percentage points. These countries increased their market shares both in sophisticated engineering industries, such as electrical engineering, and in more labour-intensive, low-skill industries such as textiles or wood.

Correlation analysis between market share gains and losses on an enlarged EU market was carried out in order to get some indications on which countries the future EU members mainly compete with. The analysis looked at changes in market shares across all 3-digit NACE subsections of manufacturing in an "enlarged EU-25", that is, covering trade flows within the present EU-15 ("intra-EU trade") and between EU-15 and the ten Central and East European acceding and candidate countries.[81] Within an EU-25 so defined, the ten Central and East European acceding and candidate countries accounted for 6.1 % of all trade in manufactured goods in 2001 – an increase of 2.6 percentage points from 1995.

[81] Data for trade among the accession countries were not available and are thus not included.

Graph 4.6 Imports of manufactured goods into EU-15: changes in market shares between 1995 and 2001



Notes: The changes depicted in the graph indicate the difference between a country's market share in 1995 and its share in 2001 (positive values are gains, negative values represent declining market shares). The countries covered are EU-15 members, the ten Central and East European accession countries, China, Japan and the US. Since not all the trading partners of EU-15 are covered, the gains and losses do not sum up to zero.

Source: WIIW estimates based on Eurostat COMEXT Database.

The results suggest that the ten Central and East European acceding and candidate countries compete mainly with exporters from Spain, Portugal, Ireland, Austria, Germany and France. On the basis of the statistically significant correlation coefficients, the Czech Republic appears to compete on the European market mainly with Ireland and Spain; Hungary with Austria, Germany and France; Poland with Austria and France; Estonia with Sweden and Denmark. Bulgaria and Romania compete mostly with Portugal and Greece, but also with Italy.

Trade balances of the ten Central and East European acceding and candidate countries with the EU have traditionally been negative. Nevertheless, their overall manufacturing trade deficit has declined from the peak of EUR 18.4 billion in 1997, reaching EUR 10.9 billion in 2001. At present, Hungary (since 1997), the Czech Republic and Slovakia (both since 1999) record surpluses in their trade with EU-15.

In the period 1995-2001, the strongest exporting industries of the Central and East European acceding and candidate countries were wood, textiles and manufacturing n.e.c. (mainly furniture), in which most of them recorded growing surpluses with EU-15. In contrast, most of these countries registered large trade deficits with the EU in the chemicals, rubber and plastic, machinery as well as pulp, paper and printing industries.[82]

4.5.2 Trade in technology- and skill-intensive products

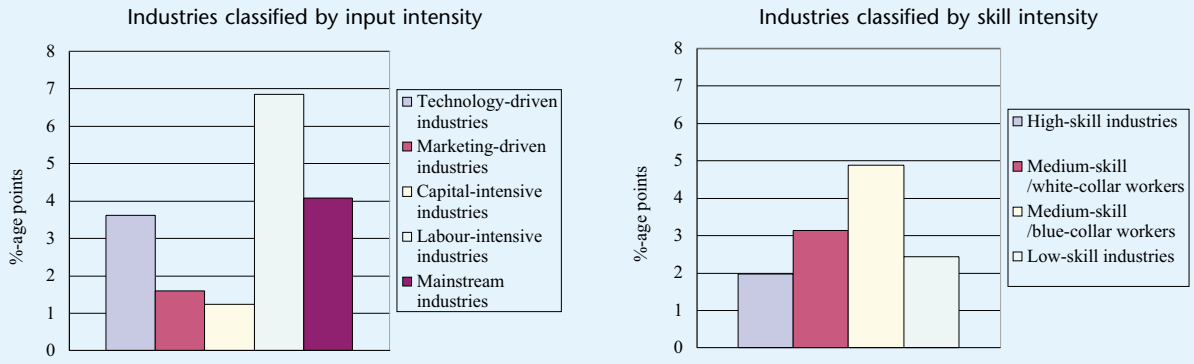
Earlier studies [e.g. Dobrinsky and Landesmann (1995); Landesmann (2000)] have shown that in 1989, before the transition, the structure of trade of the Central and East European countries with EU-12 had a profile that was typical of less developed economies. Their exports to the EU focused on labour-intensive and energy-intensive products (the latter reflecting the heritage of cheap energy supplies within the CMEA), while the role of capital-, R&D- and skill-intensive exports was limited.

This section reviews the subsequent evolution of manufacturing exports from the ten Central and East European acceding and candidate countries to the present EU-15 using two different groupings of industries:[83]

[82] Details on the evolution of trade balances with EU-15 by country and by industry are given in Appendix IV.A.3. Analysis based on conventional indicators of revealed comparative advantage [RCA; see Havlik (2003a)] gives similar results with regard to the competitive strengths and weaknesses of the ten Central and East European accession countries.

[83] The division of individual industries (NACE Rev. 1, 3-digit level) according to these two typologies is presented in Appendix 4.A.4. For details on the underlying methodology, see Peneder (2001).

Graph 4.7 Changes in the market share of Central and East European countries in the enlarged EU market between 1995 and 2001, by manufacturing industry type



Notes: "Enlarged EU" refers to the sum of the present EU-15 and ten Central and East European accession countries: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia (CEEC-8), together with Bulgaria and Romania.
Market shares within each industry category are calculated as per cent of the sum of trade flows within EU-15 ("intra-EU trade") and between EU-15 and the above mentioned ten acceding and candidate countries. Data for trade among the acceding and candidate countries were not available and are hence not included. Market shares within each industry category sum up to 100 %.
The changes depicted in the graph indicate the difference between the market share the ten acceding and candidate countries in 1995 and their share in 2001 (positive values are gains, negative values represent declining market shares). An increase in the market share of the ten acceding and candidate countries implies a decrease of an identical size in the market share of EU-15.
For the classification of industries into the two typologies used in the graph, see Appendix 4.A.4.

Source: WIIW estimates based on Eurostat COMEXT

— The first typology is based on cluster-analytic techniques. It groups industries into five categories by using criteria on *industrial organisation and input use*: mainstream, labour-intensive, capital-intensive, marketing-driven and technology-driven industries.

— The second typology groups industries into four categories according to their *skill intensity*: low-skill, medium-skill/blue-collar, medium-skill/white-collar, and high-skill industries.

The evolution of market shares, by industry type, of the ten Central and East European countries on the "enlarged EU" market is illustrated in Graph 4.7. The largest absolute market share gain was recorded for the labour-intensive industries. However, it is worth noting that in relative terms, the by far most impressive growth took place in technology-intensive industries, the – initially very low – market share of which increased nearly threefold between 1995-2001.

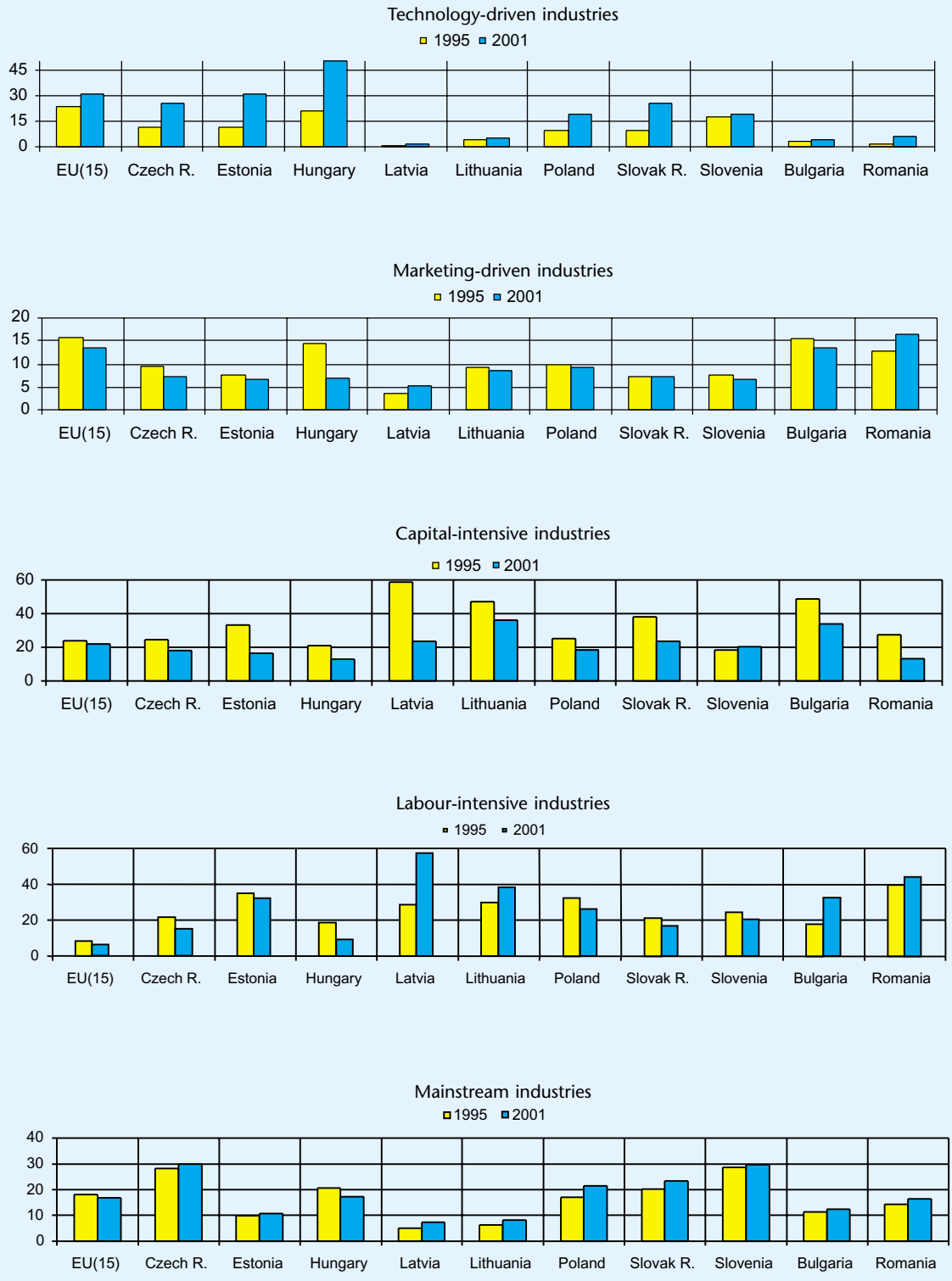
In terms of the skill intensity of manufacturing industries, the Central and East European countries recorded the largest absolute market share gains in the medium-skilled categories (Graph 4.7). However, it is important to realise that in relative terms, the fastest growth took place in the high-skill industries. The evidence thus points to a catch-up: the technology- and skill-intensive industries which started off with the largest initial gap are now recording the highest relative growth rates.

An analysis of the export structures, by industry type, of the ten individual Central and East European acceding and candidate countries points to important differences within the region (see Graphs 4.8 and 4.9). However, the general conclusion of rapid growth in exports of technology- and skill-intensive industries remains valid for the majority of these countries.

In general, *labour-intensive* industries are still strongly represented in the exports of the Central and East European countries to the EU (Graph 4.8). For Poland, the Baltic States, Bulgaria and Romania, the reliance on labour-intensive exports is particularly strong. Moreover, the share of labour-intensive industries in total exports to the EU increased between 1995-2001 for Bulgaria, Romania, Latvia and Lithuania. In the other countries, the share of labour-intensive exports declined, for some – in particular Hungary – quite sharply.

The most dramatic changes in the export structure since 1995 have taken place in the group of *technology-driven* industries where also the heterogeneity among the group of ten Central and East European acceding and candidate countries has increased most rapidly. In Hungary and Estonia, but also in the Czech Republic, the Slovak Republic and Poland, the importance of technology-driven industries has increased strongly (in fact, in many of these countries this trend had started already before 1995). Hungary's exports to EU-15 are already more focused on technology-driven industries than is the case for the exports of the present 15 EU members

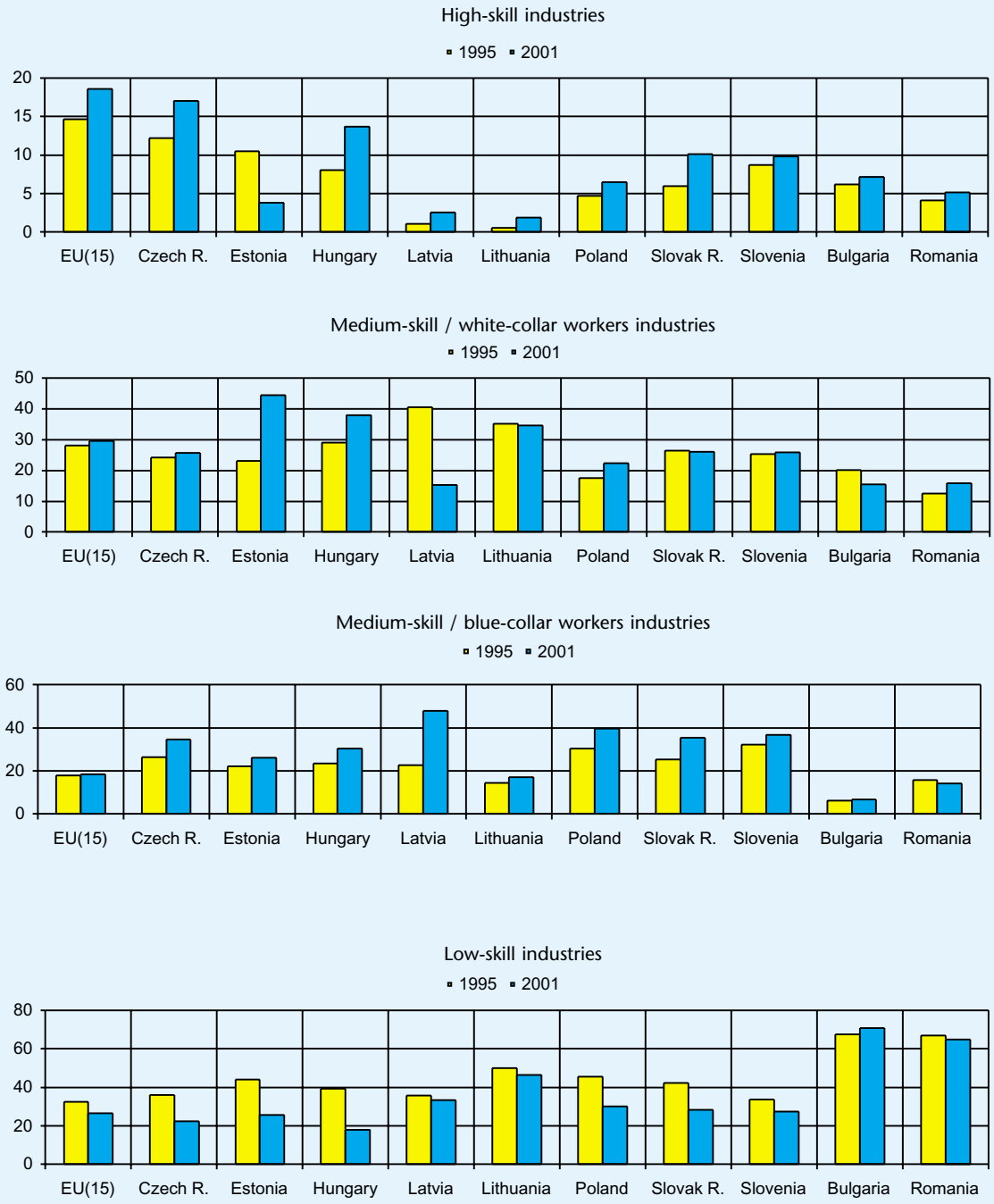
Graph 4.8 Structure of manufacturing exports of ten Central and East European countries to EU-15 by industry type (input intensity) in 1995 and 2001, % of a country's total manufacturing exports to EU-15



Notes: For the classification of industries into the input taxonomy, see Appendix 4.A.4.

Source: WIIW calculations based on Eurostat COMEXT.

Graph 4.9 Structure of manufacturing exports of ten Central and East European countries to EU-15 by industry type (skill intensity) in 1995 and 2001,% of a country's total manufacturing exports to EU-15



Notes: For the classification of industries into the skill taxonomy, see Appendix 4.A.4.

Source: WIIW calculations based on Eurostat COMEXT.

on average. In contrast, in Bulgaria, Romania, Latvia and Lithuania, the role of technology-driven industries in exports to the EU remains marginal.

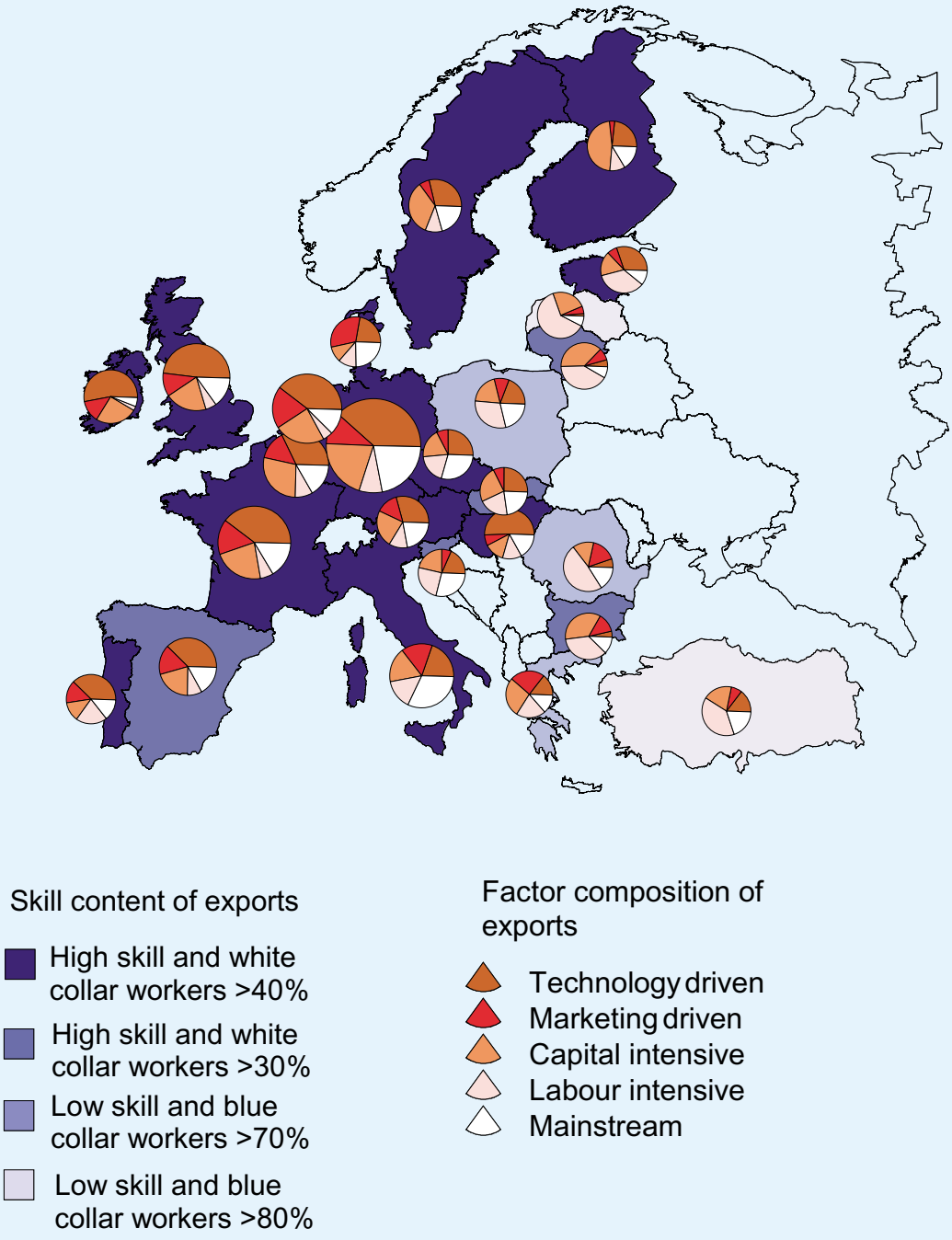
The share of *low-skill* industries in exports to EU-15 declined particularly strongly between 1995-2001 in Hungary, the Czech Republic, Estonia, Poland and the Slovak Republic (Graph 4.9). In Hungary and the Czech Republic, low-skill industries have a smaller share in total manufacturing exports to EU-15 than is the case for intra-EU-15 manufacturing exports. In contrast, Bulgaria and Romania continue to rely on

low-skill industries, which account for some two thirds of total manufacturing exports to EU-15.

The share of *high-skill* industries in total manufacturing exports to EU-15 has increased in all the Central and East European acceding and candidate countries except Estonia. Nevertheless, high-skill industries are still "underrepresented" in the exports of each of these ten countries in the sense that their share is lower than that in intra-EU-15 trade. In particular in the three Baltic States, the share of high-skill industries is marginal, four per cent or less of total manufacturing exports to EU-15.

Map 4.1 gives an overview of the present structure of manufacturing exports of each of the present 15 EU

Map 4.1 Specialisation in manufacturing exports to EU-15 by skill- and input-intensity in 2001



Note: For the two industry typologies used, see Appendix 4.A.4.

Source: WIIW calculations based on Eurostat COMEXT.

members as well as 11 acceding and candidate countries including Turkey but excluding Cyprus and Malta. The large differences across the acceding and candidate countries in the shares of technology-driven and labour-intensive exports suggest a "core-periphery" pattern, with the trade structures of the most advanced acceding countries having become rather similar to those of the present EU members.

In terms of skill intensity, the export structures of Hungary, Estonia and the Czech Republic are rather similar to those of the more advanced EU-15 members. High- and medium-skill industries are also relatively important for Slovenia and the Slovak Republic, the export structures of which are similar to Spain. In the remaining acceding and candidate countries, as well as Greece, the export structure is more biased towards the lower-skill industries.

Developments in skill intensity of manufacturing exports highlight the importance for acceding and candidate countries of implementing the range of reforms and initiatives in the areas of education and training that have been agreed in the context of accession negotiations.

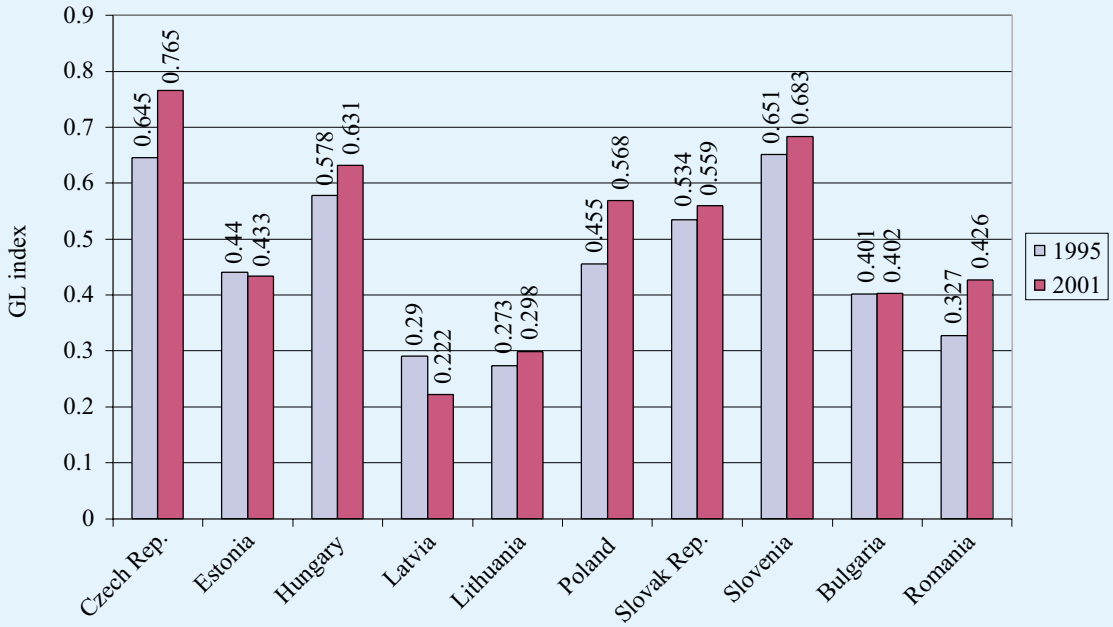
4.5.3 Intra-industry trade and quality competition

Traditional trade theories predict that economic integration will lead to a higher degree of specialisation according to comparative advantages, the latter resulting from cross-country differences in productivity or in endowments. Thus, high-income countries which are characterised by a large stock of physical capital, well educated workers, and a high potential to innovate, are predicted to specialise in capital-intensive, technology-, skill- and research-intensive industries. The traditional trade theories are helpful in the analysis of *inter-industry trade*, i.e. trade where countries exports the products of industries in which they specialise, and import products of other industries.

However, the bulk of trade between developed countries takes the form of *intra-industry trade*, where a country is simultaneously both an exporter and an importer of goods that fall into the same product category. One of the contributions of the new trade theories is to show that increasing returns to scale give an incentive for countries to specialise and trade even in the absence of differences in endowments and technologies between countries. Countries specialise in different variants of a product, and the gains from trade result from an increased choice of differentiated products.

The new trade theories suggest that between countries which are similar in their factor intensities and technologies, there will be little inter-industry trade and intra-industry trade will dominate. Between countries which are very different in their factor intensities and technologies, specialisation occurs

Graph 4.10 Intra-industry trade between ten Central and Eastern European countries and EU-15 (Grubel-Lloyd index)



Note: The Grubel-Lloyd (GL) index = 1 – Σ [ABS(x^{ij}-m^{ij}) / Σ (x^{ij}+m^{ij})] where x^{ij} and m^{ij} are exports and imports respectively of country i in sector j in trade with EU-15; calculated from data at NACE rev.1 at 3-digit level.

Source: Eurostat COMEXT database and WIIW calculations .

according to comparative advantages and inter-industry trade will dominate.

There is ample evidence for growing intra-industry trade between the Central and East European acceding and candidate countries and EU-15. Intra-industry trade is of particular importance in textiles as well as in electrical, optical and transport equipment.[84] Of the individual countries, intra-industry trade is most pronounced for the Czech Republic, Slovenia and Hungary, and least important for Lithuania and Latvia (Graph 4.10). Between 1995 and 2001, intra-industry trade with EU-15 grew most rapidly for the Czech Republic, Poland and Romania, whereas it declined slightly for Latvia and Estonia.

Intra-industry trade may reflect a different specialisation of countries in a particular production stage or product quality segment within an industry (a phenomenon referred to as "vertical intra-industry trade").[85] Vertical intra-industry trade also takes place even within large multinational enterprises, which fragment their production process geographically in order to take advantage of cross-country price differences in production factors. Previous studies have suggested that vertical intra-industry trade be particularly relevant in the trade relations between East and West European countries [Burgstaller and Landesmann (1999), Aturupane, Djankov and Hoekman (1999)].

Differences in export prices may reflect differences in product quality and give evidence of specialisation in different quality segments of a market. The position of a country at the low-, medium- or high-quality end of the product range can serve as an indicator of its competitive strengths and weaknesses.[86]

Evidence for the ten Central and East European acceding and candidate countries shows that the unit values of their manufacturing exports are significantly below the average import prices, within narrowly defined product categories, in the EU-15 market (Graph 4.11). This gives some evidence of a "quality gap" – quality being defined in the broad sense, comprising consumer loyalty to particular producers, differences in marketing and product design, and after sales services. The average price gap across the different manufacturing products varies from 16 % of the average price in Bulgaria to 4 % in Slovenia and 1 % in Lithuania. Hungary is a major exception: it is the only acceding country which currently sells its export products at prices which are above the average import prices into the EU.

Notwithstanding the – in most cases still large – existing price gaps, there has been remarkable progress in the Central and East European countries in closing the gaps during the past years. In addition to Hungary, where the price gap disappeared, Lithuania, Estonia and Romania eliminated two thirds or more of their 1995 gap in the successive six years.

For all the current EU-15 members, the export price "gaps" are positive (lower panel in Graph 4.11), reflecting specialisation in the higher-quality segment in trade in manufactured goods. Ireland, Denmark and Austria sell at the highest prices (30-40 % above the average), while for Portugal, Greece and Spain, the deviations from the average price level are of the order of 3-4 %.

Looking at industries by their input intensity, export prices of the Central and East European acceding and candidate countries increased fastest in technology-driven industries, followed by mainstream industries and skill-intensive industries [Landesmann and Stehrer (2002)]. By 2001, technology-driven industries of these countries were already exporting to the EU at prices above the average EU import price. Within the group of technology-driven industries, the most successful Central and East European acceding countries were Hungary, the Slovak Republic and Estonia.[87] Despite the increases in export prices, the price gap of the Central and East European acceding and candidate countries is currently largest in the group of mainstream industries.

4.6 Conclusions

The analysis of the competitive position of the Central and East European acceding and candidate countries has concentrated on competitiveness indicators for productivity, labour costs and market shares; other important components of competitiveness, such as labour skills, were not covered. The analysis suggests that a general catch-up of the future EU Member States towards the standards of living in

[84] Outward processing trade (OPT) is important in these industries. OPT is a form of international co-operation on a contractual basis between independent firms from different countries. The contractor exports mainly semi-processed goods to the subcontractor, who refines, assembles and finishes the product, which is then re-imported to the contractor's country. For a detailed study on OPT trade in relation to the accession countries see Pellegrin (2001).

[85] Vertical differentiation refers to different varieties of a product that are of different quality (e.g. leather shoes, plastic shoes). In contrast, horizontal differentiation refers to different varieties of a product that are of similar quality (e.g. different colour and design of shoes of similar quality).

[86] However, one should be aware that, instead of improved quality, increased relative export prices may reveal that producers have become uncompetitive in certain branches. A closer analysis of trade competitiveness requires a joint examination of price and market share movements.

[87] The high unit value ratios for Hungarian and Estonian exports mimic the experience of Ireland. They partly reflect the practice of transfer pricing by international companies.

the present EU is taking place. However, large differences in the performance of individual countries point to a risk of an emerging core-periphery pattern among the acceding and candidate countries.

Encouraging features of the catch-up are the relatively rapid progress of many acceding countries in technologically sophisticated industries, and the relatively fast upward movement in intra-branch

Graph 4.11 Export price gaps – all manufacturing products traded with EU-15(% of average EU-15 import price)

Note: Export price gaps have been calculated from product-by-product comparisons at 8-digit CN level and are expressed in percentage deviations from the average price of the products traded in EU markets (i.e. all imports into EU-15, including intra-EU trade).

Source: WIIW calculations based on Eurostat COMEXT.

product quality. A group of more advanced acceding countries has moved rapidly ahead in adjusting their industrial structures to those of the more advanced EU-15 members. In particular Hungary, Estonia, the Czech Republic and the Slovak Republic have rapidly reduced their specialisation in labour-intensive, low-skill production and made inroads into technology-driven and high-skill-intensive industries.

More worrying is the evidence of a "lock-in" of certain countries (in particular Bulgaria, Romania, Latvia and Lithuania) in labour-intensive or natural-resource-intensive, low-skill patterns of specialisation. As a result of the diverse patterns of specialisation, the Central and East European acceding and candidate countries have a relatively strong presence in three groups of manufacturing industries: in labour-intensive, low-skill branches; in natural resource-intensive branches and in more sophisticated, medium- to high-skill branches.

Challenges to the acceding countries include the successful implementation of the existing Community legislation. Policy measures required to satisfy the entry conditions to the monetary union, including exchange rate policies, are also likely to affect the competitive position of enterprises in the acceding countries. At the same time, the formal accession to the internal market will further encourage foreign direct investment in the new Member States, and support their further integration into pan-European production networks. Available evidence shows that regions bordering the present EU-15 have already benefited more strongly from increased foreign direct investment flows, and have seen faster improvements in their infrastructure.

Research on the expected impact of enlargement on the current EU-15 Member States points to two directions: in the long run, based on their stock of human capital, the acceding countries should have a comparative advantage in human capital intensive industries and thus compete mainly with the Northern EU-15 members. In the short run, analysis of trade flows suggests that the acceding countries have a comparative advantage in capital and labour intensive industries, and compete mostly with the Southern EU-15 countries (in that respect, Greece and Portugal may be most vulnerable to competition from the new Member States). In addition, EU-15 regions which are geographically close to the border with the new members will be more affected than distant regions (this applies in particular to Germany and Austria, which already display the highest degree of trade integration with the acceding countries).

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Appendix 4.A

Appendix 4.A.1 Productivity Growth in Manufacturing by Country and by Industry, 1995-2001

Relative productivity gains, winner and loser industries, 1995-2001
(average annual change in % for total manufacturing; for each industry, change in comparison to total manufacturing in percentage points[1])

		Czech Republic	Estonia[2]	Hungary	Latvia	Lithuania[2]	Poland	Slovak Republic	Slovenia	Bulgaria	Romania
D	Manufacturing total	7.2	10.6	12.7	7.5	6.4	9.6	8.2	3.6	2.2	5.4
DA	Food products; beverages and tobacco	-3.9	-7.2	-8.8	-4.8	-4.3	-3.6	-4.1	-0.6	-2.0	6.7
DB	Textiles and textile products	-4.9	2.8	-6.5	0.5	-2.3	-1.4	-8.6	0.2	-0.6	-5.1
DC	Leather and leather products	-16.1	3.7	-9.1	-2.1	9.8	-2.6	0.3	-6.0	-2.0	-2.8
DD	Wood and wood products	-1.8	15.4	-8.0	-2.0	0.1	-1.7	-2.9	-8.6	6.1	-4.2
DE	Pulp, paper & paper products; publishing & printing	-1.7	0.8	-0.8	-0.6	-5.2	-1.2	3.6	-7.0	-4.9	-8.2
DF	Coke, refined petroleum products & nuclear fuel	-2.6	.	-7.9	.	-12.2	-4.7	-4.0	.	-1.5	0.5
DG	Chemicals, chemical products and man-made fibres	0.4	4.8	-9.5	-4.2	11.2	-0.8	-2.2	2.3	1.3	-3.6
DH	Rubber and plastic products	1.4	-2.6	-7.4	10.2	0.0	-0.2	-2.9	-2.0	-2.2	-7.6
DI	Other non-metallic mineral products	-0.4	4.6	-5.0	11.2	1.3	1.0	-2.4	1.6	5.3	1.1
DJ	Basic metals and fabricated metal products	-6.8	4.1	-6.1	3.3	-3.2	-1.7	-6.7	-2.1	2.8	-0.8
DK	Machinery and equipment n.e.c.	5.4	3.7	-6.9	-5.3	-2.7	0.7	-0.2	-1.5	3.3	4.6
DL	Electrical and optical equipment	13.3	7.0	18.7	18.1	24.0	4.4	2.7	3.3	7.4	-0.8
DM	Transport equipment	2.8	5.6	6.7	-0.2	13.3	6.3	18.8	6.5	-3.2	6.0
DN	Manufacturing n.e.c.	1.2	1.2	-5.3	1.0	-4.2	-0.6	0.8	3.1	7.2	6.3

Notes: 1) Relative gains for each industry represent the difference, in percentage points, between the growth rate of labour productivity in that industry and the average growth rate of labour productivity in total manufacturing (D). For instance, the relative gain in industry DA= DA (1995-2001) - D (1995-2001).
2) 1995-2000.

Source: WIIW estimates based on national statistics, WIIW calculations.

Appendix 4.A.2 Growth of Labour Costs in Manufacturing by Country and by Industry, 1995-2001

Relative changes in unit labour costs, 1995 – 2001 (average annual change in % for total manufacturing; for each industry, change in comparison to total manufacturing in percentage points[1])

		Czech Republic	Estonia[2]	Hungary	Latvia	Lithuania[2]	Poland	Slovak Republic	Slovenia	Bulgaria	Romania
D	*Manufacturing total*	3.3	2.4	-7.8	6.0	13.8	3.0	1.5	3.6	4.7	0.0
DA	Food products; beverages and tobacco	4.0	2.9	7.1	0.7	2.6	3.5	3.9	0.3	0.8	-5.8
DB	Textiles and textile products	4.1	-3.3	5.8	0.8	-0.3	0.5	8.5	-2.8	1.9	2.5
DC	Leather and leather products	14.9	-4.6	9.8	2.0	-11.5	0.4	-1.1	5.7	2.1	-1.1
DD	Wood and wood products	1.0	-10.0	6.5	2.4	-5.3	2.3	-0.4	6.2	-4.5	1.3
DE	Pulp, paper & paper products; publishing & printing	2.9	3.8	-0.2	4.9	6.5	1.7	-1.0	9.3	6.5	6.7
DF	Coke, refined petroleum products & nuclear fuel	5.1	.	11.1	.	.	2.1	2.1	.	-1.8	6.4
DG	Chemicals, chemical products and man-made fibres	1.9	.	11.7	4.0	-9.7	2.9	1.6	1.9	-1.9	7.0
DH	Rubber and plastic products	-1.3	0.1	9.5	-13.2	9.2	-1.7	2.2	0.0	-0.4	6.7
DI	Other non-metallic mineral products	0.4	1.3	6.8	-5.4	-3.7	0.4	3.3	-0.4	-3.6	-1.8
DJ	Basic metals and fabricated metal products	4.6	-2.4	4.5	0.8	-0.6	-0.7	5.4	-0.4	-2.5	0.9
DK	Machinery and equipment n.e.c.	-4.4	-1.7	5.8	6.1	5.2	-1.0	-0.8	2.4	9.7	-2.5
DL	Electrical and optical equipment	-10.8	-1.7	-13.1	-10.2	-5.9	-3.5	-2.2	-4.7	-5.3	2.6
DM	Transport equipment	-2.6	-4.8	-9.4	2.1	-10.7	-4.8	-14.4	-5.5	-0.1	-1.7
DN	Manufacturing n.e.c.	-1.6	n.a	4.9	-1.9	4.7	-1.1	-1.9	-1.0	-7.7	-8.7

Notes: 1) Relative gains for each industry represent the difference, in percentage points, between the growth rate of unit labour costs in that industry and the average growth rate of unit labour costs in total manufacturing (D). For instance, the relative gain in industry DA = DA (1995-2001) - D (1995-2001). Negative (positive) values thus indicate larger (smaller) gains in cost competitiveness than the average for total manufacturing. 2) 1995-2000. 3) 1996-2001.

Methodological note: Labour costs refer to average gross wages, including indirect labour costs, per manufacturing employee per month. PPPs are 1999 purchasing power parities for total GDP.

Source: WIIW estimates based on national statistics.

Appendix 4.A.3 Trade Balances by Country and by Manufacturing Industry, 1995-2001

Evolution of trade balances with EU-15 by manufacturing industry in ten acceding and candidate countries, 1995-2001

	CZ	EE	HU	LV	LT	PL	SK	SI	BG	RO	Positive countries	Number of "+" (max 30)	Number of "-" (max 30)
DA Food products; beverages and tobacco	—-	—	++	—	-	-	—	—	++	—	2	4	15
DB Textiles and textile products	+++	+++	+	+++	+++	+	++	—-	+++	+++	9	22	3
DC Leather and leather products	—	—	—	—	+	—-	+++	—-	++	+++	4	9	14
DD Wood and wood products	++	+++	+	+++	++	+++	+++	+	++	+++	10	23	0
DE Pulp, paper & paper products; publishing & printing	—	-	—	—-	—	—	+	—-	—	—-	1	1	20
DF Coke, refined petroleum products & nuclear fuel	—-	+++	++	++	+++	-	+	—-	-	—	5	11	10
DG Chemicals, chemical products and man-made fibres	—-	—-	—-	—-	—	—-	—-	—-	—-	—-	0	0	29
DH Rubber and plastic products	—-	—-	—-	—-	—-	—-	—-	-	—-	—-	0	0	28
DI Other non-metallic mineral products	+++	—	—-	—	—	—	++	-	+	+	4	7	12
DJ Basic metals and fabricated metal products	+	—	—-	+	+	+	++	-	+++	++	7	11	6
DK Machinery and equipment n.e.c.	-	—-	—-	—-	—-	—-	-	-	—-	—	0	0	23
DL Electrical and optical equipment	-	+++	+++	—-	—-	—-	—	—-	—-	—-	2	6	21
DM Transport equipment	+++	—-	+++	—-	—-	—-	+++	-	—-	—-	3	9	19
DN Manufacturing n.e.c.	+++	+++	+	+	+++	+++	+++	+++	-	+++	9	23	1
Number of positive industries	6	5	7	5	6	4	9	2	6	6			
Number of "+" (out of 42 max)	15	15	13	10	13	8	20	4	13	15			
Number of "-" (out of 42 max)	18	21	19	24	19	24	11	25	19	21			

Legend for evaluation:

—-	Rising deficit	+	Small or declining surplus
—	Low or stable deficit	++	Stable surplus
-	Declining deficit	+++	Growing surplus

Note: The evaluation is based on a qualitative assessment by WIIW.

Source: Data from Eurostat COMEXT.

Appendix 4.A.4 Industry groupings (WIFO Taxonomies)

Taxonomy 1 — factor inputs

NACE rev.1	Industry clusters
	1. Mainstream manufacturing
175	Other textiles
176	Knitted and crocheted fabrics
177	Knitted and crocheted articles
212	Articles of paper and paperboard
243	Paints, coatings, printing ink
251	Rubber products
252	Plastic products
261	Glass and glass products
266	Articles of concrete, plaster and cement
268	Other non-metallic mineral products
272	Tubes
287	Other fabricated metal products
291	Machinery for production, use of mech. power
292	Other general purpose machinery
293	Agricultural and forestry machinery
295	Other special purpose machinery
296	Weapons and ammunition
297	Domestic appliances n. e. c.
311	Electric motors, generators and transformers
313	Isolated wire and cable
314	Accumulators, primary cells and primary batteries
315	Lighting equipment and electric lamps
354	Motorcycles and bicycles
355	Other transport equipment n. e. c.
	2. Labour intensive industries
172	Textile weaving
174	Made-up textile articles
181	Leather clothes
182	Other wearing apparel and accessories
183	Dressing and dyeing of fur; articles of fur
201	Sawmilling, planing and impregnation of wood
202	Panels and boards of wood
203	Builders' carpentry and joinery
204	Wooden containers
205	Other products of wood; articles of cork, etc.
262	Ceramic goods
264	Bricks, tiles and construction products
267	Cutting, shaping, finishing of stone
281	Structural metal products
283	Steam generators
294	Machine-tools
316	Electrical equipment n. e. c.
342	Bodies for motor vehicles, trailers
351	Ships and boats
352	Railway locomotives and rolling stock
361	Furniture
362	Jewellery and related articles
	3. Capital intensive industries
171	Textile fibres
211	Pulp, paper and paperboard
232	Refined petroleum and nuclear fuel
241	Basic chemicals
247	Man-made fibres
263	Ceramic tiles and flags
265	Cement, lime and plaster
271	Basic iron and steel, ferro-alloys (ECSC)
273	Other first processing of iron and steel
274	Basic precious and non-ferrous metals
343	Parts and accessories for motor vehicles
	4. Marketing driven industries
151	Meat products
152	Fish and fish products
153	Fruits and vegetables
154	Vegetable and animal oils and fats
155	Dairy products; ice cream
156	Grain mill products and starches
157	Prepared animal feeds
158	Other food products
159	Beverages
160	Tobacco products
191	Tanning and dressing of leather
192	Luggage, handbags, saddlery and harness
193	Footwear
221	Publishing
222	Printing
245	Detergents, cleaning and polishing, perfumes
282	Tanks, reservoirs, central heating radiators and boilers
286	Cutlery, tools and general hardware
335	Watches and clocks
363	Musical instruments
364	Sports goods
365	Games and toys
366	Miscellaneous manufacturing n. e. c.
	5. Technology driven industries
242	Pesticides, other agro-chemical products
244	Pharmaceuticals
246	Other chemical products
300	Office machinery and computers
312	Electricity distribution and control apparatus
321	Electronic valves and tubes, other electronic comp.
322	TV, and radio transmitters, apparatus for line telephony
323	TV, radio and recording apparatus
331	Medical equipment
332	Instruments for measuring, checking, testing, navigating
334	Optical instruments and photographic equipment
341.0	Motor vehicles
353.0	Aircraft and spacecraft

Taxonomy 2 – labour skills

NACE rev.1	Industry clusters
	1. Low skill industries
151	Meat products
152	Fish and fish products
153	Fruits and vegetables
154	Vegetable and animal oils and fats
155	Dairy products; ice cream
156	Grain mill products and starches
157	Prepared animal feeds
158	Other food products
159	Beverages
160	Tobacco products
171	Textile fibres
172	Textile weaving
174	Made-up textile articles
175	Other textiles
176	Knitted and crocheted fabrics
177	Knitted and crocheted articles
181	Leather clothes
182	Other wearing apparel and accessories
183	Dressing and dyeing of fur; articles of fur
191	Tanning and dressing of leather
192	Luggage, handbags, saddlery and harness
193	Footwear
251	Rubber products
252	Plastic products
261	Glass and glass products
262	Ceramic goods
263	Ceramic tiles and flags
264	Bricks, tiles and construction products
265	Cement, lime and plaster
266	Articles of concrete, plaster and cement
267	Cutting, shaping, finishing of stone
268	Other non-metallic mineral products
271	Basic iron and steel, ferro-alloys (ECSC)
272	Tubes
273	Other first processing of iron and steel
274	Basic precious and non-ferrous metals
	2. Medium skill/blue collar workers
201	Sawmilling, planing and impregnation of wood
202	Panels and boards of wood
203	Builders' carpentry and joinery
204	Wooden containers
205	Other products of wood; articles of cork, etc.
281	Structural metal products
282	Tanks, reservoirs, central heating radiators and boilers
283	Steam generators
286	Cutlery, tools and general hardware
287	Other fabricated metal products
341	Motor vehicles
342	Bodies for motor vehicles, trailers
343	Parts and accessories for motor vehicles
351	Ships and boats
352	Railway locomotives and rolling stock
354	Motorcycles and bicycles
355	Other transport equipment n. e. c.
361	Furniture
362	Jewellery and related articles
363	Musical instruments
364	Sports goods
365	Games and toys
366	Miscellaneous manufacturing n. e. c.
	3. Medium skill/white collar workers
211	Pulp, paper and paperboard
212	Articles of paper and paperboard
221	Publishing
222	Printing
232	Refined petroleum and nuclear fuel
241	Basic chemicals
242	Pesticides, other agro-chemical products
243	Paints, coatings, printing ink
245	Detergents, cleaning and polishing, perfumes
246	Other chemical products
247	Man-made fibres
297	Domestic appliances n. e. c.
311	Electric motors, generators and transformers
312	Electricity distribution and control apparatus
313	Isolated wire and cable
314	Accumulators, primary cells and primary batteries
315	Lighting equipment and electric lamps
316	Electrical equipment n. e. c.
321	Electronic valves and tubes, other electronic comp.
322	TV, and radio transmitters, apparatus for line telephony
323	TV, radio and recording apparatus
331	Medical equipment
332	Instruments for measuring, checking, testing, navigating
334	Optical instruments and photographic equipment
335	Watches and clocks
	4. High skill industries
244	Pharmaceuticals
291	Machinery for production, use of mech. power
292	Other general purpose machinery
293	Agricultural and forestry machinery
294	Machine-tools
295	Other special purpose machinery
296	Weapons and ammunition
300	Office machinery and computers
353	Aircraft and spacecraft

Source: Peneder, M. (2001), Entrepreneurial Competition and Industrial Location, Edward Elgar, Cheltenham, UK.

Appendix 4.A.5: Trends in concentration and specialisation of manufacturing in EU-15 and the Central and East European accession countries

4.A.5.1 Introduction

The process of European integration during the past decade was marked with the Single Market programme and the Economic and Monetary Union. The main objectives of the Single Market programme were the elimination of non-tariff barriers to trade in goods and services within the European Union, and the further liberalisation of cross-border movements of production factors. In 1999, the Economic and Monetary Union reinforced the single market by eliminating the exchange rate risk in trade within the euro area. These policies significantly reduced the transaction costs in trade within the EU.

At the beginning of the 1990s, trade liberalisation between the acceding and candidate countries and EU-15 led to an intensification of the trade relations between the two groups. The future EU enlargement will further deepen the integration of the acceding countries into the economic structures of the EU. Differences in geographic proximity to the acceding countries and in industrial specialisation suggest that the effects of the enlargement should on the current Member States.

All the different theoretical approaches to trade predict that trade liberalisation should lead to increasing specialisation across countries. High specialisation can reflect an efficient exploitation of the comparative advantages of countries, but may also involve risks. More pronounced patterns of industrial specialisation across Europe could result in increasing income differences between a rich core and a poor periphery in the case where the periphery becomes locked into mature, declining industries or low-quality products. Furthermore, a far-reaching specialisation of individual countries or regions in narrow product groups can render them excessively vulnerable to sector-specific shocks.

This Appendix looks at the trends in the location of industries and country specialisation in Europe during the 1990s, and makes some suggestions on potential changes following the forthcoming enlargement in 2004. The next section reviews the main predictions of economic theories on location. The third section surveys the existing empirical studies on the specialisation of countries and geographical concentration of industries within the EU and the Central and East European acceding countries. The fourth section provides new data on specialisation and concentration in these countries, and the final section concludes with some implications for future location patterns within the enlarged EU.

4.A.5.2 Specialisation and geographic concentration in an enlarged Europe: theoretical background

This section provides a brief overview of the predictions of the main schools in location theory: traditional trade theory, new trade theory and new economic geography. This overview is completed by a brief presentation of multinationalisation theories, which focus on the role of foreign direct investment and subcontracting strategies of multinational corporations on specialisation patterns.

Location theory[88]

Most trade models predict that economic integration leads to a higher specialisation of countries. The paradigms differ, however, in terms of the determinants of the specialisation process and, as a consequence, in terms of the locations where they predict production to concentrate. The central assumptions behind *traditional trade theories* are perfect competition, homogenous products and non-increasing returns to scale. These models predict that economic integration leads to a higher degree of specialisation according to comparative advantages. The comparative advantages of countries and regions are determined by their productivity and by their factor endowments. High-income countries, which are characterised by a large stock of physical capital, a well educated labour force and a high potential to innovate, are predicted to specialise in capital-intensive, technology-, skill- and research-intensive industries with a high incidence of product and process innovations. In industries where product differentiation is important, these countries specialise in products of the upper quality segment.

Traditional trade theory can explain a substantial proportion of inter-industry trade, that is, trade

[88] The review of the location models in this section aims to highlight some of the main mechanisms at work and not to survey the literature. For a comprehensive survey on location theory, see Wolfmayr-Schnitzer (1999). Ottaviano and Puga (1998) and Fujita and Thisse (2002) provide overviews of new economic geography, while Neary (2001) provides a critical assessment.

where the exports of a country belong a different product category than its imports. However, traditional trade theory fails to explain why different production structures are found in regions and countries which have similar factor endowments and production technologies. The bulk of the trade between developed countries is not inter-industry, but intra-industry trade, that is, a country is both an exporter and an importer of differentiated goods that fall into the same product category.

The *new trade theory* stresses scale economies, product differentiation and imperfect (monopolistic) competition. The main conclusion is that increasing returns to scale give an incentive to specialise and trade even in the absence of differences in endowments and technologies between countries. According to one class of new trade theory models, regional concentration can result from scale economies which are external to the firm: specialised supply,[89] pooled labour markets, or knowledge spillovers.[90] With external economies of scale, the larger the size of the local industry, the lower the costs. Scale economies at industry level form the basis for a regional concentration of industries.

In a second category of new trade theory models, trade provides a means to extend the market and to exploit scale economies which are internal to the firm. In the presence of transport costs, firms with internal increasing returns to scale concentrate their production in large regions or more generally in regions with good market access ('the core') moving away from remote regions ('the periphery'). Firms locate in larger markets in order to have lower transport costs.

According to new trade theory, a demand bias in favour of a particular good creates a large home market for this good, and the interaction of economies of scale and trade costs typically leads to net exports ('home market effect'). Cross-country differences in expenditure structure can thus determine the production structure and industry location; according to new trade theory, industries are more concentrated the more concentrated the demand for their goods. Countries or regions with a good access to markets tend to specialise in industries where the home market effect is strong.

Another main conclusion of new trade theory is that both inter-industry trade, reflecting comparative advantages,[91] and intra-industry trade, reflecting scale economies and demand preferences, may take place in parallel. The relative importance of intra-industry trade in comparison to inter-industry trade depends on the degree of similarity in demand and production structures. If two countries are very similar in their factor intensities and technologies, there will be little inter-industry trade, and intra-industry trade will dominate. If, in contrast, countries differ widely in their factor intensities and technologies, trade will be based essentially on comparative advantages. Where intra-industry trade dominates, the effects of increased trade on income distribution between the countries are small, and the gains from trade are based on economies of scale and increased choice.

The various models of intra-industry trade distinguish between horizontal and vertical product differentiation.[92] Models of horizontal product differentiation predict that similarities of demand and per capita incomes between countries favour horizontal specialisation. The greater the market sizes of the countries (the greater the potential to reap scale economies), the greater the amount of intra-industry trade. Models of vertical product differentiation, on the other hand, predict that vertical intra-industry trade increases with the differences in factor endowments (capital intensity, human capital, technology), in per capita incomes and in demand structures.[93]

Models of *new economic geography* emphasise forward and backward linkages, spillovers and scale economies as centripetal forces. Higher wages and higher costs of commuting and congestion, or more generally costs induced by agglomeration, in turn act as centrifugal forces. While most trade models predict that specialisation will increase with reductions in trade costs, the new economic geography predicts a u-shaped relationship: when trade costs are high, production is located close to demand and geographical concentration is low. At an intermediate level of trade costs, forward and

[89] For example, modern firms have an incentive to locate where specialised human capital is available. On the other hand, labour force with specialised skills have an incentive to move to areas where more than one potential employer is established. There is a thus reciprocal advantage to local concentration.

[90] Personal contact and the associated knowledge spillovers are an important determinant of the location decisions of many firms. Geographic proximity makes it easier to gather information about competitors and about sector-specific news, to make deals, to negotiate contracts etc. Although new technologies have allowed the relocation of some activities, proximity remains important for the vast majority of economic transactions. This is demonstrated by econometric estimates of gravity models for trade, investment, equity and technology flows (see Venables, 2001).

[91] As in the traditional trade theory, the patterns of inter-industry trade are determined by underlying differences in production factors and technology between countries.

[92] Horizontal differentiation refers to different varieties of a product that are of similar quality (e.g. different colour and design of shoes of similar quality). Vertical differentiation refers to different varieties that are of different qualities (e.g. leather shoes, plastic shoes).

[93] See Falvey (1981), Falvey and Kierzkowski (1985), Greenaway and Millner (1986), Flam and Helpman (1987).

backward linkages lead to an agglomeration of production activity. Finally, when trade costs are low, higher wages and congestion costs in the core trigger a stronger dispersion of production. The new economic geography models thus predict that in a first stage of economic integration, a reduction in trading costs might favour the core regions and, in a later stage where trade costs are further reduced, the periphery could win.[94]

In new economic geography models, agglomeration forces are weaker if labour is immobile between regions. If workers do not move, wage differences between regions persist and act as a dispersion force by increasing production costs for firms producing in locations with relatively many other firms. 'This dispersion force can moderate agglomeration and sustain non-extreme equilibria in which all regions have industry, even if in different proportions. Thus the lack of interregional mobility both postpones agglomeration in a process of regional integration and weakens it when it happens' (Puga, 2001, p. 17).

Multinationalisation theories

The location theories presented above do not explicitly account for the specific role of multinational corporations (MNCs). Multinational corporations influence the location of industries via their foreign direct investment and subcontracting strategies. According to Zysman and Schwartz (1998), the principal MNCs operating in Europe will drive the regional patterns of production, investment and venture in the acceding countries. The critical issue is whether Central and East European producers are considered as economic complements or as rivals to the international production networks created by the major MNCs.

Theoretical literature distinguishes between two polar cases of multinational activity: horizontal and vertical. Horizontal MNCs produce approximately the same product or service in multiple locations, while vertical MNCs fragment their production process geographically by taking advantage of cross-country price differences for production factors. Horizontal patterns of multinational activity are determined by the size of local markets, proximity to other markets, transport costs and scale economies, while vertical fragmentation relates to the comparative advantage of countries, as reflected in factor prices.

Models of foreign direct investment and subcontracting offer several predictions on the effects of deeper integration on the behaviour of multinational firms and the consequences for specialisation:

— For horizontal multinationals, market proximity becomes less important as trade costs decline. Consequently, the decisions on plant size and location will be based primarily on the level of production costs and the importance of economies of scale. This should lead to more specialisation within the enlarged Europe.

— Vertical foreign direct investment is predicted to increase since lower trade costs induce more intra-firm trade to exploit cross-country differences in factor prices. Intra-firm specialisation involves locating the headquarters and skill-intensive production in skill abundant countries and labour-intensive production in labour abundant countries.

Summary

Each of the theories presented above identifies a set of factors explaining industrial location. While there are significant differences in approach, some explanatory factors are common to all the theories. Three forces which influence specialisation patterns are of particular relevance in the context of enlargement: local endowments, trade costs and labour mobility. In summary, the theories lead to a number of predictions for specialisation and concentration patterns in an enlarged Europe:

— All the theoretical approaches predict increasing specialisation as a result of trade liberalisation and enlargement. The paradigms differ, however, in terms of what is seen to determine the specialisation process and, as a consequence, in terms of the location where economic activity is predicted to concentrate.

[94] New economic geography also provides an explanation for the increasing differences in production structures across different core countries as well as across different peripheral countries in Europe. According to these models, even regions which *a priori* are very similar, can end up with very different production structures and income levels. Agglomeration is determined by 'accident' (see Krugman, 1991): if one firm moves, this raises the share of goods produced locally in the receiving region and the rise in local labour demand and wages tend to attract more of the mobile workers. This enlarges the market further and causes positive demand effects and backward linkages as a greater number of consumers makes the receiving region even more attractive for firms and causes a concentration of economic activity. The result of this process of 'cumulative causation' is that all firms belonging to the sectors with increasing returns to scale end up locating within a single region (the 'core'), while the other region (the 'periphery') specialises in the traditional sector. The point is that this result is not determined by differences in endowments, but instead by history. Whichever of the two regions gets a slight advantage will build on it due to the process of cumulative causation. But agglomeration may take place even when labour is not mobile, because of direct input-output linkages: Venables (1996) shows that vertical linkages between upstream and downstream industries give rise to cost and demand linkages, which play a role equivalent to that of labour migration in endogenously determining the size of the market in different regions. Cost and demand linkages of vertically integrated firms constitute the driving force for the agglomeration of activities, whereas the location of immobile factors of production and the location of final demand act as dispersion forces.

— Traditional trade theory predicts a clear-cut difference in the specialisation of high-, middle- and low-income countries on the basis of the differences in their endowments of human capital, physical capital and technology.

— New trade theory predicts agglomeration in large markets due to either external economies of scale – based on specialised supply, pooled labour markets and knowledge spillovers – or internal economies of scale.

— According to new trade theory, the share of horizontal intra-industry trade in total trade is positively related to the similarities of demand and production characteristics, while the share of vertical intra-industry trade is positively related to differences in factor endowments, per capita incomes and demand structures.

— Economic geography emphasises centripetal (forward and backward linkages, spillovers and scale economies) and centrifugal forces (commuting, congestion, local competition). It predicts a u-shaped relationship between trade costs and specialisation (agglomeration): in a first stage of liberalisation, more economic activity concentrates into the core, while further liberalisation may benefit the periphery. The attractiveness of the periphery depends crucially on its comparative advantages (lower wages).

— According to new economic geography, even countries which *a priori* are very similar can end up with very different production structures and income levels due to 'coincidence' combined with a process of cumulative causation (centripetal forces). In the models of new economic geography, agglomeration is driven by direct input-output linkages, while labour mobility further strengthens the agglomeration forces.

4.A.5.3 Earlier studies on specialisation and concentration in Europe

This section will survey the results of earlier studies on the trends in production specialisation of individual countries and geographical concentration of industries within EU-15 and the acceding countries. The following section provides new data on the trends in specialisation and concentration in these countries.

We define *specialisation* as the extent to which a given country specialises its activities in a small number of industries. Specialisation can be measured in terms of production shares, employment, exports, or total trade (exports and imports together). If production, employment or export structures become more dispersed (the economy becomes less dependent on a small number of key industries), we are speaking of de-specialisation. Geographic *concentration* is defined as the extent to which activity in a given industry is concentrated in just a few countries. Also concentration can be measures in terms of several variables, such as production, employment, exports or total trade.

Empirical evidence for EU-15

A number of researchers have studied specialisation and concentration trends in the EU with particular attention to the effects of the single market programme. Helg et al. (1995), Amiti (1999), OECD (1999), Aiginger et al. (1999), Midelfart-Knarvik et al. (2000) and Storper et al. (2002) all show that most EU countries are becoming more specialised in terms of production activity. On the other hand, there is a (weak) tendency for export specialisation to decrease (see Aiginger et al. 1999). Instead of the relatively strong discontinuous agglomeration patterns suggested by the new economic geography models, these studies reveal a gradual process of specialisation. Export structures are substantially more specialised than production activity, which suggests that a large part of manufacturing activity remain sheltered from import competition – either due to trade costs or to a demand bias in favour of locally-produced goods (see Brülhart 2001a).

Geographic concentration trends in Europe are less clear-cut. Some studies point to increasing concentration trends (Brülhart, 1995, Amiti, 1999, Haaland et al., 1999, Midelfart-Knarvik et al., 2000), while others find that concentration is declining (Dalum et al., 1998, Molle, 1996, Hallet, 2001, Aiginger et al. 1999, Aiginger and Davies, 2001, Aiginger and Pfaffermayr, 2003).[95] Davies, Rondi and Sembenelli (1998) find no change in concentration.

A closer look at the patterns of concentration and specialisation at country and industry level reveals considerable volatility in the production structures of individual countries and markedly different specialisation patterns across country groups. Brülhart (2001b) finds increasing geographical concen-

[95] As emphasised by Aiginger et al. (1999), the opposing simultaneous trends of (slightly) increasing specialisation and decreasing concentration do not constitute a paradox as such. Since small countries registered higher growth in the 1990s, the concentration of those industries where large countries have the highest shares tended to decline, leading to a decrease in aggregate geographical concentration.

tration after 1986 in those industries which were most affected by the liberalisation measures of the single market programme.[96] He interprets this as evidence of an unexhausted potential for industrial clustering within the EU. Geographic concentration is strongest in labour-intensive and resource-intensive industries, and weakest in technology-intensive industries. Employment in footwear, pottery and shipbuilding industries is much more clustered than employment in the manufacture of plastic products, electrical apparatus and even motor vehicles.

Brülhart's findings correspond to those of Amiti (1999), who finds that footwear, carpets and jewellery industries were among the most concentrated in Europe in 1989, while plastics and iron and steel industries were the least agglomerated. These results also mirror Krugman's (1991) findings for the United States. The evidence thus suggests that geographical concentration patterns reflect primarily the comparative advantages of countries, rather than being the outcome of agglomeration forces operating in increasing-returns industries as predicted by the "new" models.

Brülhart (2001b) finds that market access has become less important in location decisions. Industry concentration is less and less determined by the geographical position – central or peripheral – of a country. While technology-intensive industries and industries with increasing returns tended to concentrate in the centre, the degree of concentration declined towards the end of Brülhart's sample period. Brülhart's results are in line with the studies of Aiginger et al. (1999) and Midelfart-Knarvik et al. (2000), who found decreasing concentration in high-tech industries over the 1990s. Concentration of production in central regions declined to the benefit of fast growing small countries which hosted successful multinational firms or attracted foreign direct investment.

Aiginger et al. (1999), Brülhart (2001b) and Midelfart-Knarvik et al. (2000) identify exogenous factor endowments (as emphasised by the traditional trade theories) and industry-specific, location-independent agglomeration economies (which are at the heart of economic geography models) as key determinants of geographical concentration in Europe. Aiginger et al. (1999) find that high wage industries (agro-chemicals, steam generators, machine tools, office computers, production of recorded media) are more concentrated than other industries, and their concentration did not decrease in the 1990s. Among the low wage industries, geographical concentration in most textile branches increased. Industries with a high degree of product differentiation, which were highly concentrated at the start, tended to become less concentrated. Finally, Aiginger et al. (1999) find no evidence of an above-average concentration of industries characterised by economies of scale.

Midelfart-Knarvik et al. (2000) show that the location of R&D-intensive industries has become increasingly responsive to countries' endowments of high-skilled workers. The location of industries which intensively use non-manual labour remains sensitive to the proportion of the labour force with secondary and higher education. On the other hand, changes in the endowments of low and medium-skilled labour appear not to play a major role in determining the changes in production structures. Finally, the location of industries with strong forward and backward linkages has become increasingly sensitive to the central/peripheral position of countries.

According to the models of vertical intra-industry trade, specialisation over the quality spectrum within industries is explained by differences in local endowments. Mora (2001) suggests that comparative advantage be an important driver of the patterns of trade within industries in Europe. According to her findings, differences in human and physical capital between countries are important determinants of specialisation of countries over the quality spectrum within industries in intra-EU trade. She also finds that in advanced manufacturing industries, rubber and plastic products and in the majority of traditional manufacturing branches, technological capital has influenced trade patterns. In manufacturing industries with demand growth and medium technological content, as well as in some traditional branches like metal products and paper and printing products, an abundant endowment of human capital is associated with an increase in the quality of exports (see also Jansen and Landesmann, 1999).

Overall, there seems to be a revival of endowment-based explanations of industrial location in Europe. However, Midelfart-Knarvik et al. (2000), after reviewing the empirical evidence on the determinants of trade costs and the effects of these costs on trade flows, conclude that not only endowments, but also geography matters in determining trade and industrial location. Aiginger et al. (1999) suggest that integration-induced specialisation in the EU in the past twenty years could have been even stronger, but had been tempered by the

[96] Textiles, clothing, leather and footwear, chemicals, coal, iron and steel, motor vehicles and furniture.

simultaneous convergence of endowments across countries. Aiginger et al. (op cit.) find that factor endowments in the EU countries became more similar between 1980 and 1996 due to a catch-up of countries like Spain, Ireland, Finland and Denmark which accumulated R&D capital, and to some extent also Portugal and Greece, owing to their investments in physical capital.[97]

Empirical evidence for Central and East European countries

Most of the earlier analyses have concluded that the acceding and candidate countries in Central and Eastern Europe are specialised in labour-intensive industries as well as in resource- and energy-intensive industries. In comparison to EU-15, the acceding and candidate countries have a comparative disadvantage in capital-, technology- and skill-intensive industries. Hence, it is likely that the effects of the forthcoming EU enlargement will differ across countries and industries.

The results of Landesmann (1995, 2000) based on trade statistics support the hypothesis of a specialisation in labour- and resource-intensive industries in the acceding and candidate countries, following an inter-industry trade pattern. Following the intensification of outward processing trade, also intra-industry trade has increased [Landesmann (1995), Dobrinsky (1995)]. Freudenberg and Lemoine (1999) conclude that the acceding and candidate countries have comparative advantages in primary (upstream production) and in consumption goods (downstream production), but comparative disadvantages in intermediate and capital goods.

Petrakos (1996, 1999) argues that the processes of internationalisation and structural change in the acceding and candidate countries have favoured metropolitan and Western regions, as well as regions with a strong industrial base. Petrakos expects the process of transition to increase disparities at the European level.

Traistaru et al. (2002) and Landesmann and Stehrer (2002) provide the first comprehensive studies on the impact of economic integration with the European Union on regional specialisation and geographic concentration of industrial activity in acceding and candidate countries. Traistaru et al. (2002) find evidence of a regional relocation of industries, leading to an increased specialisation in Bulgaria and Romania and lower specialisation in Estonia. In Hungary and Slovenia, the degree of specialisation has not changed significantly.

Landesmann and Stehrer (2002) find Poland, Bulgaria, Romania, Latvia and Lithuania 'locked in' in a rather traditional pattern of trade and industrial specialisation (low-skill, labour intensive branches), while the other acceding Central and East European countries show a more dynamic pattern of integration into the European division of labour. In particular, Hungary, the Czech Republic and Slovak Republic as well as Estonia are catching up relatively fast in technologically more sophisticated branches and are improving their positions in intra-branch product quality. Foreign direct investment and educational attainment were found to be important in determining the specialisation of individual countries.

4.A.5.4 Specialisation and concentration trends in manufacturing in the 1990s

This section presents updated statistical information on the degree of geographical concentration of industries, and on country specialisation in manufacturing production in EU-15 and the ten Central and East European acceding and candidate countries. To measure concentration and specialisation, we use the concentration ratio (CR*n*), which measures the share of the largest *n* units in the total.[98] For example, CR3 refers to the share of the largest 3 industries in a country (specialisation) or the share of the largest 3 countries in a specific industry or sector (concentration).

The analysis covers the period 1990-2001 for the acceding and candidate countries; data for EU-15 are until 2000.[99] During the 1990s, Europe faced a severe recession with devaluations in some EU countries. Major country-specific shocks during the period include the unification of Germany, the political turmoil in the Balkan region, the crises in South-east Asia, and the economic transition in the Central and Eastern European countries. The effects of these shocks differed across the EU countries and industries (European Commission, 1999).

The analysis uses aggregate data on gross production and exports. Occasionally, also data on imports and employment are presented. Gross production is measured in nominal terms, and aggregated using

[97] According to Midelfart-Knarvik and Overman (2002), EU policies have contributed to the convergence in R&D capital among the EU countries. EU support has helped countries to attract R&D intensive industries at the expense of medium-skilled industries.

[98] Existing literature proposes several indicators to measure specialisation and concentration. For the advantages and shortcomings of each of them, see Aiginger et al. (1999).

[99] Longer time series are available on trade, but the period 1990-2001 is the common ground for the bulk of the data. Even for this time span, many data points were missing and had to be estimated.

exchange rates. The choice of gross production allows comparisons with the acceding and candidate countries where data on value added are not available. Taking the nominal production value is not optimal in all cases (occasionally, purchasing power parity –based weights are used in aggregations for the acceding and candidate countries as well), but the difficulties in measuring price adjustments and quality changes for all industries in each member country imposed this choice. Also exports are measured at current prices. Data for EU-15 cover the countries which joined in 1995 for the whole period of analysis.

Output and employment specialisation

On average, the degree of production specialisation at the level of the 14 main sub-sectors of manufacturing is roughly similar in the eight Central and East European countries acceding in May 2004 and EU-15. In both regions, the 5 largest industries supply about 60 % of total manufacturing output (Table 4.A.5.1; see also Table 4.4 in the main text). If the shares of the 3 largest industries (CR3) are used as an indicator of specialisation, one finds declining specialisation in the eight acceding countries and a stable concentration ratio in EU-15.

Turning to individual countries and to a finer disaggregation of industries, data at the 2-digit NACE level again do not show major changes in the degree of production specialisation of EU Member States over the 1990s (Graph 4.A.5.1). Finally, at the more disaggregated NACE 3-digit industry level, the data show a considerable degree of restructuring in individual EU countries. Specialisation (share of the 3 largest industries in total manufacturing output) increased in Germany, France, Ireland, Finland, Sweden and United Kingdom during the 1990s. In the rest of EU-15, specialisation decreased.

In EU-15 as a whole, transport equipment and electrical and optical equipment increased their shares in total manufacturing production between 1995 and 2000 by more than other industries. The main losers in terms of production shares were food products, textiles and basic metals (see also Graph 4.5 in the main text). The importance of the electrical and optical equipment industry increased in all individual EU countries except Italy.

Of the individual countries where production specialisation increased in the 1990s, the driving forces were roughly the same in France, Germany and the United Kingdom: transport equipment, and electrical and optical equipment increased their production shares. The transport equipment sector presently accounts for some 19 % of total manufacturing production in both France and Germany. All three countries have rather similar industrial structures, characterised by high returns to scale, high technology and a relatively highly educated workforce. These characteristics have driven the specialisation patterns towards industries which depend on the supply of highly educated workers and which rely on the large home markets.

In the other three countries where production specialisation increased, Ireland, Finland and Sweden, the structure of industry changed strongly towards industries with high technology and increasing returns to scale. The structure of Irish manufacturing is highly specialised: the share of the 3 largest industries in total production is 76 %. The manufacture of electrical and optical equipment is the largest industry in Ireland, while the strongest increase in the output share over the 1990s was recorded in the chemicals industry. The food industry, a former stronghold, in turn lost ten percentage points. The move towards more sophisticated production activities corresponds to the dramatic increase in the share of employees with higher education. The share of research-intensive industries in total manufacturing is currently higher in Ireland than in any other EU-15 country, while the share of labour-intensive industries is the lowest in EU-15.

In EU-15, Finland has the second most specialised production structure in manufacturing, but remains far less specialised than Ireland: the 3 largest industries account for 55 % of total manufacturing output.

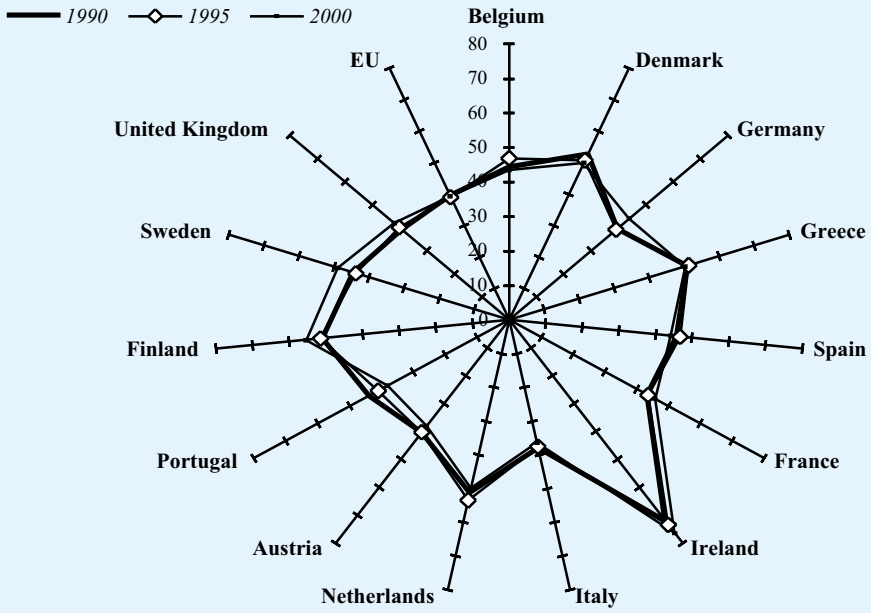
Table 4.A.5.1 CEEC-8 and EU-15 industry structures in 1990, 1995 and 2000

	CEEC-8			EU-15		
	1990	1995	2000	1990	1995	2000
Concentration ratio (CR5)	62.5	60.2	60.8	59.3	59.3	60.5
Concentration ratio (CR3)	47.2	45.4	42.7	39.5	39.0	39.3

Note: CEEC-8 refers to the eight Central and East European countries which are due to enter into EU in 2004.

Source: WIIW Database incorporating national statistics, WIFO and WIIW calculations using SBS.

Graph 4.A.5.1 Manufacturing production specialisation in EU-15 (CR3)



Note: Share of 3 largest industries in production, calculated from 2-digit NACE sections of manufacturing.
Source: WIFO calculations using Eurostat SBS.

Finland is characterised by a high ratio of capital to labour. The rising importance of the electrical and optical equipment industry – in particular telecommunications equipment – has contributed to raising the degree of specialisation; electronics have replaced pulp and paper as the largest domestic industry. In Sweden, both the electrical and optical equipment industry – telecommunications equipment as in Finland – and the transport equipment industry – motor vehicles – increased their production shares, while the importance of food production, pulp and paper, and basic metals declined.

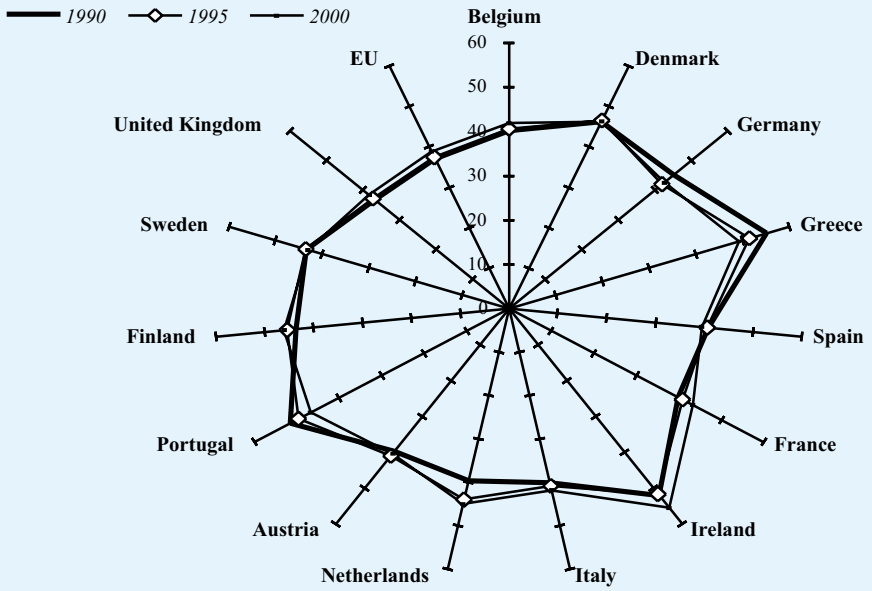
Manufacturing employment in EU-15 is slightly more focused on the 3 largest industries than output (Graph 4.A.5.2). Most countries show a stable or rising employment specialisation over the 1990s. Exceptions are Germany, Greece, Spain and Portugal, where the share of the 3 largest industries in total manufacturing employment declined. In many cases, industries which increased their share in total manufacturing production recorded a simultaneous decrease in the employment share. This suggests a further specialisation towards technology-intensive and capital-intensive industries with an above-average labour productivity.

Manufacturing production structures in the ten Central and East European acceding and candidate countries are more specialised than those in EU-15. Specialisation increased dramatically during the first half of the 1990s. Among the NACE 2-digit industries, the 3 largest account for between 50-60 % of total manufacturing output in each of the acceding and candidate countries (Graph 4.A.5.3).[100] In most EU-15 countries, the production shares of the 3 largest industries are clearly lower, varying between 40-50 % – the most notable exception is Ireland where they account for almost 80 % of the total. The higher specialisation of the acceding and candidate countries makes them potentially more vulnerable to asymmetric shocks.

In general, the large structural changes in the ten acceding and candidate countries were characterised by an increasing importance of the transport equipment industry and of electrical and optical equipment, while the production shares of the food, beverages and tobacco industries declined. The 3 largest manufacturing industries were the same in 2001 as in 1995 in all the ten acceding and candidate countries except Hungary, Poland, the Slovak Republic and Estonia. In the latter group of countries, the changes were characterised by the

[100] Some inconsistencies remain in the production and employment data for these countries, which have been collected from national sources (in particular, in the period before 1995 there were changes in data sources and in methodological approaches, e.g. the coverage of SMEs). The Vienna Institute for International Economic Studies (WIIW) has made available a more consistent data set, but only at the level of the 14 main subsections of manufacturing (DA-DN) of NACE rev. 1 – see Table 4.A.5.1.

Graph 4.A.5.2 Manufacturing employment specialisation in EU-15 (CR3)



Note: Share of 3 largest industries in employment, calculated from 2-digit NACE sections of manufacturing.
Source: WIFO calculations using Eurostat SBS.

rising importance of the transport equipment industry and, in Hungary, of the electrical and optical equipment industry. In Estonia, wood industry became more important, while the relative importance of the chemicals industry declined.

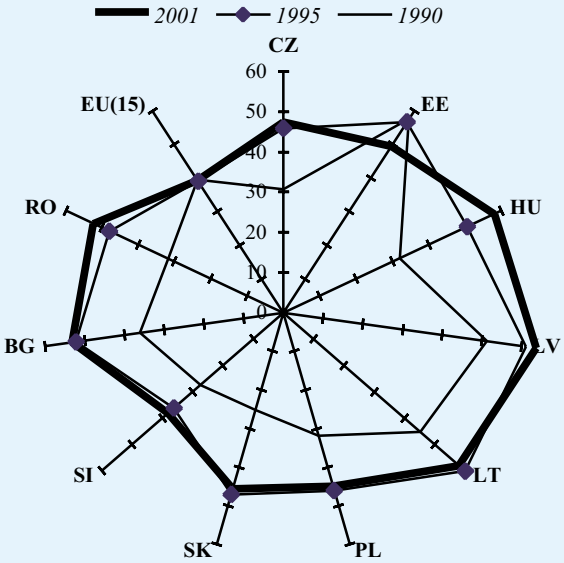
Manufacturing employment in the ten acceding and candidate countries is somewhat more dispersed over the different industries manufacturing output (Graph 4.A.5.4). During the 1990s, employment declined in most manufacturing industries and in manufacturing as a whole. The largest employers are currently the food and beverages industry, textiles, basic metals and fabricated metal products, as well as mechanical engineering. Changes in employment shares of individual industries over the 1990s were small compared to the changes in production shares; the largest changes in employment specialisation took place in Latvia, Lithuania and Bulgaria, where manufacturing employment became more focused on the 3 main industries. In comparison to EU-15 members, manufacturing employment in the acceding and candidate countries relies more heavily on the 3 largest industries.

Graphs 4.A.5.5 and 4.A.5.6 look at production and employment structures in the ten Central and East European acceding and candidate countries by country and by industry. Typically, the most important industries in the acceding and candidate countries include food, beverages and tobacco, transport equipment, as well as basic metals and fabricated metal products. In addition, textiles and wood products are usually among the largest manufacturing industries in the Baltic States (Graph 4.A.5.5). In general, production shares of these sectors in the acceding and candidate countries are above the EU-15 average. On the other hand, the acceding and candidate countries have lower production shares than the EU-15 Member States in paper and printing; chemicals; machinery and equipment as well as – and with the notable exception of Hungary – in electrical and optical equipment. In terms of manufacturing employment, textiles and textile products are more important in the acceding and candidate countries than in EU-15, while the role of transport equipment is smaller (Graph 4.A.5.6).

Export specialisation

In the second half of the 1990s, the general trend in EU-15 was towards an increased specialisation in exports. This was reflected mainly in the increasing shares of six technology-driven industries in total EU-15 exports: pharmaceuticals, telecommunications equipment, aircraft and spacecraft, office machinery and computers, electronic components, and motor vehicles. Like the data on specialisation in production, evidence of the export structures thus point to an increasing role of more sophisticated industries in EU-15 manufacturing.

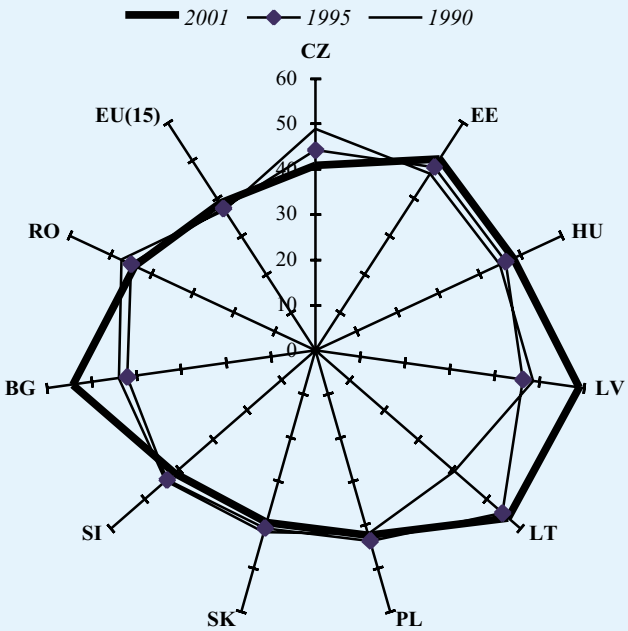
Graph 4.A.5.3 Manufacturing production specialisation in 10 acceding and candidate countries (CR3)



Note: Share of 3 largest industries in production, calculated from 2-digit NACE sections of manufacturing.

Source: WIIW calculations based on WIIW Industrial Database and AMECO.

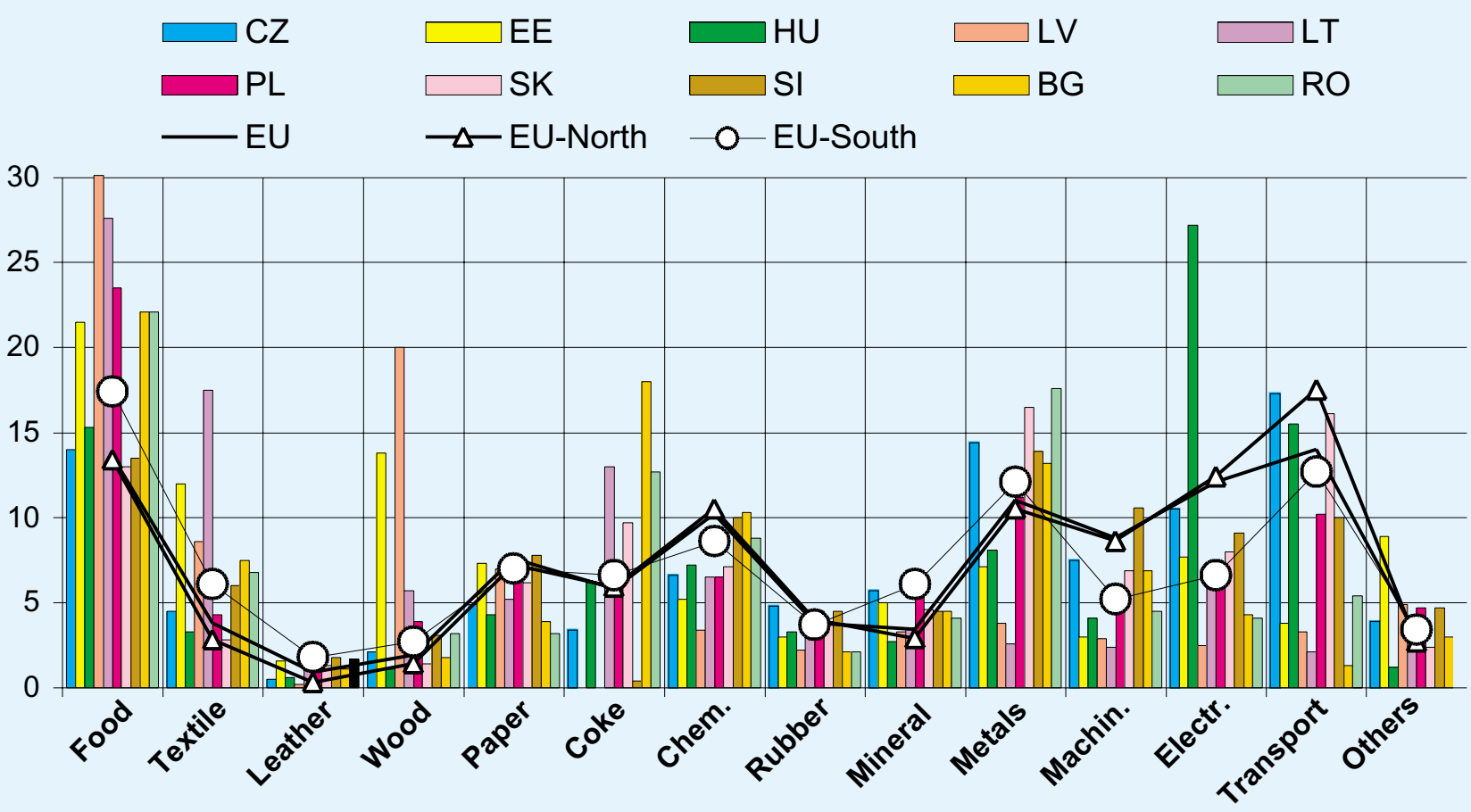
Graph 4.A.5.4 Manufacturing employment specialisation in 10 acceding and candidate countries (CR3)



Note: Share of 3 largest industries in employment, calculated from 2-digit NACE sections of manufacturing.

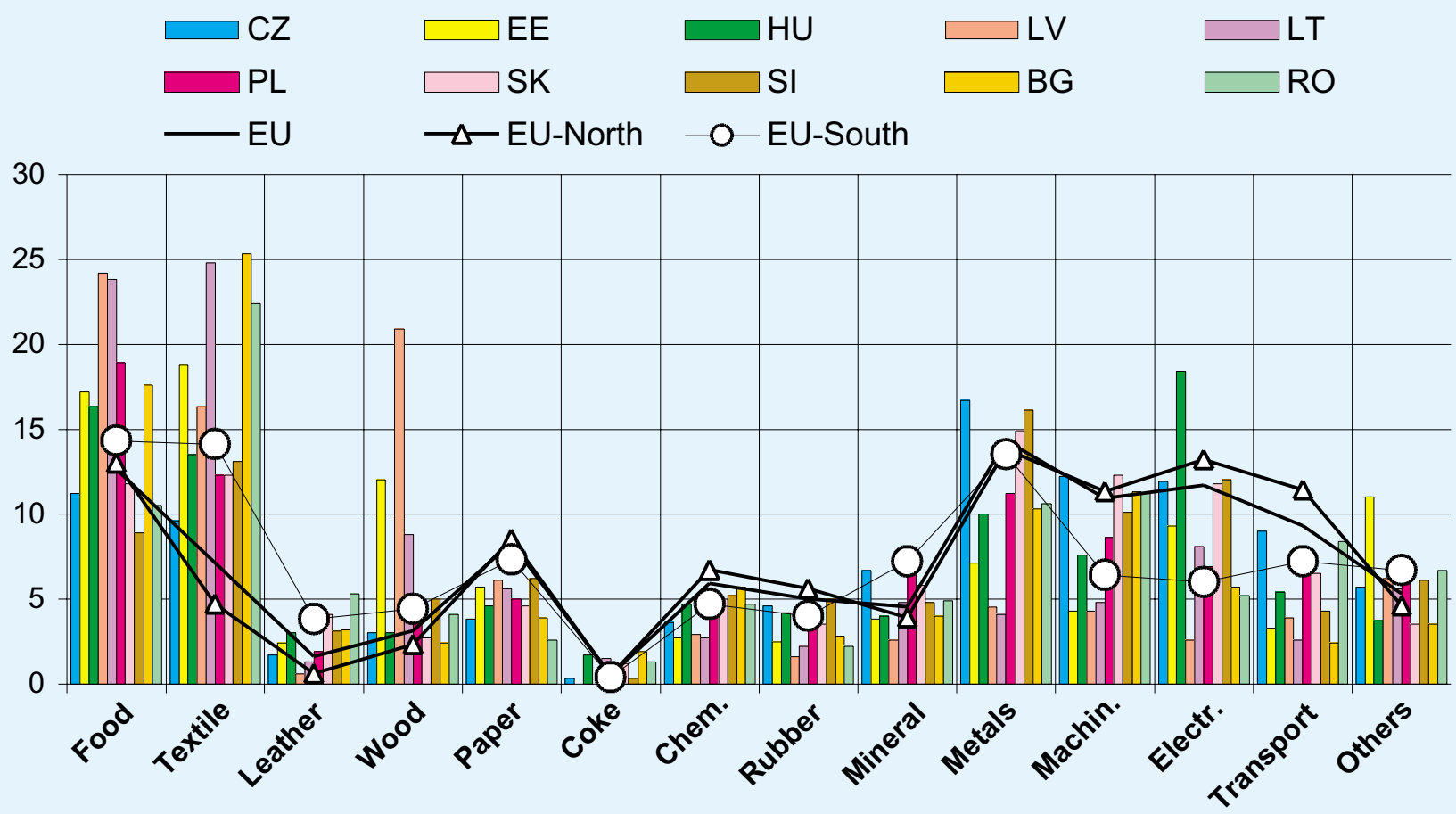
Source: WIIW calculations based on WIIW Industrial Database and AMECO.

Graph 4.A.5.5 Manufacturing production structure in 10 acceding and candidate countries compared to EU-15, 2001



Source: WIIW Industrial Database, Eurostat NewCronos.

Graph 4.A.5.6 Manufacturing employment structure in 10 acceding and candidate countries compared to EU-15, 2001



Source: WIIW Industrial Database, Eurostat NewCronos.

Over the 1990s, the exports of five EU countries became more focused on the key exporting sectors (Graph 4.A.5.7 illustrates the shares of the largest five 3-digit NACE industries in total manufacturing exports). The increased export specialisation was driven by the aircraft and spacecraft industry, motor vehicles and pharmaceuticals in France; basic chemicals and pharmaceuticals in Ireland; office machinery and computers and electronic components in the Netherlands; telecommunications equipment in Finland; and by telecommunications equipment and pharmaceuticals in the United Kingdom. In Greece and Portugal, export structures became more diversified, while in the rest of EU-15, changes in the degree of specialisation in exports were small.

Export specialisation in trade with the EU increased in most of the ten Central and East European candidate countries between 1995 and 2001 (exceptions are Latvia, Lithuania and Poland – see Graph 4.A.5.8). EU-15 exports from the three Baltic States, Bulgaria and Romania are more focused on the five key sectors than exports from the other acceding countries, with the 5 largest exporting industries accounting for some 60 % of the total in these five countries.

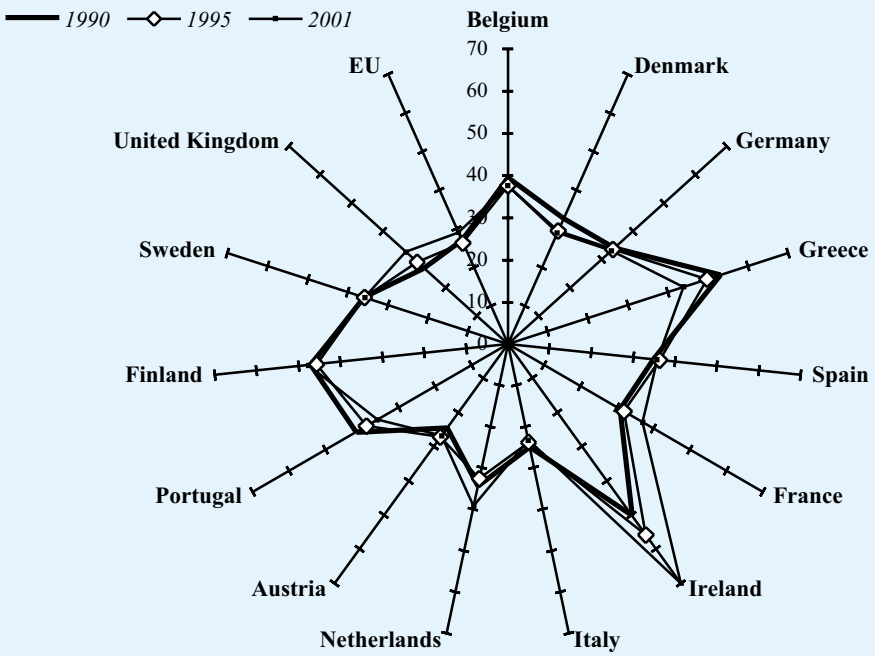
Concentration in EU-15

In most industries in the EU-15 area, geographic concentration of production activity as well as exports decreased strongly during the 1990s. Measured by the share of the 3 largest countries in total EU-15 production, concentration rates rose only in three out of the 14 main sectors: coke and refined petroleum products; leather products; and transport equipment.

Leather products and transport equipment are the most concentrated industries (Graph 4.A.5.9). In these two industries, the leading 3 countries together produce about 90 % of the total EU-15 output. Italy expanded its share in the leather industry from 46 % in 1990 to over 57 % in 2000. In the transport equipment industry, both Germany and France increased their – already high – output shares.

Production activity is most dispersed in the wood industry, where the 3 largest countries account for some 50 % of total EU-15 production. Geographical concentration in the wood industry decreased over the 1990s, but less than in electrical and optical

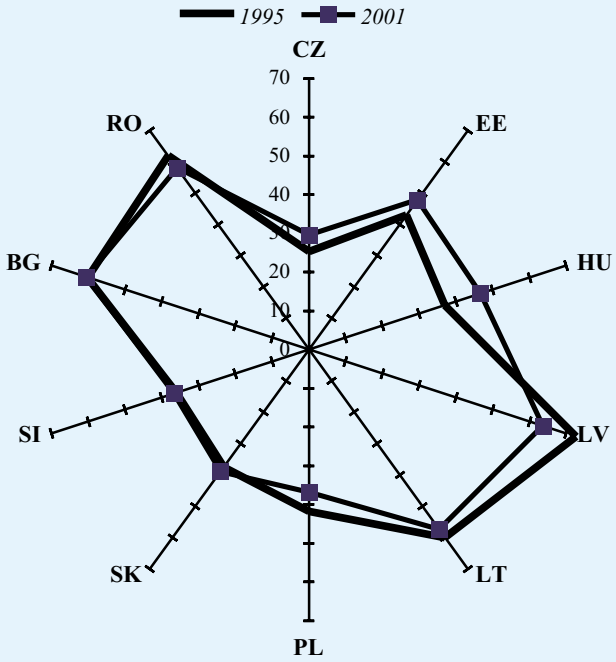
Graph 4.A.5.7 Export specialisation in EU-15 (CR5)



Note: Share of 5 largest industries in exports, calculated from 3-digit NACE subsections of manufacturing.

Source: WIFO calculations using Eurostat COMEXT.

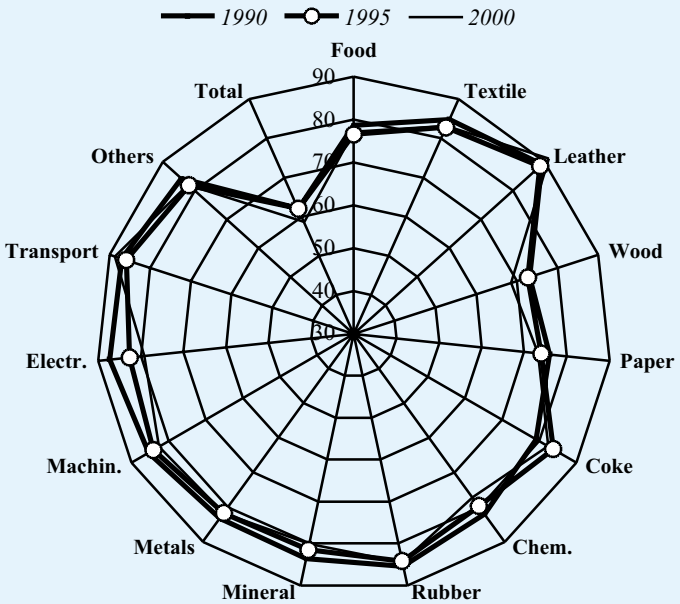
Graph 4.A.5.8 Export specialisation in 10 acceding and candidate countries (CR5)



Note: Share of 5 largest industries in exports to EU-15, calculated from 3-digit NACE subsections of manufacturing.

Source: WIIW calculations using Eurostat COMEXT.

Graph 4.A.5.9 Geographical concentration of manufacturing production in EU-15 (CR3)



Note: Share of the 3 largest countries in total EU-15 production by manufacturing industry.

Source: WIFO calculations using Eurostat SBS.

equipment and in chemicals, which recorded the largest decreases in their concentration ratios.

Analysis at the more disaggregated NACE 3-digit level confirms the tendency towards more dispersed production patterns in EU-15 manufacturing. Geographical concentration of manufacturing production (share of the 3 largest countries in total production) decreased during the 1990s in two thirds of 95 EU-15 industries. Among the activities where geographical concentration declined the most were large industries such as basic chemicals and the manufacture of television and radio transmitters. In these two industries, the share of the 3 largest countries in total EU-15 production declined by 7 and 9 percentage points respectively. The largest increase in geographical concentration during the 1990s was recorded in the aircraft and spacecraft industry, where the share of the 3 largest producer countries in total EU-15 production rose by 9 percentage points.

The trend towards a stronger geographical dispersion was even stronger in exports than in production activity. The share of the 3 largest countries in total EU-15 manufacturing exports increased in only 6 out of 95 industries between 1990-2001. On average, the export share of the 3 largest countries decreased by 11 percentage points across the industries. Most of the decline in the geographical concentration of exporting activity took place in the first half of the 1990s, while changes in the second half of the decade were less significant.

Among the different types of industries[101], production activity is most concentrated in the technology-driven branches. This is in line with the predictions of modern location theory which stresses the importance of knowledge spillovers and pooled labour markets in dynamic industries. Mainstream industries and capital-intensive industries are geographically more dispersed than other industries.

Overall, the evidence does not support the view that the internal market should lead to increased geographical concentration of either production or exporting activity. In most industries, geographical concentration declined during the 1990s. New economic geography models suggest that economic integration, by lowering the costs of trade, should favour the core regions and possibly, in a more advanced stage of economic integration, the periphery. The above evidence for EU-15 shows few signs of a strengthening of the core at the expense of the periphery. On the contrary, in the majority of industries, geographical concentration has decreased as core countries – Germany, and to some extent France and Italy – lose production shares to the periphery, mainly Ireland, Finland, Sweden, the United Kingdom and Spain.

One might argue that a decade is too short for analysing fundamental changes in industry location. During the 1990s, economic growth in Germany was weaker than in most other EU-15 Member States; in particular, some of the peripheral Member States registered very strong growth rates. This reduced the strength of the home market effect in Germany and reduced the centripetal forces in industries which heavily rely on the home market. The weak performance of the home market could be one of the reasons for the declining production shares of German industries in research- and capital intensive branches.

Haaland et al. (1999) show that the geographical distribution of expenditure is an important determinant of the location of production activity. Deepening economic integration in Europe has further strengthened the role of market size in location decisions. Furthermore, industry concentration affects expenditure concentration and vice versa, triggering a process of cumulative causation as predicted by the new economic geography. Another interpretation of the increasing dispersion of production activity, also stemming from the new economic geography, is that the further reduction of trade costs within EU-15 has made peripheral countries more attractive when higher wages and congestion costs drive production activity away from the core.

4.A.5.5 Implications for the future industrial landscape in Europe

Factors determining the location of industries

Earlier studies which looked at the effects of the Europe Agreements on individual EU-15 members came to the general conclusion that the effects of trade liberalisation would be larger on the candidate countries than on EU-15.[102] Of the Southern EU-15 countries, Greece stood to gain the most due to the potential for increased exports and foreign direct investment to Bulgaria and Romania, although some sectors (chemicals, transport equipment and natural resource intensive sectors) might lose (Dimelis and Gatsios, 1995). Spain would benefit from its large

[101] The typologies referred to here are described in Appendix 4.A.4 above.

[102] The Europe Agreements entered into force in 1994 for Poland and Hungary, 1995 for Bulgaria, Romania, the Czech Republic and Slovakia, and 1998 for the Baltic States and Slovenia.

domestic market, while it was expected to lose some market share in exports and suffer from some diversion in foreign direct investment flows (Martin and Gual, 1994). Portugal was expected to be the main loser in both export market shares and foreign direct investment inflows (Corado, 1994).

The post-war experience in the EU is probably not a good guide for predictions on income convergence and specialisation patterns following the next enlargement. Today, the EU market is more integrated due i.a. to the internal market and monetary union. Restrictions on foreign direct investment have been dismantled; new forms of inter-firm co-operation have emerged; and the transport and communication networks are more developed, which facilitates the geographical dispersion of production activities.

Location theories suggest that the impact of the forthcoming enlargement be larger on two groups of countries within EU-15: first, countries with industrial structures that are closer to those of the acceding countries; secondly, countries which are geographically closer to the acceding countries. According to Traistaru et al. (2002), both factor endowments and geographic proximity to core European countries determine the location of manufacturing in the acceding countries. Three groups of factors are discussed below in view of their importance to the future industrial structure in Europe: comparative advantages (factor endowments), trade costs (including transport costs, which are linked to the geographical distance to markets), and factor mobility are particularly important.

— *Factor endowments*[103]: Boeri and Brücker (2001) show that the stocks of physical capital as well as the human capital endowments in the acceding and candidate countries are significantly below the EU average. The quality of education in the acceding and candidate countries falls short of the average standards in the present EU. However, in comparison to those EU-15 members which have roughly similar levels of income as the acceding and candidate countries, the human capital endowments of the acceding and candidate countries are high (see also Landesmann and Stehrer, 2002). In general, the acceding and candidate countries have a comparative disadvantage in terms of endowments in technology, the institutional framework and public infrastructures.

Most empirical studies show patterns of industry specialisation across countries which correspond to the strengths in factor endowments: the acceding and candidate countries are specialised in labour-intensive, resource- and energy-intensive production. Relative to EU-15, the acceding and candidate countries in general have a comparative disadvantage in R&D- and human capital-intensive industries. However, cross-country differences can be significant. The data on industrial specialisation of countries presented above suggests that the majority of the Central and East European acceding and candidate countries currently have an industrial structure which is between that of the industrially less advanced EU-South (Greece, Portugal and Spain) and the more advanced EU-North countries (Belgium, Germany, France, Italy and the United Kingdom). At country level, the production structures in Czech, Hungarian, Slovenian, and Slovak manufacturing are very close to the EU-15 average; Poland is slightly different; while the Baltic States, Bulgaria and Romania are far apart from the EU-15 structures.

Policy measures can shape the structure of national factor endowments (Midelfart-Knarvik and Overman, 2002). Interactions between trade and education, or between trade and immigration, as well as technological and pecuniary externalities can also influence comparative advantages (Venables, 2001). Finally, comparative advantages of the acceding and candidate countries can change also as a result of inflows of foreign capital and foreign direct investment bringing in technology and firm specific brands.

— *Trade costs*: EU accession implies a move from what is close to a free-trade area into a customs union and into the internal market. Membership in the customs union implies i.a. the abolition of all the remaining formal trade barriers such as import tariffs and export subsidies within the EU. For some acceding and candidate countries (Poland, Slovenia, Bulgaria and Romania), the adoption of EU's common customs tariffs implies reductions in the tariffs on imports from outside the EU.

The accession to the internal market reduces also non-tariff barriers to trade and is hence likely to lead to an increase in trade volumes (see Lejour et al., 2001). First, administrative barriers to trade, such as customs formalities, will be eliminated or reduced to levels comparable to those between current EU members. Secondly, the internal market reduces technical barriers to

[103] There is ample evidence of the differences in factor endowments between the accession countries and the EU; see e.g. European Commission (1994), Dobrinsky and Landesmann (1995), Landesmann (1995), Boeri and Brücker (2001).

trade by means of a harmonisation of rules, introduction of common minimum safety requirements, or the mutual recognition of different national technical regulations. Finally, EU membership will also reduce other types of risks and uncertainties related to trade.[104]

The abolition of formal and administrative trade barriers will considerably reduce transaction costs between the acceding countries and the rest of the EU. However, although transport costs may decline, they will not disappear completely, and geographical proximity to the largest markets within the EU will continue to play a significant role. Transport costs can also be an important obstacle to vertical fragmentation, i.e. carrying out different stages of production in different locations. The relative importance of intra-industry trade and outward processing trade seems to be stronger among regions with territorial contiguity, suggesting that the international division of labour is not influenced only by production cost differentials, but also by transport costs (Caetano et al. 2002). A further geographical fragmentation of production activity can affect middle-income countries in EU-15 for example when the processing of primary or labour-intensive products is relocated to low-wage regions near the borders.

— *Labour mobility and migration:* migration rates in Europe are low in comparison with the US. Present migration rates are low also by historical standards.[105] Temporary restrictions on labour mobility from Portugal and Spain after their accession to the EU appear to have had relatively small effects on migration flows (Boeri and Brücker, 2001). However, drawing on past experience to predict the implications of the next EU enlargement in the EU may be a mistake. In the past enlargements, the income differentials between the new (Southern) members and the rest of the Union were not as large as those between the present EU-15 and the majority of the acceding Central and East European countries. Furthermore, while past migration flows mainly involved blue-collar workers in manufacturing and unskilled labour in services, future migration might be more dispersed. The formal education levels of migrants from the acceding countries are high, and over time they may increasingly compete with high-skilled workers in modern industries in the present EU.

  Also geographical factors affect migration flows. Around 80 % of the current migrants from the acceding and candidate countries reside in Austria and Germany. Migrants tend to move into prosperous industries and regions, where output and investment adjust to accommodate the increase in labour supply (Boeri and Brücker, 2001). A higher propensity to migrate to the EU-15 countries which are geographically closer to the acceding and candidate countries can strengthen the agglomeration forces in these countries.

Existing studies on the effects of enlargement on industry structures point to two directions. Analysis of trade flows suggests that in the short run, the acceding and candidate countries appear to have comparative advantages in capital- and labour-intensive industries, and thus compete primarily with the Southern EU-15 members. In the long run, the relatively high stock of human capital in the acceding and candidate countries could give them a comparative advantage in human capital intensive industries. In the latter case, they would compete mainly with the Northern EU-15 members.

The studies of Brown et al. (1997) and Baldwin et al. (1997) based on general equilibrium models conclude that EU-15 as a whole gains from enlargement, although the South gains much less than the North. In particular, Germany would gain the most, whereas Portugal would be the only country losing due to its heavy reliance on textiles, the sector most likely affected by enlargement.

Studies based on new economic geography models show gains for the East, while the expected effects on EU-15 depend strongly on the scenario considered (see Forslid et al. 1999, Baldwin et al. 2000, Midelfart-Knarvik et al. 2000). Forslid et al. (1999) found that the effects on enlargement will be less favourable on the countries which are geographically closer to the new Member States (Austria, Denmark, Germany and Switzerland) than on other European regions; the overall effect on these four countries will be negative due to significant losses of production activity in labour-intensive sectors.

In the acceding countries, peripheral regions may lose in industries where transport costs are important. On the other hand, it is possible that regions situated closer to Eastern urban centres are better positioned to exploit potential economies of scale and hence to register significant production growth (Palme, 1999).

[104] One type of such a risk is the possibility that one agent defaults in the chain from producer to consumer. This is especially important for goods moving from East to West as export credit guarantees are less well developed in the accession countries.

[105] In the 1960s migration rates in Europe were much higher than in the 1990s. Puga (2001) discusses several possible reasons for the low mobility in Europe.

Sensitive regions in EU-15

The proximity of Germany and Austria to some of the more advanced acceding countries makes them more sensitive to the effects of enlargement than the more distant EU regions. On the other hand, the similarities in factor endowments between some of the lower-income Southern EU members and the acceding countries suggest that the next enlargement might have stronger effects on countries such as Greece and Portugal. In the following, the situation of these four countries is briefly reviewed.

Greece and Portugal

Among the EU-15 members, Greece and Portugal are considered the most vulnerable to the more intensive competition resulting from deeper integration of the acceding and candidate countries. The effects on these countries are likely to be strongest in low-wage industries and in industries with little product differentiation and limited spillovers.

The two countries have rather similar industrial structures. The three most important industries in Portugal are food, textiles and electrical and optical equipment (in terms of production) and basic metals (in terms of employment), while food, coke and refined petroleum and basic metals are most important in Greece. Industry is, on average, characterised by low technology and low returns to scale; the capital-labour ratios are moderate but increasing. Greece and Portugal are also the two countries with the lowest shares of non-manual workers and employees with higher education in total manufacturing employment. The final demand bias (the consumer orientation of the industry) is the highest in the EU (see Midelfart-Knarvik et al., 2000). Both countries have heavily regulated product markets, and are relatively weakly placed with regard to indicators on research, technology and innovation (see European Commission, 2001).

Ardy et al. (2002) identify four areas where the economic impacts of enlargement on the relatively less developed EU-15 countries could be particularly strong: allocations from the EU Structural Funds and other fiscal implications; competition; foreign direct investment; and the widening membership of the economic and monetary union. Enlargement may lead to a re-orientation of inward foreign direct investment away from Portugal and Greece (and possibly Spain) towards the acceding countries. The evidence so far, however, does not indicate such a substantial diversion of foreign direct investment flows (see UNCTAD 2001, Buch et al. 2001 and 2003).

Existing literature suggests that trade liberalisation preceding the enlargement has already led to higher competition between the acceding and candidate countries and EU-15, in particular in industries characterised by labour intensive production. Analysis carried out for the present European Competitiveness Report (see Section 4.5.1 of this Chapter) suggests that Portugal and Greece may have lost market shares in the EU to Bulgaria and Romania, both of which show rather similar patterns of trade and industrial specialisation in low-skill, labour-intensive as well as natural resource-intensive branches.

It is likely that Bulgaria and Romania will mirror the developments in Greece and Portugal after the mid-1980s, when the latter rapidly specialised in industries with slow growth and unskilled labour. This would lead to a further intensification of competition among the four countries. During the 1990s, changes in the structure of manufacturing output were modest in Greece, while Portugal significantly diversified its manufacturing structures. Among the EU-15 countries, Greece is among those with the highest dependence on a small number of the key manufacturing industries (half of manufacturing output originates from the three largest industries).

Germany and Austria

Within EU-15, Germany, Austria, Finland and Italy together account for some two thirds of the trade with the acceding Central and East European countries. Conversely, of the acceding countries, the Czech Republic, Hungary and Poland account for two thirds of the trade with EU-15 (WIIW, 2002). The German regions which are located on the border with the Czech Republic and Poland trade twice as much with these countries as do other German regions (Boeri and Brücker, 2001). According to Heijdra et al. (2002), Germany and Austria are the two countries which will be most affected by East-West market integration, whereas for the other EU-15 Member States economic integration seems less important than the fiscal implications of enlargement.

Effects of trade liberalisation with the acceding countries have already been felt in Austria and Germany as an intensification of competition. The market shares of both Austria and Germany on the EU-15 market have decreased, and their losses correlate with the market share gains of the acceding countries. Both countries are becoming increasingly specialised in technology-intensive exports, while capital- and labour-intensive industries and mainstream industries are becoming less important in total exports.

Results of earlier research on border regions are conflicting. The findings of Hanson (1998) suggest that better access to a larger market following trade liberalisation positively affects wages and employment in border regions. However, numerous case studies on border regions point to a rather diverse development of these areas after trade liberalisation. Niebuhr and Stiller (2002) conclude that neither theoretical nor empirical studies provide comprehensive and consistent results on the impact of integration on border regions.

Palme (1999) finds that the opening of the markets in Central and Eastern Europe has benefited Austrian manufacturing. In a study on the effects of enlargement on Austrian regions, the authors conclude that no major structural changes need to be expected at the regional level (Mayerhofer and Palme, 2002b). Regarding the competitiveness of the German manufacturing industry as a whole, enlargement is not likely to lead to major restructuring in Germany either. However, the industrial structure of the border regions in Germany appears more vulnerable to competition from the new Member States. According to Scharr and Untied (2001), industry even in the more advanced Bavarian border regions is characterised by labour-intensive, wage-sensitive production.

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Additional useful information on the work of Commissioner Erkki Liikanen and the Enterprise Directorate-General is available through printed publications and on the web.

Commissioner Erkki Liikanen, responsible for Enterprise and the Information Society:
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Enterprise Europe is a free-of-charge newsletter published quarterly in the 11 Community languages by the Enterprise Directorate-General. It covers the whole range of Enterprise DG's work, announcing new initiatives as well as providing practical information.

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