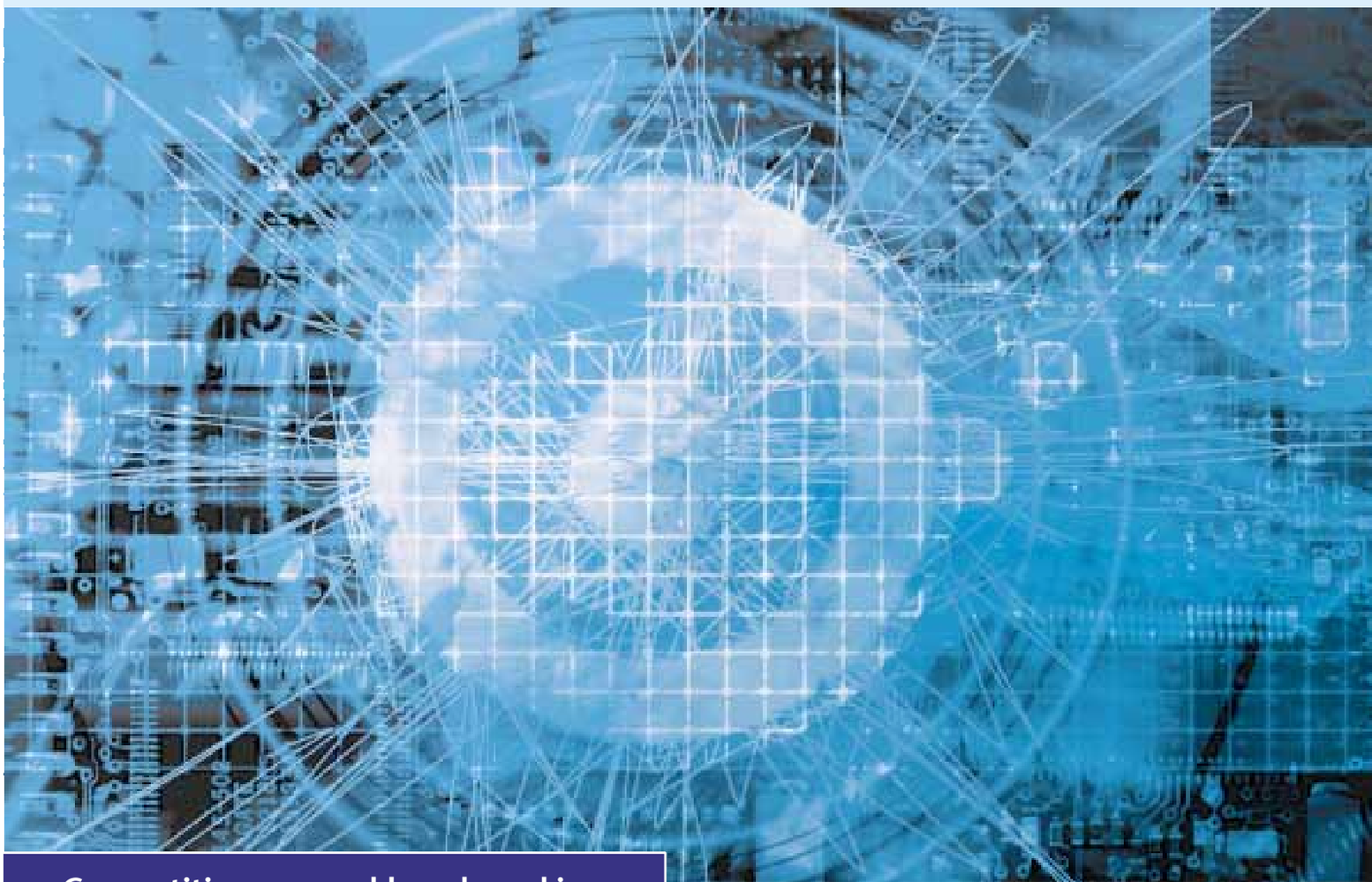
Enterprise publications



Competitiveness and benchmarking

European competitiveness report 2002

European competitiveness report 2002

European Commission

European competitiveness report 2002

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European Commission

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Contents

Executive summary

The 2002 competitiveness report complements and extends the material discussed in the 2001 European competitiveness report. The two complementary parts concern, respectively, the importance of human capital in European economic and productivity growth and productivity performance in European services. These complete the overview of European productivity performance and its proximate determinants in the period since the mid-1990s initiated in last year's competitiveness report.

Two other parts of the present report are new to this reflection. First, the report discusses the relationship between enterprise policy and competition policy and the synergy that exists between the two policies. Maintaining and strengthening this synergy is important because there is a clear link between the intensity of competition in an economy and its competitiveness on a global scale. Second, a possible conflict exists in the unrestrained pursuit of economic and productivity growth and the respect for sustainability constraints. The report reviews the performance of the manufacturing industry in the European Union from the perspective of environmental sustainability.

Human capital and productivity growth

Last year's report explored the causes of the widening of the productivity gap of the European Union vis-à-vis the United States by focusing, basically, at the innovative capacities of EU and US manufacturing. It highlighted the role of R & D but also of investment, particularly in ICT, in output and productivity performance.

This year's report extends the scope of the analysis to human capital developments. Indeed, given the crucial complementarity between physical and human capital formation, the EU's underperformance might be rooted also in inadequate supply of human capital.

The report found that, in general, and at European Union level, this was not the case but trends do point to possible problems ahead. At country-level, a wide variety of situations exist and some imbalances are already present.

Skills and labour demand

From the point of view of labour demand, an overall skill upgrading of EU employment has taken place in recent years, with a shift from the low to the intermediate level of educational attainment within sectors and a sustained net growth in the demand for highly-educated workers.

The structure of labour demand in the European Union has changed in important ways in recent years. For every new job creation in manufacturing corresponded eight in the services sector. By 2000, two out of every three jobs in the European Union were in the service sector.

However, data for 1995–2000 suggest that the changing nature of labour demand in the European Union is accounted for largely by changes in the skill content of jobs rather than changes in the sectoral location of employment growth.

Over the period 1995–2000 employment growth was largely confined to jobs for medium- and high-skill workers. The demand for skilled workers continues to be strongest in high-tech and high-education sectors, which accounted for more than a third of net job creation between 1995 and 2000. In contrast, the number of low-skill workers in employment fell in almost all sectors.

The data also suggest that the growth of medium- and high-skill demand (as measured by employment) in the European Union has outstripped the growth of the supply of employees with the corresponding attainment levels. With the exception of Austria and Sweden, all Member States display a higher growth of employment of high-skill workers that the corresponding attainment growth, suggesting that the tightening of the labour market for high skills is a general phenomenon across the European Union. Considering that the participation rates are already highest for this group, the scope for filling this gap by increasing participation looks rather limited.

Supply trends, accumulation and mismatch

From the point of view of labour supply, a first finding is that the average years of schooling in the European Union has been rising and, in 1999, reached 87 % of the corresponding US level, up from around 70 % in 1971.

How well the distribution of educational attainment for the adult population matches the skill content of labour demand is an indicator of the extent to which the various national education systems and labour market institutions are able to match skills to jobs. The evidence suggests that the overall efficiency of the matching process, thus defined, has been better in the European Union than in the United States. The skill composition of employment and that of the wider population (aged 15–65) was closer in the European Union than in the United States in recent years. This implies that the educational attainment of (potential) labour supply fits better the skill content of labour demand in Member States than in the United States. Since 1995, however, the United States has seen a more pronounced improvement in the employment efficiency of education output than the European Union as a whole.

The match between skills demand and the skill endowments of the younger generation (aged 25–34) is substantially better than for the overall population, suggesting that the matching performance in the European Union may improve further in the future if this trend is sustained. Realising this potential, however, requires that labour mobility within the European Union in increased because the aggregate relationship between the distribution of attainment for the young age cohort and skills demand does not hold equally strong across individual Member States.

Between the skill composition of those aged 15–64 not participating in the labour market and the skill content of demand the fit is rather poor, both in the European Union and in the United States, reflecting the skill selectivity in employment growth in the latter half of the 1990s, which has been skewed towards the employment of high-skill professionals. Even so, the performance of the European Union, both at an aggregate level and for individual Member States, is better than the United States and may improve further following the development and implementation of policies and programmes to promote social inclusion and enhance labour market participation.

Skill gaps

The combination of these factors — growth in high-skilled employment, low levels of unemployment amongst the high-skilled and relatively low growth in the attainment of tertiary education — suggest that tertiary-level skill gaps, which already have appeared in some Member States, may emerge more widely in other Member States' economies as demand exceeds the supply of high-skilled workers.

Skill gaps, reflecting the tightness of the labour market for high-skilled workers, are most significant in the fastest growing sectors of the economy (general business services, and health and social work) across the EU, with particularly high values for Luxembourg, the Netherlands and the United Kingdom. Skill shortages have already appeared in Germany, France, Italy and the UK, despite high unemployment in the first three (around 70 % of the EU science and technology employees are found in these Member States). Skill gaps are prevalent in manufacturing across all Member States, following significant structural changes in the skill content of jobs as production has been shifting to more high-tech, innovative, manufacturing processes. The effect of this shift was particularly pronounced in Austria and the United Kingdom.

Data also show that, compared to the US, the European Union has a higher proportion of non-participants in the labour force with tertiary-level skills relative to the skills of those employed. This indicates that there is a potential, if limited, pool of skilled labour that is not currently active in the labour market and that increased participation may ease some of the pressures exerted by prevailing skill gaps. Furthermore, it is clear that the potential for a better spatial allocation of labour in the European Union will require measures to support labour mobility across EU borders.

The comparison of recent trends raises suspicions of an imperfect match between human and physical

capital formation in the European Union, despite its convergence in terms of the stock of human capital towards the level of the United States. Indeed, the rate of growth in 'physical' capital intensity was lower in most Member States in the 1990s compared with the earlier decade, while 'human' capital growth tended to increase. However, in most Member States for which comparative data exist for the two periods hourly labour productivity growth declined in the 1990s relative to the previous decade. In contrast, the United States during these periods saw an acceleration in labour productivity growth, an increase in the rate of accumulation of physical capital and a modest deceleration in the growth of employment and in human capital accumulation.

As recognised and highlighted by the European Council in Lisbon, the access for all to appropriate education and training is fundamental to meet the ambitious objectives set for the EU. Following Lisbon the EU Education Ministers reported to the Council on the concrete future objectives of education and training systems. The three main objectives were identified as: increasing the quality and effectiveness of education and training systems in the EU; facilitating the access of all to the education and training systems; and opening up education and training systems to the wider world. The Barcelona European Council (March 2002) has confirmed these proposals and has set the objective of making its education and training systems a world quality reference by 2010.

Whereas education (school, university) and initial vocational training are focusing on younger people, continuing vocational training aims at updating and upgrading the skills of those that are or have already been in the labour market. For the time being however, the % of people that have regularly access to continuing vocational training in Europe, is too low. Therefore it is important to define and implement the appropriate measures and incentives that will it make more attractive for the companies, organisations and the individual worker to participate in continuing vocational training to maintain or improve their skills and competence. It also needs to be recognised that the EU definition of lifelong learning goes beyond vocational training to include broader competencies such as social skills, languages and, above all, learning how to learn. The objective is to create a genuine learning culture.

Productivity growth in EU services

This year's report completed the exploration of the causes for the productivity gap with a survey of developments in the services sector. Indeed, the problem of weak productivity growth in the European Union in recent years is particularly acute in the service sector.

Services are the most important sector in our economies, accounting for some 70 % of all jobs and of GDP. The demand for services tends to rise faster than incomes, indicating a continuous increase in the share of services in the total economy.

Productivity developments in business sector services

Many service industries are highly labour intensive, with allegedly limited scope for raising productivity through investments in physical capital. Traditionally, productivity growth in services has indeed been slower than in manufacturing industries — though sectoral differences across service industries are large. Simultaneously, employment in services has increased at a faster rate than in other sectors. Clearly, developments in the service sector will be the key to economic growth in the future.

The vigorous introduction of many ICT applications in this sector has not contributed, apparently, to rapid productivity growth, or its acceleration. Indeed, the slowdown in aggregate productivity growth in the European Union during the second half of the 1990s compared to earlier years, and the small acceleration in productivity growth in the manufacturing sector, suggest that the service sector will have seen a notable slowdown in labour productivity growth during this period. The problem is, of course, compounded by the fact that the share of services in EU GDP has been rising over time even though it remains considerably lower than in the US economy.

Productivity growth in business sector services in the United States accelerated from an average of 1.3 % in the period 1990–95 to an average of 3.1 % in the period 1995–99. In contrast, in the EU, with the exception of two (France and the United Kingdom) of the seven Member States for which comparable data are available, service sector productivity growth in fact declined during the second half of the decade, and where it rose it did so by a modest 0.1 to 0.3 percentage points. In contrast to productivity, employment growth accelerated in both regions.

Analysis of the individual sectors that constitute the market services reveal that the stronger US performance in the aggregate market services productivity

results from their very strong productivity gains in the wholesale and retail trade sector, which compare with weak growth on the European side. On the other hand, the European Union witnessed a very strong productivity growth in telecommunications, in the late 1990s, while in financial intermediation and in the transport sector, some — but not all — EU countries also recorded solid productivity growth. Productivity developed very weakly, and even declined in some countries, in the hotel. and restaurant sector as well as in the wholesale and retail trade sector.

For three sectors within market services, productivity growth seems to be negatively correlated with employment growth: hotels and restaurants, post and telecommunications, and transport and storage. Clearly, in the case of the post and telecommunications sector, the negative correlation is a reflection of the possible dominance of the post component of the data; modern post and telecommunications encompass very different activities and data that refer to this unrepresentative composite sector may not be entirely trustworthy. For the other sectors, the evidence of any correlation is less clear. For the sectors where a trade-off between employment and productivity growth seems to exist, one finds an upward shift in this relationship between the first and the second half of the 1990s: at present, a given productivity growth rate seems to be associated with higher employment growth.

It is possible that measurement errors conceal the underlying productivity performance of the service sector. Measuring accurately the output of this sector, especially in a period of rapid technological change, is extremely difficult. If the inflation in the service sector is overstated (invariably because of difficulties in accounting for quality improvements following innovations and organisational changes) then the implicit productivity growth is understated. Extended to the economy as a whole, this suggests that European productivity growth may not have been as weak as *prima facie* the data suggest.

Factors influencing productivity in services

Among the possible determinants of productivity, innovation — introduction of new products, applying a new technology, organisational changes etc. — is an important one. However, innovation in services may be poorly captured by traditional measures such as R & D spending, since services innovations tend to be closely linked with the way in which the services are delivered, and may result from the interaction between the service supplier and the customer. Survey data nonetheless indicate that high-technology service firms, such as computer services and telecommunications, carry out innovative activities even more often than manufacturing firms.

Typically innovations in this sector are introduced through acquired technology — ICT, organisational changes and human capital — rather than through direct R & D spending by service firms themselves. The service sector is an important user of ICT and, as mentioned earlier, lower levels of ICT expenditure are at the source of the recent slowdown in productivity growth in the EU. Institutional factors (bargaining conventions, part-time work arrangements, length of working day etc.) could play a crucial role in this process.

The service sector is generally characterised by below average productivity growth and at the same time, an increasing share in GDP. Yet, the implied greater employment growth has not materialised sufficiently in the European Union to make a decisive difference to Europe's employment performance. Because of the rising demand for services as incomes grow, the European Union must ensure that the potential employment gains associated with the growth of the service sector are realised. This requires that obstacles to the growth of the service sector be removed.

Market liberalisation, by increasing competition and making markets more responsive to change, tends to increase the speed of diffusion of new productivity-enhancing innovation across the economy. Recent initiatives already, or to be, undertaken within the Lisbon/Barcelona framework ought to contribute to raising productivity growth and employment growth in the service sector. Examples from the Member States where early liberalisation and deregulation has occurred (utilities in the United Kingdom, Finland and Germany, for example), tend to confirm this. Productivity has not only been faster than in others but it has also accelerated during the second half of the 1990s. Thus, market liberalisation measures as well as steps towards a single market in financial services ought to be pursued vigorously.

Finally, and following the example of what happened in the United States, there seem to be important, and as yet untapped, reserves of productivity in the distribution and retail sectors. Releasing them would necessitate easing of the environment

determining the performance of this sector, including rules that govern the entry of new firms.

Enterprise policy and competition policy

Competition and enterprise policies complement each other. They share the aim of increasing social welfare. The main objective of competition policy is to prevent distortions of competition, thus enabling the competitive process to function. Enterprise policy aims at increasing competitiveness of firms and entire industries by creating a favourable business environment and by addressing particular market failures. Both policies play a significant role in the creation of the world's most competitive and dynamic knowledge-based economy capable of sustainable economic growth, the goal set out by the Lisbon European Council.

Competition and enterprise policies are closely entwined in the EC Treaty. Enterprise policy focuses on the conditions necessary for safeguarding competitiveness, and the Treaty specifies that this objective should be achieved through the policies and activities pursued under all other provisions set out in it. However, no measure can be introduced which could lead to distortions of competition. The Treaty provisions on competition policy enable the Commission to balance the anti-competitive effects of a given agreement or state aid measure against their economic benefits. However, such balancing is not possible for abuses of dominant position and cartels. The EC Treaty and secondary competition law provide opportunities to take enterprise policy considerations into account.

Even though enterprise and competition policies share a basic view of market–led growth and are mutually reinforcing, each policy has its own emphasis. They need to be balanced, as the following examples make clear:

(1) Proper product and geographic market delineation is crucial for competition decisions. This is so because it makes it possible to calculate market shares that convey meaningful information regarding market power. While market definition is not required for enterprise policy, its instruments — such as internal market legislation, standardisation and benchmarking — may speed up changes in market structures which should be reflected in the appropriate market delineation of competition decisions.

(2) Enterprise policy emphasises the need to foster innovation by creating widespread and closely entwined knowledge pools, which in particular help to raise the R & D potential of SMEs. From a competition perspective, certain cooperation agreements may imply anti-competitive behaviour such as market foreclosure or hampering rivals' innovation capability.

(3) Concentrations and cooperation agreements between enterprises have the potential to increase productive efficiencies and thus competitiveness. Most cooperation agreements are not problematic for competition and benefit from antitrust exemptions due to efficiency considerations. For the same reason, the large majority of mergers is also approved without raising any competition concerns.

(4) Technological development and innovation, the drivers of increased productivity, are by their nature uncertain. Assessing their effects for future market dynamics and for future competitive conditions is a permanent challenge. Competition decisions can take such developments into account to the extent that their consequences can be predicted with sufficient certainty.

(5) Overall reduction of State aid to a minimum is a generally agreed objective in light of their potential market distortion effects. Yet, market failures occur and justify targeted public support mechanisms at a European, national or regional level. A balance between State aid control and overcoming market failures needs then to be struck.

The situation in the United States is somewhat different from that in the European Union. This is the case for both institutional and substantive issues, as concerns the synergy between competition and enterprise policies. For example, the US competition authorities do not supervise aid granted by federal or state institutions. Subsidies in the fields of SMEs and venture capital, R & D in 'strategic sectors' like aerospace or semi-conductors appear to have been more generous and targeted than in the EU. The Commission and the authorities of third countries must continue to work for more coherence between the differing competition and related economic policies and to minimise scope for incompatible outcomes and for conflicts.

Currently, major parts of EU legislation governing competition law are being reviewed. This provides

an occasion to consider further ways to balance enterprise and competition policies.

The Green Paper on the review of the merger regulation opens a debate on the issue of merger-specific efficiencies. In particular, the question is to what extent verifiable efficiency gains resulting from a proposed merger can offset negative effects such as price increases caused by the creation or strengthening of a dominant position. Mergers in innovative sectors are a case in point, because economies of scale in R & D achieved through mergers must be balanced against the need to preserve sufficient R & D competition.

The modernisation of antitrust procedures will remove the need to notify certain agreements in advance, but companies will themselves have to check whether their agreements and practices comply with competition law. This will help to avoid time-consuming administrative procedures, but will also increase the necessity for rules guaranteeing sufficient legal certainty. In this context, emphasis must be also on the coherent application of Community law. The challenge of the review of the technology transfer block exemption regulation is to create a regulatory environment that fosters R & D cooperation and innovation while preventing anti-competitive practices that may reduce consumer welfare.

In its Communication on State aid and risk capital, the Commission has recently established new criteria enabling measures for the promotion of venture capital to finance the start-up and early stages of SMEs. The next step will be to evaluate to what extent this and other instruments have permitted an acceleration of entrepreneurial activity.

In sum, the interaction between the competition and enterprise policies of the European Union shows their synergy. Both policies need to adjust continuously to new challenges: new markets, new ways of doing business, new drivers of growth and of dynamic competition. The reformulation of enterprise policy in the light of the strategy adopted at the Lisbon European Council and the ongoing revision of competition legislation highlight the need to be constantly attentive to maintaining and strengthening this synergy.

Sustainable development and the EU manufacturing industry

At the June 2001 Gothenburg summit, EU leaders endorsed a strategy for sustainable development relating to economic, social, and environmental aspects of development. In this context the European Council stressed the importance of decoupling economic growth from resource use.

Manufacturing industry, directly involved in the transformation of materials into products, has often been considered one of the major contributors to environmental degradation. To examine the sustainability of growth requires taking a broader definition of productivity to include the concept of environmental productivity or 'eco-efficiency'. This notion takes into account the impact of production on material resource use and the emission of pollutants.

The presence of distortions in resource use and the absence of obvious market mechanisms for the reduction of emissions of pollutants make public action necessary. This can take different forms.

The major finding of this report is that EU manufacturing industry has very largely achieved decoupling its growth from pressures on resources and the environment. These substantial improvements in EU industry's eco-efficiency have been achieved through increased regulation and stronger market competition (Single Market programme, deregulation), but also through increased investment and better management of resources by industry itself.

Thus, despite the rise in manufacturing production over the last 20 years, emissions of acidifying gases declined by 67 % . Industrial emissions of ozone-precursors (local air pollutants) have been reduced in absolute terms by some 25 %. Production of ozone-depleting gases in the European Union has now almost ceased. Meanwhile energy consumption has remained broadly constant and industrial minerals consumption rose in line with production until 1993 but less rapidly since then. A fall has occurred in climate changing greenhouse gases since the Kyoto baseline date of 1990.

Environmental policies have had a clear role in these developments. For example, the most significant decoupling of acidifying gases from economic growth followed the Large Combustion Plants Directive of 1988. Environmental policy played a key role also in the phasing out of CFC ozone-depleters. Policy progress has also been made on local air pollution, albeit at a slower pace. Manufacturing industry has responded by developing new technologies, improving its management practices, and greater investment in pollution prevention technologies. It is clear that the additional resources made available by increased growth and produc-

tivity have been essential for the successful financing of environmental progress.

Internationally, the performance of EU industry compares favourably with that of US industry. In the extreme case of acidifying emissions, the eco-efficiency of EU industry has increased almost twice as quickly as in the United States.

To achieve these improvements EU industry has had to substantially increase its environmental protection expenditures that now stand at some 2 % of the value-added of the manufacturing and energy sectors. It is clear that this represents an aggregate average and that in some sectors the cost has been significantly higher. Also, these expenditures do not include all costs of environmental protection since some will be classified as higher input prices or investment in new capital equipment.

Introduction

The present 2002 competitiveness report complements and extends the material discussed in the 2001 European competitiveness report. The two complementary parts concern, respectively, the importance of human capital in economic and productivity growth and the productivity performance in European services. These, together with the discussion of the determinants of productivity performance in European manufacturing undertaken in last year's Report, provide an overview of European productivity performance and its proximate determinants in the period since the mid–1990s.

Two other parts of the report extend the discussion in other directions. First, the growth of knowledge-based industries, the central role of information and communications technologies (ICT) and the increasing importance of innovation in competitive performance in recent years have important implications for the conduct of policies in the EU. One particular aspect is the synergy between enterprise and competition policies. The report discusses the relationship between these two policies in their application in the EU.

Finally, in recent years it has become evident that success in increasing productivity, employment and economic growth will only be temporary unless it respects long-term sustainability constraints. These are often associated with environmental sustainability but the Gothenburg European Council endorsed a broader concept involving economic and social sustainability as well. While all sustainability aspects are crucial to Europe's future, the report examines only progress made by EU manufacturing industry in conforming to the environmental dimension in recent years.

The report is organised as follows:

Chapter I updates the evidence of productivity growth in the European Union and the United States during 2001 on the basis of recent data. The discussion in last year's report was based on provisional and forecast data. What has been particularly notable according to recent data is the mild slowdown in economic activity relative to initial expectations during 2001 and, especially in the United States, the continuing growth in labour productivity. While less strong than in previous years, US productivity growth continued during a year of recession, a feature that is at variance with the historical pro-cyclical performance of productivity growth. One interpretation of that is that it constitutes evidence suggestive of a structural break in the determination of productivity growth. In the European Union, productivity growth remained positive but a substantially weaker rhythm.

Chapter II examines the issue of human capital and its relationship to economic and productivity growth in the European Union. The issue of skill formation has been of great importance in the European Union and many initiatives have been developed to encourage it. Nevertheless, in recent years there has been, in parallel with the acceleration of economic growth, a concern that the demand for skilled employees cannot be met within the present EU labour markets. Some Member States appear to have experienced severe shortages. Not only national labour markets have been inefficient in providing the skills that firms require but also the persistently limited labour mobility in the European Union has not provided the necessary workers through migration. Yet, a key question is whether the under-performance of the European Union in productivity and employment growth during the second half of the 1990s could be attributed in part to problems associated with skill imbalances. This chapter gathers and discusses the evidence on this and related questions.

Chapter III reviews the performance of productivity growth in Europe's service sector. The problem of

weak productivity growth in the European Union in recent years has been particularly acute in the service sector. Productivity in this sector is more difficult to estimate and, despite the fact that many ICT applications have been introduced vigorously in services, this apparently has not contributed to rapid productivity growth, or its acceleration, here. Indeed, the slowdown in aggregate productivity growth in the European Union during the second half of the 1990s compared to earlier years, and the small acceleration in productivity growth in the manufacturing sector, suggest that the service sector will have seen a notable slowdown in labour productivity growth during this period. The problem is, of course, compounded by the fact that the share of services in EU GDP has been rising over time even though it remains considerably lower than in the US economy.

In the European Union, strong productivity growth in telecommunications was recorded during the late 1990s. In financial intermediation and in the transport sector, some Member States have also recorded solid productivity growth. The stronger US performance in the aggregate market services productivity results from their very strong productivity gains in the wholesale and retail trade sector, which compare with weak growth on the European side. For the sectors where a trade-off between employment and productivity growth seems to exist, one finds an upward shift in this relationship between the first and the second half of the 1990s: at present, a given productivity growth rate seems to be associated with higher employment growth.

Innovations in services may be poorly captured by traditional measures such as R & D spending, but survey data indicate that high-technology service firms, such as computer services and telecommunications, carry out innovative activities even more often than manufacturing firms.

Many services sectors have been traditionally highly regulated, but the general trend in the past two decades has been towards extensive liberalisation and regulatory reform. Evidence on market liberalisation points to enhanced productivity and higher growth following liberalisation measures. Structural reforms put forward at the European Council meeting in Lisbon in March 2000 call for a continuation of this process. The creation of a genuine internal market in services is a major challenge for the European Union.

Chapter IV reviews the relationship between enterprise policy and competition policy and, in particular, the way in which they complement each other. This complementarity is crucial for any coherent policy framework. High and sustainable productivity growth depends on a regulatory environment that enables enterprises to access new markets and to turn inventions into innovations; this is a key objective of enterprise policy. At the same time, this environment must also ensure that all market participants are subject to uniform rules, an objective pursued by competition policy. In principle, both policies are reinforcing each other. Safeguarding effective competition induces firms to search for efficiency-enhancing solutions that raise productivity and lead to product and process innovation, whereas enterprise policy corrects market failures and enables more firms to engage in market transactions, thus increasing the population of potentially innovative firms.

While enterprise and competition policies share a common of market-led growth, the reformulation of enterprise policy in the light of the strategy adopted at the Lisbon European Council, and the ongoing revision of competition legislation highlight the need to be constantly attentive to maintaining and strengthening this synergy.

Chapter V discusses the progress made by the manufacturing industry in the European Union in meeting the environmental sustainability objectives set out in the Gothenburg Council. As real incomes increase, emissions of pollutants at first increase but subsequently peak and begin to decline at higher income levels, and this has clearly been seen over the last 20 years in the case of the manufacturing enterprises in the European Union. The data suggest that the manufacturing industry has been able to achieve higher economic growth without increasing environmental pressure and it appears that, far from increasing, environmental pressures from manufacturing are generally declining.

The role of environmental policy has been crucial in these developments. For example, the most significant decoupling of acidifying gas emissions from economic growth followed the Large Combustion Plants Directive of 1988 and environmental policy has also played a key role in the phasing out of CFC ozone-depleters. In addition to environmental policy, stronger market competition, increased investment in pollution prevention technologies, developing new technologies and better management of resources by industry have also contributed to this progress.

CHAPTER I
Productivity growth in the European Union in recent years

I.1 Introduction

The present chapter discusses some evidence on productivity, output and employment growth in the European Union during 2001, thus updating the evidence presented in 2001 European competitiveness report, and reviews some ideas that were central to the 2001 Report. In essence, the purpose of this chapter is to set the stage for the discussion in the rest of the present report.

The 2001 competitiveness report stressed that the decline in productivity growth during the second half of the 1990s in the EU, which contrasted markedly with the experience of the United States, was related to the slow take up of ICT and the timid and fragmented innovation record of Europe. The role of ICT in these developments, and after some initial doubts about the interpretation of the evidence, is now widely accepted[1]. A variety of factors could explain these developments, and the diversity of performance between the smaller EU Member States and the larger ones, suggests that country-specific elements may be decisive. Partly as a consequence of the slowdown in productivity growth, but also because of slow employment growth, the standards of living in the European Union have grown at slow pace and relative to the United States there has been a decline throughout the previous decade.

The role of firms, as the 2001 report saw it, is crucial in economic growth. Growth of firms is determined by their ability to innovate, which is closely related to their ability to develop and utilise technological advances and exploit the commercial opportunities of their innovations. The environment where firms emerge and develop, a wide network of relationships between industry and the scientific base of a nation and among researchers, as well as the stock of internal-to-the-firm capabilities play also a crucial role. These innovations are facilitated and stimulated by the employment of new techniques in production and by corresponding organisational changes associated with the deployment of new information and communications technologies[2]. A clear example is the use of ICT in making possible the growth of the life sciences sector and, in particular, biotechnology. Biotechnology also offers clear evidence of the need for the European Union to develop new instruments and approaches to support the growth of this sector[3].

The report also stressed, among other considerations, that productivity growth in manufacturing in the United States and in the European Union alike is dependent upon these factors and on the firms' R & D activity. The report found that high R & D intensity is never associated with low productivity growth while low R & D intensity is usually associated with low productivity growth[4]. R & D intensity and productivity growth are significantly related across sectors and it is possible that spillover effects are also present. Technology-driven industries have invariably been the leaders in productivity growth in both the European Union and the United States and the sectoral patterns of productivity growth is becoming similar over time. Clearly, the larger size of the technology-driven sectors in the US economy than in the European Union implies that the contribution of these sectors to overall productivity growth is more marked.

1 Among various difficulties in assessing unambiguously the role of ICT in US growth has been the issue of quality adjustment of investment. Pakko (2002), however, concludes that 'tests for evaluating how important high-tech investment is in explaining the rapid growth rates of the late 1990s are largely invariant to (this) accounting for quality'.

2 Evidence is now emerging about the character and reasons for firm restructuring across various nations. In Canada, for example (no comparable studies are easily available for the Member States), the most common form of restructuring has been the adoption of new technologies, which, in turn, has been driven primarily by the availability of new technologies and less by their cost; see Kwan (2002).

3 In acknowledging the importance of biotechnology for Europe's future the Commission adopted in January 2002 an action plan to support it; see European Commission (2002).

4 See European Commission (2001), chapter 4.

Another strand of literature is now emerging concerning the character of the new economy and the role of ICT and knowledge in economic growth. Quah (2002) argues that, unlike the conventional supply-side view that ICT affects productivity growth, ICT affects economic growth through the demand side. ICT, and the new economy with which it is virtually synonymous, does not simply affect cost conditions and the supply of goods and services but, more fundamentally, the nature of goods and services which are now beginning to resemble knowledge. This means that these goods have 'all the relevant economic properties of knowledge, infinite expandability and disrespect for geography' (Quah, p. 10). Such goods are now crucial both because they constitute a rising fraction of consumption and because they are available directly to a large and increasing number of consumers. This implies that the spread of ICT and of the new economy may be constrained by not only existing rigidities in modern economies and by low technical expertise among potential users but, more crucially, by reluctance of consumers to participate in it. Ignorance and poor appreciation of scientific knowledge may be at the root of the slow diffusion of ICT in some Member States.

I.2 Output, employment and productivity growth in 2001

Recent data show that labour productivity growth in the United States has continued to advance through 2001 despite the recession, albeit at a pace weaker than in recent years. For the year as a whole, labour productivity growth advanced at 1.2, indicating that fundamental factors that have affected productivity in recent years are continuing to play a role in US economic performance[5]. While it is possible that during the recovery phase unanticipated increases in demand could lead to higher levels of capacity utilisation and, thus, productivity growth, the persistence of strong productivity growth in the United States during a year of recession indicates that investment in new technology and innovation assets are producing benefits for the firms that have undertaken them and for the economy as a whole.

In the EU, labour productivity growth was only 0.5 % in 2001, persisting on the path of slow growth that began in the mid-1990s. The contrasting experience of the European Union and the United States in 2001 shows the importance of technological and other innovations in supporting productivity growth even during weak economic conditions. It appears that the US economy is enjoying considerable flexibility to be in a position to accommodate positive productivity growth during a recession period, suggesting that perhaps a structural change in the behaviour of labour productivity has occurred which could have significant implications for the medium term growth prospects of the US economy[6].

Such evidence has not emerged conclusively for the EU economy yet, even though it is possible that the effects are currently operating in the background[7], possibly resembling the same difficulties in detecting the impact of ICT on the economy as in the United States in previous years. During the second half of the 1990s, the importance of ICT capital accumulation in the European Union has undoubtedly increased[8] and the euro area is beginning to experience these benefits. However, a decline in total factor productivity growth during this period indicates that spillover effects from ICT to the rest of the economy have yet to be seen[9].

Graph I.1 shows trends in the standards of living in the United States and the European Union over the period 1970–2003 (the data for 2002 and 2003 are based on the Commission's autumn 2001 forecasts), measured by GDP per capita in PPS in 1995 prices as well as the ratio of the two variables (lower panel). Although both variables have trended upwards during the period in question, the European Union variables has grown at a markedly slower pace than the US variable. As a result, the ratio has stagnated within a narrow range of between 65 % and 70 %. In 2001 this ratio was 68.6 %. Table I.1 shows the ranking of the Member States in terms of US GDP per capita.

Clearly, under present circumstances, the global ambitions of the Lisbon strategy will be difficult to realise. Nevertheless, the performance of selected Member States is comparable or even better than the United States. Table I.2 presents relevant data on economic growth for the Member States and

5 The Bureau of Labour Statistics estimated that in the last quarter of 2001 (2001:Q1) non-farm business productivity advanced at an annual rate of 5.2 % bringing the annual average to 2.0 %. Productivity growth is pro-cyclical, that is, it slows down during periods of slow growth and accelerates in the recovery, a reflection of labour hoarding behaviour on the part of firms. It is possible, however, that an over-adjustment of employment following the September 2001 terrorist shock may also have contributed to the productivity growth in 2001:Q4.

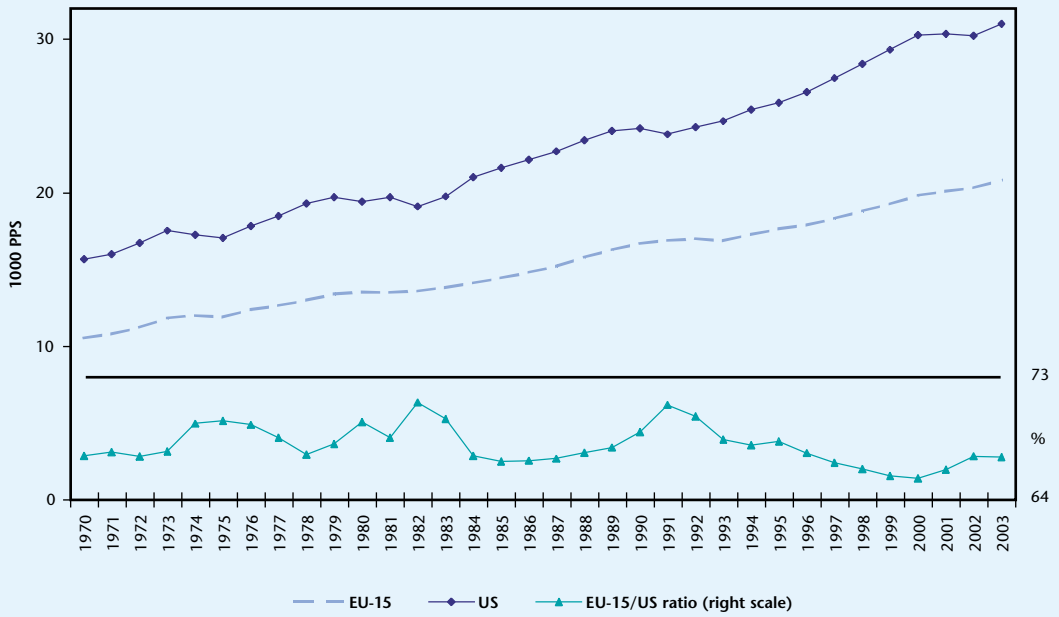
6 The Council of Economic Advisers suggests that the structural component of labour productivity growth since 1995 in the United States averaged to 3.07 % and it contributed 1.7 percentage points to measured labour productivity growth of 2.60 % during the period 1995 to 2001; see Council of Economic Advisers (2002), chapter 1, p. 61.

7 See Vijselaar and Albers (2002) for this suggestion.

8 Vijselaar and Albers (2002) estimate that ICT capital accounted for 21 % of output growth in the euro area in the period 1996–99, up from 13 % in 1991–95.

9 Again, Vijselaar and Albers (2002) estimate that total factor productivity contributed 92 % of output growth in the euro area in the period 1991–95 but only 33 % in the period 1996–99.

Graph I.1: GDP at 1995 market prices per head of population
(left scale in 1995 PPS; 2001estimate; 2002–03 forecasts; right scale EU/US ratio)



Source: AMECO databank update 25.02.2002 (DG ECFIN).

Table I.1: GDP per capita in EU Member States, US and Japan in 2001 (US=100)

Luxembourg	137	Germany	72	Spain	57
Ireland	83	Italy	70	Portugal	50
Denmark	83	Finland	70	Greece	49
Netherlands	79	United Kingdom	70	**EU–15**	**69**
Austria	75	Sweden	69	United States	100
Belgium	73	France	68	Japan	72

Source: Commission services.

Table I.3 data on the employment growth. The Member States are ranked according to the best performance in the second half of the 1990s.

In 2001, GDP growth in the European Union was 1.6 % and employment growth 1.1 %. In the United States, the corresponding data are 1.1 % and – 0.1 %, while in Japan both employment and productivity growth resulted in a decline in GDP growth of 0.6 %. It is likely that the growth in labour productivity during the slow growth of last year in the United States effectively prevented the recession from becoming worse. Productivity growth kept disposable incomes, which typically slump during a recession, growing and consumer spending supporting domestic and international demand growth. While it is difficult to forecast developments in productivity growth in coming years, it is possible that the structural improvement in US productivity growth, suggested by the data, will augur well for income and wealth growth. It is clearly important that the European Union moves towards a similar growth trajectory to improve its medium-term income and wealth prospects.

The accompanying tables indicate that the performance of the Member States was diverse in 2001, however broadly matching that of previous years. Ireland registered the fastest growth in real GDP in 2001 (6.5 %) followed by Greece (4.1 %) and Luxembourg (4.0 %). Of the largest EU economies, the United Kingdom grew at 2.3 %, France at 2.0 %, Italy at 1.8 % and Germany at 0.6 %. Compared the ranking in terms of GDP growth in the 1995–2001 period, Finland experienced the largest decline in GDP growth falling to 0.5 % in 2001.

Table I.2: Growth of real GDP in EU Member States, US and Japan in 1975–2001

(average annual growth (%), ranked according to performance in 1995–2001)

	1975–85	1985–90	1990–95	1995–2001	2001
Ireland	3.5	4.6	4.7	9.3	6.5
Luxembourg	2.4	6.4	3.9	6.0	4.0
Finland	2.9	3.3	- 0.7	4.3	0.5
Spain	1.6	4.5	1.5	3.6	2.7
Greece	2.1	1.2	1.2	3.5	4.1
Portugal	3.0	5.7	1.7	3.5	1.7
Netherlands	1.9	3.3	2.1	3.3	1.5
United Kingdom	1.9	3.3	1.8	2.8	2.3
Sweden	1.6	2.5	0.6	2.7	1.4
Belgium	2.1	3.2	1.4	2.6	1.3
Denmark	2.1	1.3	2.0	2.4	1.3
France	2.4	3.3	1.1	2.4	2.0
Austria	2.4	3.2	2.0	2.3	1.1
Italy	3.0	2.9	1.3	1.9	1.8
Germany	2.2	3.4	1.5	1.6	0.6
EU–15	**2.3**	**3.3**	**1.4**	**2.4**	**1.6**
United States	3.4	3.2	2.4	3.6	1.1
Japan	3.8	4.9	1.4	1.1	- 0.6

Source: Commission services.

Table I.3: Employment growth in EU Member States, US and Japan in 1975–2001; employment rates in 2001

(average growth (%), ranked according to performance in 1995–2001)

	1975–85	1985–90	1990–95	1995–2001	2001	Employment rate in 2001
Ireland	0.0	1.1	1.9	5.1	2.3	67
Spain	- 1.6	3.3	- 0.5	2.7	2.3	58
Netherlands	0.5	2.3	1.1	2.5	2.0	76
Luxembourg	0.0	1.4	0.5	2.5	5.5	65
Finland	0.5	0.3	- 3.8	2.1	1.4	67
France	0.2	1.0	- 0.2	1.3	1.6	63
United Kingdom	- 0.2	1.8	- 0.9	1.2	0.7	72
Belgium	- 0.4	1.0	- 0.2	1.1	1.2	60
Italy	0.8	0.8	- 0.7	1.1	1.5	59
Denmark	0.5	0.1	- 0.2	1.0	0.4	78
Sweden	0.5	1.0	- 2.2	0.9	1.8	75
Germany	0.2	1.4	- 0.8	0.6	0.1	69
Portugal	- 0.3	1.1	- 0.6	0.5	1.5	73
Greece	1.2	0.7	0.6	0.5	1.1	55
Austria	0.1	0.8	0.2	0.4	0.0	73
EU–15	**0.1**	**1.4**	**- 0.6**	**1.2**	**1.1**	**66**
United States	2.2	2.0	0.9	1.3	- 0.1	74
Japan	0.9	1.0	0.8	- 0.1	- 0.3	77

Source: Commission services.

Table I.4: Labour productivity in EU Member States, US and Japan in 1975–2001
(average annual growth of GDP/employed person (%), ranked according to performance in 1995–2001)

	1975–85	1985–90	1990–95	1995–2001	2001	Labour productivity in 2001 (US=100)
Ireland	3.5	3.5	2.7	4.0	4.1	90
Greece	1.0	0.5	0.7	3.0	3.0	64
Portugal	3.3	4.6	2.3	2.9	0.2	49
Finland	2.4	3.0	3.2	2.1	- 0.8	77
Austria	2.4	2.6	2.1	1.7	1.1	89
Sweden	1.1	1.4	2.8	1.7	- 0.4	69
United Kingdom	2.1	1.5	2.7	1.5	1.6	73
Luxembourg	2.2	3.1	1.2	1.5	- 1.4	108
Belgium	2.5	2.2	1.6	1.4	0.1	92
Denmark	1.6	1.2	2.2	1.4	0.9	78
France	2.4	2.4	1.5	1.2	- 0.2	87
Germany	2.0	1.9	1.5	1.0	0.4	74
Italy	2.1	2.1	2.1	0.9	0.3	83
Spain	3.2	1.2	2.0	0.7	0.4	73
Netherlands	2.0	1.1	1.2	0.7	- 0.4	94
EU–15	**2.2**	**1.9**	**1.9**	**1.2**	**0.5**	**78**
United States	1.2	1.0	1.2	1.9	1.2	100
Japan	2.9	3.8	0.6	1.2	- 0.3	67

Note: Growth rates were calculated on the basis of GDP at constant 1995 prices and national currencies, while the 2001 productivity levels are based on GDP at current market prices and PPS.

Source: Commission services.

Employment growth moderated significantly across the European Union in 2001 but the ranking of the Member States remains broadly similar as during the 1995–2001 averages. However, in some cases employment growth accelerated considerably. In Luxembourg, it advanced at a rate of 5.5 %; in Sweden, at 1.8 %; in Portugal, at 1.5 %; and in Greece, at 1.1 %. These growth rates are twice as high as those corresponding during the 1995–2001 averages are.

Table I.4 updates the data on labour productivity growth. There were marked changes in the pattern of productivity growth across the Member States especially those that had a stellar performance during the 1995–2001 period. Portugal, Finland, Sweden, Luxembourg, France and the Netherlands saw a sharp decrease in the rate of productivity growth and, with the exception of Portugal, these also had negative productivity growth last year. These developments mirror the employment growth seen in these countries. Nevertheless, productivity growth substantially exceeding the EU average was recorded in Ireland, (4.1 %), Greece (3.0 %), Austria (1.1 %), the United Kingdom (1.6 %) and in Denmark (0.9 %).

The remaining ten Member States saw positive growth of labour productivity and of employment during 2001. Table I.5 tabulates the Member States according to positive or negative productivity growth in 2001. An encouraging feature of this tabulation is that a majority of Member States realised both job creation and positive productivity growth last year[10]. Such a configuration of these variables is, clearly, the ultimate objective of the Lisbon strategy.

The decline in ICT stock values in recent months has led some to suggest that the 'new economy' has come to an end. It is important to recall, however, that the recent cycle of boom and bust in ICT investment is not exceptional but consistent with the historical experience associated with new technological breakthroughs. As noted earlier, the modernisation of those economies that have succeeded in entrenching the role of ICT in productive life has

10 The characteristics of employment, productivity and GDP growth in recent years were discussed extensively in European Commission (2001), chapter 2. Vijselaar and Albers (2002) note that the effects of ICT on European productivity may already be 'discretely operating in the background' but because of long gestation periods they are not immediately apparent. If this is true, then estimates of potential output growth in the Euro area over the medium term should be skewed towards the upside.

Table I.5: Labour productivity growth in 2001

Positive productivity growth	Negative productivity growth
Belgium, Denmark, Germany, Spain, Greece, Ireland, Italy, Portugal, Austria, United Kingdom	France, Luxembourg, the Netherlands, Finland, Sweden

Source: Tables I.3 and I.4

made it possible to cushion the impact of the slowdown on income and spending growth. Sustained productivity growth has permitted private disposable incomes to grow, thus supporting economic activity and mitigating the effect of the recession. The ICT-based transformation of economic activity has led to a structural break resulting in a higher rate of productivity growth. The experience of the United States, but also of some of the EU Member States, suggests strongly that a new era of higher structural productivity growth may be under way[11].

The Lisbon and subsequent European Councils have also stressed the importance of the technological modernisation of the European Union and a more comprehensive and supportive approach to encouraging innovation. The Barcelona Council re-affirmed that target of modernising the economic and social structures to enhance productivity and employment growth and put special emphasis on encouraging the growth of frontier technologies[12]. It remains to be seen, however, whether entrepreneurs will consider these reforms as sufficient to spur the necessary modernisation and innovations to set EU productivity growth on a permanently higher path.

11 The argument about the unimportance of ICT in the sharp acceleration of productivity growth in recent years is that there is a dominant cyclical component in productivity that is difficult to distinguish from underlying trends. Nevertheless, after the persistence of productivity growth in 2001, the notion that there has been a structural break in labour productivity growth is gaining acceptance. The United States Council of Economic Advisers, for instance, projects that real GDP growth over the period 2001:Q3 to the end of 2012 will average 3.1 %, marginally higher than the average growth rate recorded during the period 1990:Q3 to 2001:Q3. Labour productivity growth in the non-farm business sector is projected to average 3.1 %, the same as in the 1990s, while civilian employment to grow at an average of 1.0 %. Labour productivity grew by an average of 2.9 % during the period from 1960 to 1973, and by 1.4 % during the period from the end of 1973 to 1990:Q3; see Council of Economic Advisers (2002), chapter 1.

12 See Presidency Conclusions — Barcelona European Council, 15 and 16 March 2002.

References

Council of Economic Advisers (2002): *Economic Report of the President*, United States Government Printing Office, Washington, 2002.

European Commission (2001): European competitiveness report 2001, Commission staff working paper, SEC(2001) 1705, 29.10.2001.

European Commission (2002): 'Life sciences and biotechnology — A strategy for Europe', Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, COM(2002) 27, 23.1.2002.

Kwan, C., (2002): 'Restructuring in the Canadian Economy: A Survey of Firms', Bank of Canada working paper 2002-08, April.

Pakko, M., (2002): 'The High-Tech Investment Boom and Economic Growth in the 1990s: Accounting for Quality', *Federal Reserve Bank of St. Louis Review*, March/April.

Quah, D., (2002): 'Technology Dissemination and Economic Growth: Some Lessons for the New Economy', CEPR discussion paper No 3207, February.

Vijselaar, F. and Albers, R., (2002): 'New technologies and productivity growth in the Euro area', Working Paper No 122, European Central Bank, February.

CHAPTER II
Human capital and productivity growth in the European Union

II.1 Introduction

The issue of skill shortages has gained prominence in the European Union specifically because it has emerged in the context of continuing high unemployment and because it concerns skills in areas where the European Union has ambitions to excel. According to recent evidence, the United States continues to dominate the world's knowledge economy while the European Union is trailing behind[13]. The advance towards a knowledge-based economy, such as visualised by the Lisbon European Council, must be characterised by a process of accumulation of scientific and technical skills and by a general upgrading of the stock of human capital in the EU. Furthermore, it is also necessary that the proper flexibility in the allocation of human capital, in those occupations where its marginal product is highest, be present.

This chapter reviews mismatches in skills and their importance in hampering productivity growth in the EU. Section II.2 discusses briefly the importance of human capital in economic growth; section II.3 discusses the changing structure of the demand for skills in the EU; section II.4 discusses the issue of the supply of skills and, finally, Annex 1 provides a brief review of the literature on schooling, earnings and economic growth.

In recent months, evidence of skill shortages has characterised the European Union in a revealing manner. In spring 2002, for example, the German government debated the introduction of legislation that would permit foreign scientific and technical personnel to work in the high-technology industries of Germany. It appears that the implications of skill imbalances in some EU Member States is now threatening the growth prospects of new technologies in Europe and the prospects of economic growth more generally.

The coexistence of unfilled skill vacancies[14] and of unemployment is indicative of the presence of, perhaps severe, labour market imbalances. In a recent review, the European Central Bank stressed that despite an average unemployment rate of 8.1 % in 2001 in the euro area, many employers reported difficulties in recruiting workers. This constitutes evidence of difficulties in matching demand for and the supply of labour. In particular, the Beveridge curve[15] for most of the euro area Member States for which unfilled vacancy data are available[16] appears to have shifted outwards over the period 1980–2000. Compared to 1980, the Beveridge curve has shifted outwards in Belgium, Germany, Greece and, to a lesser extent, Luxembourg, Austria and Finland. Such a movement is also suggested to have taken place in France and in Italy. In the Netherlands there was an inward shift of the curve while in Spain and Portugal and, as suggested, in Ireland no discernible movement has taken place.

At the background of these shifts there is, first, a mismatch suggested by the demand for and supply

13 See Robert Huggins Associates (2002). This Report provides a ranking of the top 90 world's most knowledge competitive regions in 2002. In total, 49 US regions are included in this group of the 90 world regions, and of these 45 are present in the top 50 performers. There are 32 European regions in the group but only 4 (Stockholm, Switzerland, Uusimaa in Finland and London) feature in the list of the top 50 performers.

14 The lack of reliable and comprehensive statistics concerning vacancies constitutes a major obstacle in analysing labour demand and the occurrence of skill shortages.

15 The Beveridge curve plots the rate of unemployment against the vacancy rate. A priori, the relationship is expected to be negative, so that an increase in vacancies would correspondingly lead to a reduction in unemployment, and vice versa. Thus, movements along the curve reflect the influence of the business cycle. However, when the curve shifts away from the origin, this is suggestive of structural problems as, for a given level of vacancies, for example, corresponds a higher level of unemployment. On the contrary, shifts towards the origin suggest an allocational improvement in the labour market. Movement of the Beveridge curve over time can be used to indicate whether the efficiency of the matching process in the labour market is improving or deteriorating; see European Central Bank (2002).

16 These are Belgium, Germany, Spain, Greece, Luxembourg, the Netherlands, Austria, Portugal and Finland; no vacancies data for France, Ireland and Italy were available.

of skills/employees along educational attainment–educational mismatch. This appears to have been particularly pronounced during the 1997–2000 growth spurt but, more generally, educational mismatches in 2000 have worsened when compared to 1992. This has been most notable in Germany, France, Ireland and Austria but also, albeit less so, in Belgium, Italy and Finland. On the other hand, educational mismatches have declined sharply in the Netherlands and in Portugal.

Second, there is an occupational mismatch which in ten of the euroarea Member States (data for France and the Netherlands are not available) worsened substantially between 1992 and 1997. However, between 1997 and 1999 the extent of the occupational mismatch decreased. Moreover, it appears that occupational mismatches were present not just in high-technology areas but also in areas requiring lesser skills.

Finally, there is a regional mismatch, a characteristic and consequence of labour immobility. This plays an important role in Belgium, Germany and Italy where this mismatch is particularly pronounced. In the euro area as a whole, regional mismatch increased during the 1997–99 period after considerable reductions in the 1990–97 period[17].

The issues suggested by these phenomena are crucial to the good functioning of labour markets and to attaining sustainable economic growth. Educational mismatches, in particular, are also critical in the adoption and diffusion of new technologies and for future income opportunities in a knowledge-based economy.

II.2 The role of human capital in economic growth

There is a substantial body of literature that examines the role of human capital in economic and productivity growth. A growing economy depends in a crucial manner on the rate of accumulation of human capital, and the latter depends on raising the private return to investing in this knowledge. Also, some models emphasise the role of the stock of human capital in economic growth because this constitutes the basis on which innovations are built[18]. Ultimately, the continuous process of human capital accumulation, as well as the stock of human capital, as reflected in the growth of new technological and educational opportunities, sustain economic growth.

Human capital plays a crucial role in economic growth due to the externalities associated with it[19]. The presence of these externalities implies that the social rate of return to education exceeds the private rate of return. Such externalities occur when knowledge accumulation leads to innovations and an expansion of technological possibilities, where knowledge is a complementary factor in the introduction and efficient use of new technologies, or where threshold effects in human capital accumulations stimulates the creation of new knowledge and expands the range of economic and scientific possibilities. Nations with a high level of education are able to absorb new technologies developed elsewhere faster and with less cost compared to those nations with a lesser stock of human capital; moreover, these nations have a greater potential to produce domestically scientific, technological and commercial innovations. Higher levels of human capital, which are invariably associated with R & D intensive activities, increase the rate of technological progress and the introduction of newer vintages of capital, thus raising the rate of economic growth. Finally, increases in the level of education are invariably associated with higher labour force participation rates, especially among females, a point of particular importance in the European Union considering present trends in this variable and in view of the Lisbon goals[20].

Barro and Sala-i-Martin (1995) provide empirical evidence[21] on the role of human capital, among other variables, in economic growth within a convergence framework[22]. In two samples of 87 and of 97 coun-

17 See the discussion in European Central Bank (2002) of the evidence on the three types of labour market mismatch.

18 See, for example, Krueger and Lindahl (2001) for a survey of the empirical evidence. The authors are sceptical about whether there is reliable formal evidence on the impact of education on economic growth; also for a discussion of the theoretical and empirical issues see Barro and Sala–i–Martin (1995), especially chapter 12, and also Romer (1996), especially chapter 3.

19 The more recent theories of economic growth, where knowledge is a central factor, were reviewed in the European Commission (2001a), Annex II.1.

20 However, it is also possible that higher levels of education may not contribute to output growth when education is simply a credential signalling an individual's productivity, or when there is widespread unemployment among the educated in which case increases in the level of education could reduce output growth; clearly, in these cases the social rate of return to education is lower than the private rate of return.

21 See Barro and Sala–i–Martin (1995), chapter 12, p. 431–432 in particular. The Barro and Sala–i–Martin reference is chosen here partly because it represents a good summary of the material but also because the empirical literature supports the hypothesis that the level of human capital, as formulated by Barro and Sala–i–Martin, rather than the rate of its accumulation, as proposed by endogenous growth theories, affects economic growth. The significant impact of the stock of human capital on economic growth suggests that large externalities are present and that this variable stands in for the potential to absorb and diffuse technology rather than being just a factor of production in itself. Bils and Klenow, on the other hand, find that the causality runs from growth to education rather than the other way around; see Bils and Klenow (1998).

22 Specifically, the convergence framework postulates that the growth rate of GDP per capita over a particular period is inversely related to the initial level of GDP per capita, a hypothesis that finds support in a variety of data sets. The underlying reason for this is the fact that diminishing returns to reproducible factors characterise the economy so that the richer countries would tend to grow slower than the less wealthy ones. Krueger and Lindahl (2001) attempt a reconciliation between the macroeconomic (social rate of return to education) and the microeconomic (private rate of return to education) approaches to the question of the contribution of human capital to economic growth. The microeconomic approach, of course, is not interested in the economy–wide implications of education.

tries covering a broad spectrum of growth experiences, they test whether lagged values of educational variables affect the growth rate in the current period. The initial values of the sample cover the period 1965–75 and 1975–85. The empirical results suggest that the initial state of school-attainment variables positively affects growth rates in subsequent periods. In particular, secondary and higher level schooling for males and females observed at the start of the decade, in 1965 and in 1975, enter the equations with statistically significant positive coefficients while primary level attainment variables are insignificant.

The gender disaggregation is also found to be jointly statistically significant. The results suggest that for the decade 1965–75, an increase in male secondary schooling by 0.68 years raises the subsequent growth rate by 1.1 percentage points per year and an increase in higher schooling by 0.091 years raises the growth rate by 0.5 percentage points per year. However, the Barro and Sala-i-Martin results find that the initial levels of female secondary and higher education tend to affect negatively the rate of economic growth in subsequent periods. Barro and Sala–i–Martin note that this puzzling evidence may be suggestive of the possibility that wide differences between male and female educational attainment reflect the backwardness of the nations in question, with the consequence that less female educational attainment signifies more backwardness and, therefore, greater convergence potential. Finally, the results indicate that the speed of convergence is positively and significantly affected by the presence of human capital in the economy, so that the higher the stock of human capital the faster the convergence process.

However, some empirical evidence has questioned the presumption that human capital has played an unambiguous role in productivity and economic growth, thus casting doubt on the theoretical predictions based on the accumulation effects of human capital. It is possible that, in addition to accumulation effects, allocation effects as well as the matching process between skills and jobs are crucial[23]. The purpose of this chapter is to review these aspects.

The 2001 competitiveness report has already suggested that the deceleration of European productivity during the second half of the 1990s be related to the under-performance in investment in new technologies, in R & D and in innovation. Graph II.1 shows that the sources of Europe's

23 Quah (2002) considers that the absence of such evidence derives from the misunderstood nature of the new economy. The rise in the importance of total factor productivity in economic growth is a reflection of a successful economy where the science and knowledge base is expanding rather than a mismeasurement of factor inputs. In one class of models human capital can determine the level of productivity but not its growth rate, which depends on the growth of technology but not on human capital decisions; in another class, human capital determines productivity growth. As mentioned in chapter I, the characteristics of goods and services in the ICT-based new economy resemble those of knowledge and depend to a large extent on the behaviour of the demand side.

Graph II.1: Average years of education of the working population, 1971–99

(Average years of US education = 100)

Source: Calculated from de la Fuente and Domenech (2001) and extended using OECD (2001) data and de la Fuente and Domenech's (2001) perpetual inventory method and graduation weights.

under-performance relative to the United States may be deeper-seated and related also to educational attainment. The data suggest that for the EU, throughout the past 30 or so years, there has been a convergence process in the formation of human capital towards the higher level attained by the United States. It is possible that the lower level of educational attainment of the European Union compared to the United States has coalesced with various other aspects that play a role in the introduction and diffusion of new technologies to result in slower productivity growth. Technological modernisation and the stimulus to innovation depend crucially on the availability of skilled professionals to facilitate and take advantage of the opportunities that emerge. Even though Europe has made significant strides in raising the average level of education in the working population throughout the past 30 years, there still remains a significant gap relative to the United States to be bridged. The evidence of skill imbalances indicates a failure to take full advantage of new technologies and to sustain an increase in economic growth.

By 1999 average years of schooling in the working population of the European Union had risen to around 87 % of the corresponding US level (Japan's performance is virtually identical to that of the US with average years of schooling approaching the same level as in the US), up from just over 70 % in 1971. The data suggest that it took the European Union around 15 years from 1971 to halve the initial difference in the average level of education against the United States. It is clear that Europe's ambition for a knowledge-based economy should at least be to cover the remaining distance in the shortest period of time. The competitive race for growth in the knowledge economy is a challenge that Europe must confront without delay.

II.3 Skills and employment growth

The structure of labour demand in the European Union has changed in important ways in recent years. The coexistence of skill shortages and the under-performance of most EU economies with respect to the resurgence in US productivity growth has led to the notion that a broadening of investment in education, training and research may serve to fulfil the growth potential. This section reviews the skill content and relative factor intensity of changes in EU employment and output in recent years. What exactly is the nature of the change in labour demand with respect to educational attainment, what are the differences by Member State and how does the growth of employment relate to the accumulation of capital and knowledge? This information is essential to be in a position to adequately weigh the supply response and evaluate the role of matching efficiency in comparative growth performance.

II.3.1 Employment growth in the European Union

A first question in the changing structure of EU labour demand concerns the extent to which developments in employment parallel systematic sector differences that reflect the asymmetric labour market effects of technological change[24].

As technological innovations are often labour saving, jobs in some sectors are lost while others are created in emerging branches of economic activity. In the second half of the 1990s, employment growth in the European Union was heavily dominated by service sector activities, which created 11.4 million jobs in net terms[25]. Over half of employment creation in the service sector reflected job creation in general business services and health and social work. About 1.4 million jobs were created in industry in the same period, roughly divided between manufacturing (especially in high-tech sectors) and construction. However, this growth was offset by significant job losses in agriculture, fishing, mining and utilities. By 2000, two out of every three jobs in the European Union were in the service sector.

Overall employment growth between 1995 and 2000 at the sectoral level, disaggregated on the basis of skill content, shows that job growth was largely confined to jobs for medium- and high-skill workers. There was strong growth in the employment of high-skill workers across all sectors, except fishing and mining, with especially high rates of growth in transport, general business services and private households with employed persons. The demand for medium-skill workers was also strong across the service sector, but experience in industry has been much more varied. More specifically, employment of medium-skill workers increased in those sectors where the demand for high-skill workers was also strong: in manufacturing, construction and, to a lesser extent, agriculture. In fact, the demand for skilled workers continues to be

24 Needless to say, recruitment difficulties have been reported in lower-skilled occupations in several Member States so that the skill imbalances and recruitment difficulties that have received most attention, those in the high-technology, high-human capital occupations, constitute only part of the picture.

25 Due to definition differences in the minimum number of hours, these estimates differ from those quoted in European Commission (2001b), p. 29, which puts overall net job creation at just under 10 million.

Table II.1: Employment growth by NACE 1 digit sector, 1995–2000

	Total employment absolute growth	Total annual rate of growth	ISCED 1–2 annual rate of growth	ISCED 3–4 annual rate of growth	ISCED 5–6 annual rate of growth
Agriculture, hunting, forestry	- 1 270.3	- 3.8	- 6.2	0.4	2.1
Fishing	- 46.9	- 4.5	- 4.5	- 4.4	- 4.7
Mining, quarrying	- 153.8	- 5.6	- 9.1	- 4.8	0.0
Manufacturing	705.0	0.5	- 2.9	2.2	3.7
Electricity, gas and water supply	- 143.4	- 2.3	- 6.2	- 2.0	0.4
Construction	750.0	1.3	0.2	1.8	3.6
Wholesale and retail trade, repair	1 343.9	1.2	- 3.9	4.3	4.9
Hotels, restaurants	429.1	1.5	- 2.6	5.8	5.1
Transport, storage, communication	696.1	1.6	- 3.8	4.1	6.4
Financial intermediation	259.6	1.0	- 12.5	2.1	5.7
Real estate, renting	3 656.6	6.5	0.9	7.5	8.4
Public administration, defense	954.8	1.7	- 2.8	2.4	4.4
Education	910.1	1.9	- 5.5	3.9	2.5
Health and social work	2 179.0	3.3	- 3.7	5.8	4.4
Other community, social, personal service activities	775.8	2.3	- 4.3	5.1	5.1
Private households with employed persons	182.5	2.4	0.2	8.2	8.3
Extra-territorial organizations and bodies	- 4.1	- 0.6	- 11.0	- 1.0	4.1
Total	**11 224.0**	**1.5**	**- 3.2**	**3.6**	**4.6**

Note: Total employment growth is in thousands; on ISCED definitions of educational attainment see Table II.5 below.

Source: Computed from Eurostat: *Labour Force Survey*, 1996–2001.

strongest in high-tech and high-education sectors, which accounted for more than a third of net job creation between 1995 and 2000. In the previous year alone, these sectors created a net total of 1.6 million jobs[26]. In contrast, the number of low-skill workers in employment fell in almost all sectors, but it was particularly pronounced in the non-manufacturing parts of industry and in financial intermediation (shedding no less than one-eighth of its low-skill employment per year). Only construction, general business services and private households exhibited employment growth for low-skill workers, albeit at very moderate rates — see Table II.1[27].

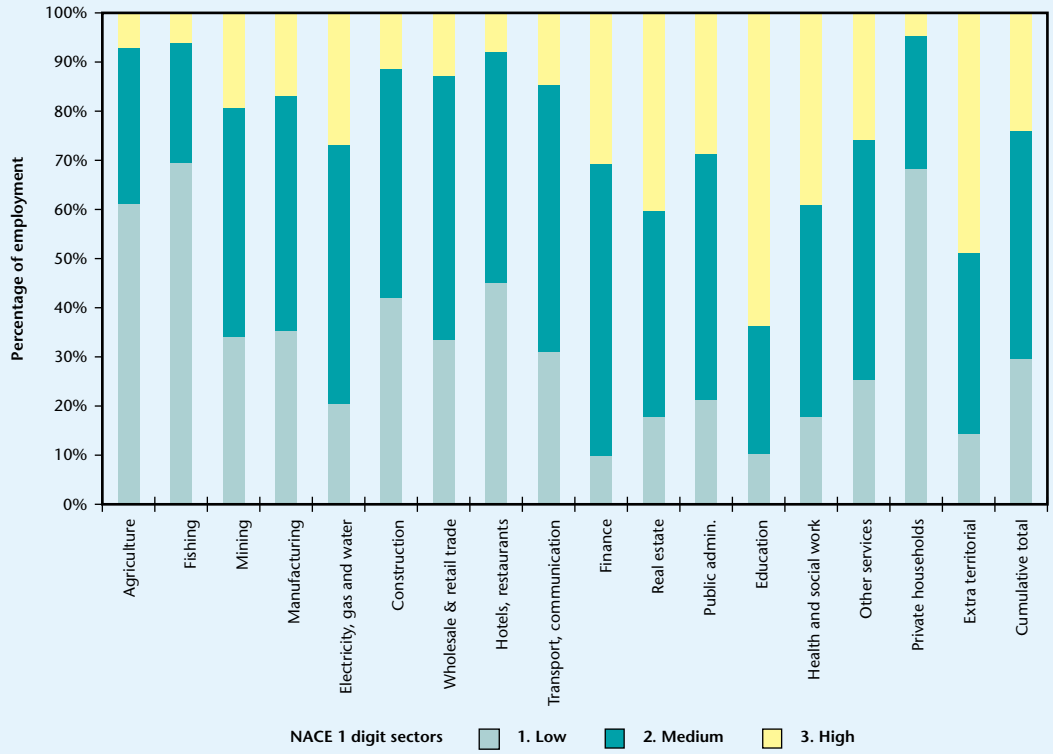
The general consequence of these sector-specific developments is that since 1995 and for the European Union as a whole, the proportion of medium- and high-skill employees has increased while the share of low-skill workers in employment has fallen. In 2000, medium-skill employees represented the largest group in the EU, accounting for some 45 % of all employees.

The distribution of employees' educational attainment across sectors follows a pattern that is broadly similar to that of employment growth. Overall, highly skilled workers account for a larger proportion of the service sector's employment compared with agriculture and industry. The main exceptions to this are hotels and restaurants and private households, where employment is characterised by relatively low wages. High skill workers account for a very low share of these sectors' employment in the

26 See European Commission (2001b), p. 29–44.

27 Given the persistently high level of unemployment in the EU, it is important to stress that job creation across all skill categories would have contributed decisively to reduction in joblessness. Note also that the data of the present table, based on the Labour force survey, differ slightly from those reported in chapter I where the source is the national accounts statistics.

Graph II.2: Distribution of educational attainment of employees by economic activity; EU–15 in 2000
(NACE 1 digit sectors)



Source: Computed from Eurostat, *Labour force survey*, 1996–2001.

EU, as shown in Graph II.2. Yet, as can be seen from Table II.1, even in these sectors employment growth was strongly biased towards a higher level of skills, suggesting structural changes in the skill content of employment. Even in agriculture, where 1.3 million net jobs were lost, an increased demand for high-skill labour was registered.

In those sectors where highly-educated workers already dominate employment, an even greater concentration of skills is taking place, as reflected in the comparatively high growth rates for employees with tertiary educational attainment. In business services, transport and communication, finance, trade and health and social work — all 'knowledge intensive' sectors — the growth rate of high-skill employment exceeded the overall average rate of growth of employment. Moreover, obscured by the general 'manufacturing' heading is the differentiated performance of various production industries. As emphasised in *Employment in Europe 2001*, employment growth in high-tech manufacturing industries since 1995 accounted for 16 % of total net job creation in the EU, reaching annual growth rates of almost 5 % in 2000[28].

In general, in addition to the sectoral concentration of skilled labour in knowledge-intensive and ICT-using services and in high-tech manufacturing industries, an overall skill upgrading of EU employment has been taking place in recent years. In particular, there has been an underlying shift from the low to the intermediate level of educational attainment within sectors and a sustained net growth in the demand for highly-educated workers.

II.3.2 Skills and employment growth in the European Union and the Member States

This section reviews evidence on the growth of skills in the Member States between 1995 and 2000 which is at the base of the aggregate data seen previously. The European Union economies still exhibit wide differences in economic structure, policies and institutions that are likely reflected in the composition of labour demand. However, recent

28 See European Commission (2001b), especially chapter 2. On the basis of NACE rev. 1 Eurostat defines the following manufacturing sectors as high–tech: chemicals; machinery and equipment; office machinery; electrical equipment; radio, television and communication equipment; medical, precision and optical instruments; motor vehicles; and other transport equipment.

Table II.2: Developments in the skill composition of labour demand, 1995–2000
(percentage change, annual averages, and difference between the two series)

	Employment growth			Attainment growth (15-64)			'Difference'		
	low	medium	high	low	medium	high	low	medium	high
Austria	- 5.3	- 0.1	11.6	- 3.2	0.1	12.3	- 2.2	- 0.3	- 0.7
Belgium	0.5	0.9	3.8	- 1.3	- 0.1	3.0	1.8	1.0	0.8
Germany	1.7	- 0.8	1.3	- 2.3	- 1.0	1.2	4.0	0.2	0.0
Denmark	2.2	0.5	- 0.4	0.8	- 0.4	- 0.8	1.4	1.0	0.5
Spain	0.7	6.6	8.7	- 2.6	1.5	6.9	3.3	5.1	1.8
Finland	- 0.5	1.2	9.7	- 3.2	- 1.1	9.2	2.7	2.3	0.6
France	- 0.6	0.7	4.5	- 0.5	0.1	4.0	- 0.1	0.6	0.5
Greece	- 3.3	4.4	4.0	- 2.7	3.6	3.6	- 0.5	0.8	0.3
Italy	- 3.3	5.0	4.2	- 3.7	3.7	4.3	0.3	1.3	0.0
Luxembourg	- 6.5	9.7	4.5	- 7.7	9.5	4.0	1.2	0.2	0.6
Portugal	0.4	1.9	- 3.8	- 1.6	- 0.9	- 4.2	2.1	2.8	0.4
Sweden	- 3.2	0.9	2.1	- 2.2	0.9	3.2	- 1.0	0.0	- 1.1
United-Kingdom	- 23.9	10.2	4.1	- 21.3	9.6	3.5	- 2.6	0.7	0.5
EU–15	**- 3.2**	**3.6**	**4.6**	**- 3.9**	**2.6**	**4.2**	**0.7**	**1.0**	**0.4**
United States	0.4	0.5	1.8	- 0.5	0.3	1.9	0.9	0.2	- 0.1
Japan	- 3.8	- 0.6	1.4	- 3.0	- 0.1	1.8	- 0.8	- 0.5	- 0.5

Note: Due to lack of data for Ireland and the Netherlands prior to 1997 the EU average has been calculated using 1998–2000 and 1997–2000 growth rates for these countries, respectively, applied to the full-year period.

Source: Computed from Eurostat, *Labour force survey* 1996–2001.

developments in the skill content of employment growth have been fairly similar across the Member States, as can be seen in Table II.2. The data suggest that there has been an upgrade of skills in employment across the Member States in the second half of the 1990s, which appears to be unrelated to differences in their economic structure.

Table II.2 presents data on the average change of employment by three categories of skills, the average change in the population aged 15–64 according to educational attainment and the difference between the two variables.

With the exception of Denmark and Portugal, where employment creation was confined to low- and medium-skilled jobs, all Member States have registered significant growth in high skilled jobs against a widespread decline of low-skill employment. Austria, Finland and Spain recorded particularly strong growth in the employment of high-skill workers during the period under consideration. Demand for medium-skill labour was strongest in the United Kingdom, Luxembourg and Spain. Changes in the employment of low-skill workers were much more varied. Austria, Luxembourg and the United Kingdom saw sharp rates of decline in low-skill employment compared to the European Union as a whole, while modest growth occurred in Belgium and Spain.

The national rates of change in educational attainment of the population aged 15–64, however, do not match the change in employment at EU level, providing a first indication of the structure and extent of possible imbalances in the labour market with respect to skills. The last three columns of Table II.2 show the difference between the change in employment and the change in educational attainment[29].

The data suggest that the growth of medium- and high-skill employment in the European Union has outstripped the growth of the supply of employees with the corresponding attainment levels. The imbalance appears to be particularly pronounced in the intermediate, medium-skill, level where

29 Caution should however be used in reading the data in the last three columns, for two reasons. First, the attainment growth is only a rough approximation of skills supply since it refers to the population rather than to the labour force, as a consequence, if labour force participation becomes more biased towards some skill level, these figures will overstate the relative supply growth of those skills less prone to participation. Second, even ignoring the previous difficulty — or alternatively, reading the attainment figures as an upper bound on potential skills supply — a positive value for the difference between employment and attainment growth can only be interpreted as a skill gap if the starting situation was balanced or presented already a skill gap. With these caveats in mind, a significant positive difference for high skills seems more likely to translate a shortened supply of high skills relative to demand than would be the case for low skills (implicitly assuming that in 1995 the situation for high skills was already displaying a supply shortage, or at least was not characterised by excess supply). An eventual decrease of participation in the low skill group relative to the high would reinforce the argument. In fact, in the case of low skills it is harder to assess whether a positive difference reflects a correction of a previous excess supply or adds to an existing excess demand.

attainment growth in the European Union has fallen short of employment growth by 1.0 % during the 1995–2000 period.

For the two upper attainment categories, these imbalances stand in contrast with the experience of the United States where a widening shortage of medium-skill workers and a modestly declining pressure in the market for high-skill workers has been recorded. In contrast to these, Japan saw an overall attainment surplus across all categories of skills as the pace of skill formation exceeded employment growth during the second half of the 1990s, due to Japan's weak employment performance.

In terms of national experiences, in Austria and Sweden the growth of attainment in the population was greater than the growth in the corresponding employment across all groups. Concerning possible high-skill shortages, Spain, and to a lesser degree Belgium, appear to be more vulnerable than the other Member States, with a difference value well above the one for the European Union as a whole. With the exception of Austria and Sweden, all Member States display a higher growth of employment of high skill workers than the corresponding attainment growth, suggesting that the tightening of the labour market for high skills is a general phenomenon across the European Union. Considering that the participation rates are already highest for this group, the scope for filling this gap through raising the participation rate is limited[30].

II.3.3 The skills content of jobs and the sectoral distribution of employment

An important question is whether the changing patterns of labour demand in the European Union in recent years reflect changes in the skill content of jobs rather than changes in the sectoral distribution of employment. In other words, the question posed is whether the overall human capital intensity in the European Union has increased in recent years or whether changes in the sectoral allocation of employment, given the level of skills, have dominated the picture.

Table II.3 reports data on this issue for the year 2000. The data presented in the first three columns

30 In the EU, the participation rate (in the 15 to 64 years of age population) of those in the high-skill category is around 86 percent, against 76 % for medium skilled and 57 % for low-skilled population.

Table II.3: The structure of employment and job turbulence within the EU, 2000

	Attainment			Educational job turbulence	Output sector		Sectoral job turbulence	Labour productivity
	Primary/ lower sec	Upper secondary	Tertiary	1995-2000	Industry	Services	1995–2000	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Austria	20.3	64.2	15.6	1.36	30.0	63.9	0.75	96
Belgium	30.9	35.9	33.3	0.67	25.8	72.3	1.00	126
Germany	17.2	57.2	25.6	0.55	33.5	63.8	0.82	97
Denmark	21.9	53.4	24.8	0.33	25.5	70.8	0.84	104
Spain	53.9	18.8	27.3	1.72	30.8	62.4	0.74	89
Finland	22.8	43.7	33.5	1.86	28.0	65.8	0.93	104
France	30.0	44.7	25.3	0.78	26.3	69.5	0.44	107
Greece	43.1	37.0	19.9	1.88	22.5	60.5	0.95	81
Ireland	33.9	26.7	39.4	3.42	28.7	63.4	1.71	119
Italy	45.1	42.7	12.2	2.04	31.8	63.3	0.99	113
Luxembourg	33.0	45.6	21.4	3.46	20.8	76.8	1.50	198
Netherlands	29.9	44.5	25.6	2.74	21.6	75.1	0.87	99
Portugal	76.7	13.1	10.2	0.45	36.2	55.8	1.54	66
Sweden	20.5	49.2	30.3	0.79	24.4	72.7	0.79	92
United Kingdom	13.2	57.5	29.4	5.91	25.4	73.1	0.76	98
EU–15	**29.6**	**46.3**	**24.1**	**1.57**	**29.0**	**66.9**	**0.62**	**100**

Note: Turbulence is measured as $\frac{1}{2} \Sigma |\Delta(N_i/N)|$ where N_i/N is the employment share of category i (according to educational attainment or sector), and then standardised to average changes per year (see Layard et al. (1997)); indices of labour productivity are for 2001 (see *European competitiveness report 2001*, op. cit.). The data show the percentage of jobs changing between the categories (educational or sectoral) per year

Sources: Eurostat, *Labour force survey,* 2001 and OECD, *Employment outlook*, 2001.

of the table concern the educational attainment of workers by three categories of education (primary and lower secondary, upper secondary and tertiary) in percent of all employees. An index of educational job turbulence is presented in the fourth column. This index summarises shifts from one educational attainment category to another and is measured by the sum of the absolute changes between 1995 and 2000 of each educational attainment category in employment, measured in percent (see note in Table II.3). Output shares in percent, based on the 17 sectors of the NACE 1-digit classification and divided into two categories, industry and services, are presented in the fifth and sixth columns of the table. A corresponding measure of job turbulence across the 17 sectors is reported in the seventh column and the last column shows the level of labour productivity in 2000.

As noted previously, with strong growth in medium- and high-skill employment, there has been a notable shift from one skill group to another (1.57 % per year, see column (4)) in the European Union as a whole. Those countries with negative rates of growth in high-skilled employment (Denmark and Portugal) are also the ones with the lowest overall rates of job turbulence with respect to skills. On the other hand, the overall extent of industrial change was relatively low, with 0.62 % of jobs shifting between sectors. The changing nature of labour demand at EU level is, therefore, accounted for largely by changes in the skill content of jobs rather than changes in the sectoral location of employment growth. This was particularly true in the United Kingdom and the Netherlands, compared with higher rates of employment change between sectors in Belgium, Germany, Denmark and Portugal. However, Ireland, Luxembourg and — to a lesser extent — Italy, exhibit relatively high rates of structural change due to changes in both the skill content of jobs and in the sectoral distribution of employment.

A summary of the evidence on skill shifts, sectoral employment shifts, and productivity growth, can be obtained from Tables II.3 and II.4. It is clear that those Member States that have experienced significant shifts in labour demand across sectors **and** across skill groups, such as Ireland and Luxembourg, display a high level of labour productivity and have experienced high labour productivity growth — see Table II.4 below. Productivity growth is slower in cases where the labour market has been dominated by changes in the skill content of employment alone (relatively high rates of sectoral job turbulence and stable skill content, as in Greece and Spain, correspond to low levels of labour productivity and modest rates of productivity growth).

Table II.4: Productivity growth, employment growth and factor accumulation 1980–99

	1980–90				1991–99				
	Hourly labour productivity growth	Employment growth	Change in physical capital intensity	Change in human capital	Hourly labour productivity growth	Employment growth	Change in physical capital intensity	Change in human capital	GDP per capita, 2001 (EU–15 = 100)
Belgium	2.1	0.1	2.0	0.5	2.4	0.5	1.8	1.0	112
Denmark	2.8	0.3	1.1	0.4	1.6	0.4	1.0	0.4	120
Germany	2.5	0.5	1.5	1.2	1.9	0.0	2.2	0.3	104
Greece	1.2	1.0	2.0	1.1	0.9	0.9	1.7	1.7	69
Spain	3.1	0.8	2.2	1.5	1.5	1.2	2.1	2.1	82
France	2.9	0.3	2.3	0.5	1.7	0.5	1.5	0.8	98
Ireland	4.1	- 0.2	3.5	1.0	4.5	4.1	- 0.6	1.0	123
Italy	2.0	0.6	2.0	1.4	1.9	- 0.1	1.9	1.8	102
Luxembourg	4.8	0.7	0.5		4.9	1.5	1.3		196
The Netherlands	2.8	1.1	1.3	1.0	1.8	1.9	0.2	0.6	118
Austria		0.1	2.6	0.8		0.3	3.2	0.6	110
Portugal		0.2	4.0	0.4	3.7	- 0.4	4.0	0.8	74
Finland	3.0	0.5	2.4	0.8	2.3	- 0.4	0.4	0.9	104
Sweden	1.0	0.7	1.2	0.9	2.0	- 0.6	1.2	0.5	102
United Kingdom	2.7	0.5	1.2	0.8	2.3	0.6	1.2	1.1	103
United States	1.4	1.8	0.6	0.3	1.7	1.5	1.0	0.2	154

Note: Changes in human capital are measured as annual percentage change in average years of education.

Source: European Commission (2001b), and source used in Graph II.1.

II.3.4 Productivity, employment and capital intensity

The skill intensity of employment growth depends in part on the growth of demand for other complementary factors, in particular capital. Table II.4 presents data on the experience of the EU Member States, and on that of the United States, for the relation between relative factor intensities, productivity growth and employment performance. It is evident that, compared to the United States, productivity gains were generally higher across the European Union in the 1980s compared with those achieved in the 1990s, although the former are partly associated to losses in employment rather than to changes in capital intensity. Moreover, the rate of growth in **physical** capital intensity was lower in most Member States in the 1990s compared with the earlier decade (except in Austria, Germany and Luxembourg), while **human** capital tended to increase more in the last decade.

In the 1990s compared to the previous decade in eight Member States (Belgium, Finland, France, Greece, Italy, Portugal, Spain and the United Kingdom) human capital grew faster, while in two countries (Denmark and Ireland) it grew at the same rate as before. In the remaining Member States, there was a slowdown in the rate of human capital accumulation. Concerning the rate of accumulation of physical capital during the same periods, three Member States (Austria, Luxembourg and Germany) saw an acceleration, and three Member States (Sweden, Portugal and the United Kingdom) recorded the same rate of growth as previously. The remaining Member States recorded a decelerating growth in physical capital accumulation. Thus, only two Member States (Portugal and the United Kingdom) recorded a simultaneous acceleration in physical capital intensity and human capital during the 1990s.

In a majority of Member States (Austria, Belgium, Denmark, France, Ireland, Luxembourg, the Netherlands, Spain and the United Kingdom) employment grew faster during the 1990s compared to the previous decade but in the remaining it declined. However, in the Member States for which comparative data exist for the two periods, in only three (Belgium, Ireland and Luxembourg) was hourly labour productivity growth faster in the 1990s compared to the previous decade.

Finally, the United States during these periods saw an acceleration in labour productivity growth, an increase in the rate of accumulation of physical capital and a modest deceleration in the growth of employment and in human capital accumulation.

This discussion suggests that, despite the convergence of the European Union in terms of the stock of human capital towards the level of the United States, its underperformance in the 1990s, both in terms of output, employment and productivity growth, could perhaps reflect an imperfect match between human and physical capital formation. The complementarity between these factors, especially in recent years when the transition of economies to a state where human capital and knowledge play a prominent role, is undoubtedly crucial in making possible the realisation of the gains from the division of labour and its effect on innovation.

II.4 Supply trends, accumulation and mismatch

The previous section suggested that the general upgrading of the skills of the labour force in the European Union should be expected to have been a significant contributor to economic and productivity growth. Yet, to explain the weak performance recorded in recent years it is essential to ask whether the supply of human capital played a role. The emergence of skill imbalances suggests that this is a reasonable hypothesis to examine. Has the supply of human capital been effective? This section reviews, first, the character and extent of human capital accumulation in the EU; it then examines the matching efficiency of schooling and employment at the national and sectoral level; next, it seeks to establish national differences in skill supply and on productivity performance; and, finally, some evidence on the extent and location of skill gaps in the Member States is provided, and the impact of such gaps on recent growth performance is examined.

II.4.1 Comparative human capital accumulation in the European Union

Prior to any discussion of comparative human capital formation, it should be noted that the measurement of the amount of knowledge and skills embodied in a typical member of the labour force, has been the subject of considerable methodological debate.

Three different approaches can be distinguished (OECD, 1998, chapter 1). First, that seeking to measure the number of school years per employee; second, that reflecting the percentage of the

Table II.5: Distribution of the population 25 to 64 years of age by level of educational attainment in 1999
(percent of the population according to the highest level attained)

	Pre-primary and primary education	Lower secondary education	Upper secondary education	Post-secondary non-tertiary education	Tertiary-type B education	Tertiary-type A and advanced research programmes	Average years of education (labour force)
	ISCED 0/1	ISCED 2	ISCED 3	ISCED 4	ISCED 5B	ISCED 5A/6	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Austria[1]	x(2)	26.1	56.9	6.1	4.7	6.1	12.5
Belgium	19.9	23.3	30.7	x(3)	13.9	12.1	11.8
Denmark	n	20.3	53.1	x(3)	19.9	6.6	12.9
Finland	x(2)	28.5	40.2	x(3)	17.4	13.9	12.5
France	20.0	18.1	40.2	n	10.5	11.0	11.2
Germany	2.2	16.7	53.3	5.0	9.9	13.0	13.3
Greece	40.6	9.5	26.8	5.4	5.5	12.2	10.6
Ireland[1]	23.1	25.6	30.2	x(3.5)	10.5	10.6	11.1
Italy	24.7	31.8	29.8	4.5	x(6)	9.3	10.9
Luxembourg	24.2	13.5	43.9	a	6.6	11.7	11.1
Netherlands	12.3	23.0	42.1	x(3.5)	2.5	20.1	12.4
Portugal	66.7	12.1	11.5	x(3)	2.7	7.1	8.0
Spain	42.2	22.7	14.1	x(5)	6.2	14.8	9.9
Sweden	10.9	12.4	47.8	x(5)	15.6	13.2	12.0
United Kingdom	x(2)	18.0	57.2	x(total)	8.2	16.6	12.5
United States	4.7	8.4	51.2	x(3)	8.3	27.5	12.8
Japan	x(2)	19.1	49.3	x(total)	13.4	18.3	12.6

Note: x(•) denotes the categorisation of results in a different column due to diverging definitions in types of schooling, where the number between brackets indicates the present column number.

Source: OECD (2001) and calculated using de la Fuente and Domenech (2001).

working population with a given degree of educational attainment (mostly upper secondary and higher); and third, that based on observed differences in earnings (Mulligan and Sala-i-Martin, 1995). Given the problems in interpreting wage outcomes as reflecting schooling differentials and the need for an arbitrary benchmark in the second case, international comparisons of aggregate human capital formation have typically been made in terms of the number of years of schooling[31].

Table II.5 summarises recent OECD data on the **composition** of this accumulation according to the ISCED categorisation of general education[32] while Graph II.3 shows the latest data for the first two approaches on the comparative accumulation of human capital within the EU.

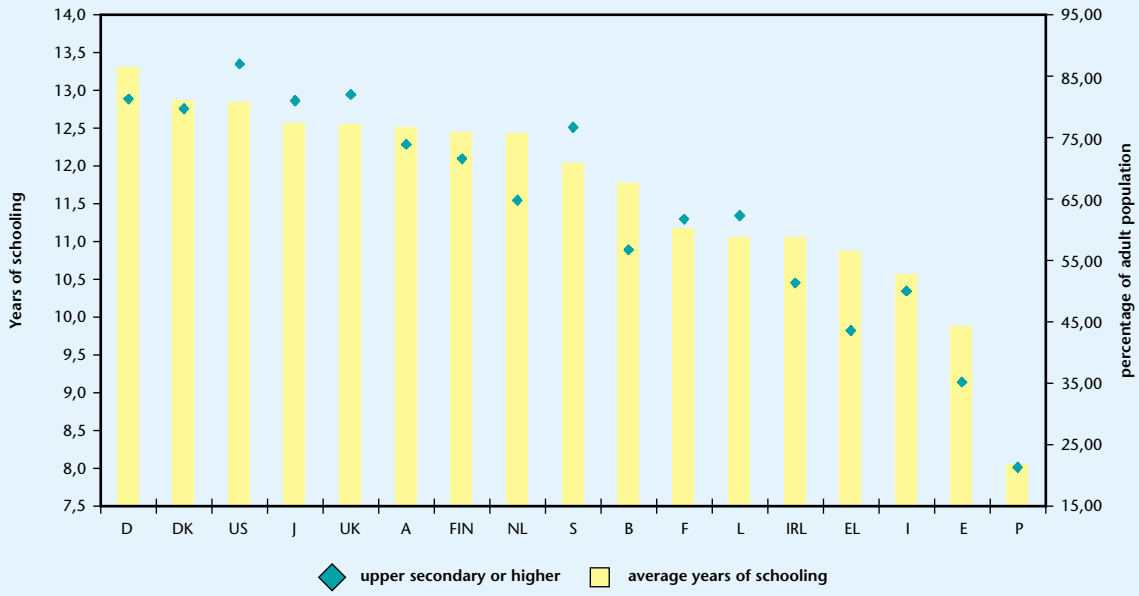
These data show that, in spite of a prolonged convergence in educational attainment relative to the United States (suggested in Graph II.1 previously), there still are considerable differences among the various Member States. Educational attainment in Greece and Portugal was particularly low in 1999 (the latest year for detailed information), with over 40 % of the 25–64 age group educated to pre-primary or primary level only. While Spain also has a high proportion of the adult population with low levels of education there is growing evidence of polarisation; a comparatively low proportion of the 25–64 age group held intermediate qualifications in 1999 alongside a relatively high proportion with tertiary-type A education and advanced research programmes.

Attainment in Germany, Austria and the United Kingdom tends to cluster around intermediate levels of educational achievement, where over half of the adult population has upper secondary or post-secondary, non-tertiary, education. In contrast, over a quarter of the adult population in Belgium, Denmark, Finland and Sweden had completed high, tertiary, level education.

The aggregation of these compositional effects into average years of schooling logically reflects the same

31 See Barro and Lee (1993) and de la Fuente and Domenech (2001).
32 ISCED stands for International Standard Classification of Education, first designed in the 1970s by Unesco.

Graph II.3: Two measures of educational attainment of the adult population (1999)
(highest level of attainment and average years of schooling)



Source: OECD (2001) and calculated using de la Fuente and Domenech, (2001).

pattern. While average years of schooling in Germany, Denmark, the United Kingdom, Austria, Finland, the Netherlands and Sweden are generally comparable with those in Japan and the United States, countries such as Italy, Spain and most notably Portugal still exhibit considerable education gaps. The average duration of education within Portugal is only eight years, at least four years less than most of its EU counterparts and almost five years shorter than the average length of schooling in the United States.

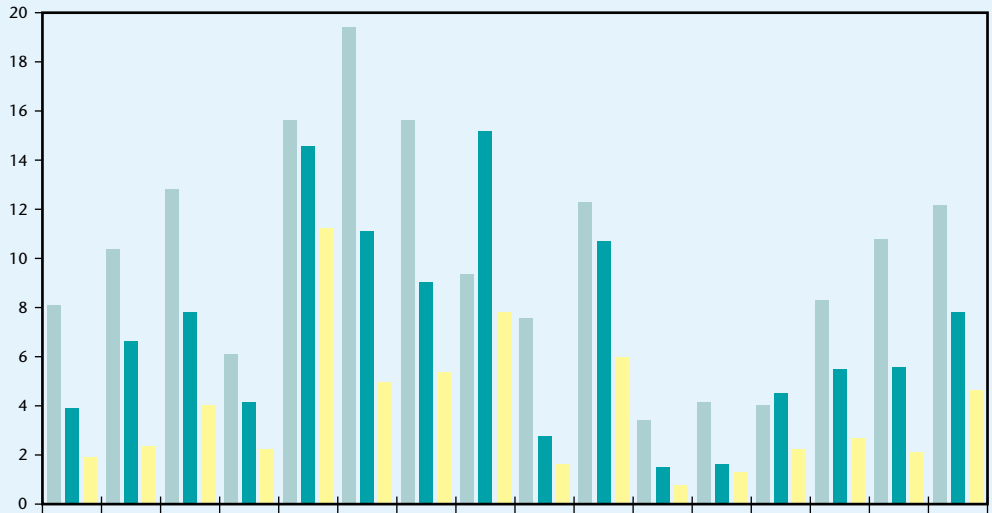
Despite this result for Portugal, there is no clear relationship between the length of schooling and educational attainment across the EU. Only Sweden, Luxembourg and the United Kingdom follow a similar pattern to the United States and Japan, where the proportion of the adult population with upper secondary or higher education is relatively high in comparison to the average time spent in education. Elsewhere in the EU, medium and especially high-level educational attainment relative to the duration of schooling lags behind the United States and Japan, particularly in Germany, the Netherlands Belgium, Ireland, Greece and Spain.

One element in the explanation of this divergence lies in the length of graduation periods. In the absence of a harmonisation of educational programmes, it is difficult to say whether such differences matter to the quality of human capital (i.e. is a four-year secondary education equal or less effective than a five-year tuition period?). Another source for the difference between the two measures relates to the distribution of primary versus lower secondary education in the population. The two measures shown in Graph II.3 reflect the extreme positions of either upper-secondary achievement or counting the number of years spent in school, serving to emphasise the difficulties in measuring human capital alluded to earlier.

II.4.2 The matching efficiency of schooling and employment

As noted previously, the general skill upgrade of the European labour force is going on in parallel with a strong concentration of job creation in high-tech and knowledge-intensive sectors. However, does the supply of education meet the changing structure of labour demand? How efficient is the combined matching process of education output and labour market allocation that ties education to jobs? A first indication of this process is gained from data on unemployment rates according to educational attainment. Structural changes in labour demand towards higher skill jobs could be reflected in unemployment rates. In general, employees with low levels of education are more likely to be unemployed in the European Union than those with medium or high levels of attainment, as Graph II.4 suggests. This was true across all Member States in 2000 except for Greece and Portugal where unemployment was highest amongst medium-skilled workers. At the same time, unemployment of high-

Graph II.4: Rates of unemployment by level of educational attainment, 2000; EU–15



	A	B	D	DK	E	FIN	F	EL	IRL	I	L	NL	P	S	UK	EU
Low	8.2	10.4	12.7	6.3	15.4	19	15.4	9.4	7.7	12.2	3.7	4.4	4.3	8.4	10.8	12.1
Medium	4.2	6.8	7.9	4.4	14.4	11.1	9.1	15	3.1	10.7	1.9	2	4.8	5.7	5.8	7.9
High	2.3	2.7	4.3	2.6	11.2	5.2	5.6	7.9	2	6.2	1.2	1.7	2.6	3	2.5	4.9

Note: As before, 'low', 'medium' and 'high' are defined as ISCED 1–2, 3–4 and 5–6 respectively.

Source: Eurostat, *Labour force survey*, 2001.

skill labour was relatively low in all Member States with the exception of Spain, Greece and Italy.

The extent to which the various national education systems and labour market institutions are able to match skills to jobs can be gained by comparing the distributions of educational attainment for different populations. Calculating the variation in educational attainment for the population of working age, for the unemployed and for those aged 15–64 not participating in the labour force relative to the skill content of employment tells us how adequate the fit of educational attainment for each of these groups is. The results are presented in Table II.6.

To make this comparison possible, an adjusted version of the coefficient of variation is computed using the ratio of those with a particular level of educational attainment in employment to those with the same educational attainment in each of the other categories (working-age population, unemployed and those aged 15–64 not participating in the labour force). This is discussed more precisely in Box II.1. While such a comparison between the skill content of those in employment and the distribution of attainment among the entire working-age population only compares labour demand with 'education output', the comparison against the other two groups, the unemployed and those not participating in the labour force, indicates the selectivity of the labour market matching process. To what extent are differences between the distribution of attainment among the population of working age and the skill content of employment reinforced by the matching process itself?

The data used in this comparison derive from Eurostat's most recent *Labour force survey*, which contains information on the highest level of educational attainment achieved for 2000 at three ISCED-defined levels: pre-primary up to lower secondary, upper secondary and tertiary. Since for those in employment it also defines the sector in which they are active, it is also possible to decompose the overall extent of mismatch into its sectoral components, indicating the extent to which labour demand in individual sectors is subject to disparities between the distribution of attainment among the group of potential employees and the skill-content of current employment; this is done in Table II.7.

The data in Table II.6 present the adjusted coefficient of variation for the ratio of employment to each of the categories in the columns. Clearly, a low (high) value of this coefficient indicates that the distribution of educational attainment in any of the categories in question is close to (distant from) the distribution of educational attainment of those in employment. The higher the value of this ratio is, the worse the mismatch of supply relative to the educational structure of employment.

Table II.6: The distribution of educational attainment among the population, the unemployed and non-participants in the labour market compared to that of the employed — 2000

(adjusted coefficients of variation by order of matching performance)

	Population 15 to 65, 1995	Population 15 to 65, 2000	Population 25 to 34, 2000	Unemployed	Non participants			
	(1)	(2)	(3)	(4)	(5)	(3)/(2)	(4)/(2)	(5)/(2)
Portugal	11.4	8.2	21.4	13.7	28.8	2.62	1.68	3.52
Denmark	14.3	12.9	21.7	29.8	62.3	1.68	2.30	4.81
Germany	21.0	13.4	10.0	37.3	45.9	0.75	2.79	3.43
Luxembourg	15.9	14.0	3.8	42.6	37.8	0.27	3.04	2.70
Sweden	14.6	14.8	19.1	35.9	62.9	1.29	2.42	4.24
Netherlands	12.6	15.0	10.2	44.2	58.8	0.68	2.95	3.93
Greece	13.3	15.3	31.9	31.7	43.2	2.08	2.07	2.82
Spain	16.9	15.4	20.7	14.4	40.3	1.34	0.93	2.61
United Kingdom	13.2	16.5	8.0	47.8	75.5	0.48	2.89	4.56
Finland	23.1	20.1	21.8	51.3	71.8	1.08	2.55	3.57
Austria	16.5	20.6	11.1	42.0	68.5	0.54	2.04	3.33
Italy	19.0	21.1	12.1	18.7	51.7	0.57	0.88	2.45
France	20.7	22.4	16.8	41.1	63.1	0.75	1.84	2.82
Ireland	25.6	24.2	15.0	61.5	67.9	0.62	2.54	2.81
Belgium	29.5	27.7	13.6	49.4	74.5	0.49	1.78	2.69
EU–15	**19.5**	**19.1**	**8.2**	**34.1**	**59.5**	**0.43**	**1.78**	**3.11**
United States	24.5	22.4	0.4	68.4	81.7	0.02	3.05	3.65
Japan	5.8	6.2	26.1	22.5	25.2	4.19	3.60	4.04

Note: For the methodology used to compute the coefficients of variation see Box II.1; the years of reference in column (1) for Ireland and the Netherlands are 1997 and 1998 respectively; all distributions of attainment mentioned in the column headings are compared with that of employment for three levels of education.

Source: Computed from Eurostat, *Labour force survey*, 1996–2001; OECD, *Employment outlook*, 2001 (on the United States and Japan and for Ireland and the Netherlands with respect to data before 2000).

Table II.7: The distribution of educational attainment among the population, the unemployed and non-participants relative to that of sectoral employment, EU–15 — 2000

	Employment share, 2000	Population 15 to 65, 1995	Population 15 to 65, 2000	Population 25 to 34, 2000	Unemployed	Non-participants
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture, fishing, mining	4.4	1.6	1.2	0.8	1.2	0.3
Manufacturing	20.1	1.3	0.9	1.1	2.8	7.7
Electricity, gas and water supply	0.8	0.3	0.2	0.0	0.3	0.6
Construction	7.8	0.9	0.9	0.8	0.4	1.9
Wholesale and retail trade, repair	14.8	1.6	1.8	1.2	2.6	6.2
Hotels, restaurants	3.9	0.8	0.8	0.6	0.6	0.8
Transport, storage, communication	6.0	0.7	0.7	0.4	1.3	2.8
Financial intermediation	3.4	1.3	1.6	0.4	3.0	4.7
Real estate, renting	8.7	2.2	2.5	0.6	5.0	7.9
Public administration, defense	7.7	1.9	1.6	0.2	3.5	5.9
Education	6.8	3.9	3.7	1.2	6.7	9.5
Health and social work	9.6	2.7	2.8	0.6	5.5	8.7
Other service activities*	5.8	0.3	0.3	0.2	1.2	2.6
Total	**100.0**	**19.5**	**19.1**	**8.2**	**34.1**	**59.5**

Note: * includes private households with employees and extra-territorial organisations. Due to the absence of sector-level data in the LFS since 1997 the EU–15 average excludes Ireland. Note that none of the distributions mentioned in the column headings are defined by sector but denote general distributions by level of education (i.e. only employment is sector-specific). Otherwise, the methodology is the same as in Table II.6 (with added sectoral decomposition).

Source: Computed from Eurostat, *Labour force survey*,1996–2001.

Box II.1. Comparing distributions of educational attainment

In order to compare the skill distribution of employment with that of potential labour supply, we need some measure that captures the extent of the variation in the relation between each pair of the distributions involved. Ideally, the distribution of employment over ISCED categories of educational attainment would be mirrored in the skill structure of the population of working age, of school leavers and of the unemployed. The extent, then, to which the distributions are dissimilar defines the allocational inefficiency caused by the supply of skills and the matching process on the labour market.

The measure that captures this 'deviation from a situation of one-on-one distributions' is the coefficient of variation for the ratio of the number of people employed on the one hand and those within each of the other categories distinguished on the other, per level of educational attainment. In the present case, the Eurostat Labour Force Survey allows for a subdivision of educational attainment in three categories: primary through lower secondary, upper secondary and tertiary (ISCED categories 1–2, 3–4 and 5–6 respectively). Calculating a coefficient of variation (standard deviation of the observations relative to the mean of the series) would, however, produce inconsistent results. Although the three groups are very different in size, as part of a normal coefficient of variation the dispersion in each would be equally weighed. Thus, a given dispersion for the typically small group of higher educated people would, for instance, unduly influence the overall result. For this reason, one should not measure dispersions from the simple unweighted average of the three ratios, but instead from the overall ratio of the populations compared. The standardisation then, of course, should also be relative to this ratio. Thus, the size-effect can be solved through the application of weights rather than the use of the unweighted average of dispersions.

The adopted measure of variation φ is defined as:

$$\varphi = \sqrt{\frac{\left[w_l \left(\frac{e_l}{p_l} - \frac{e_0}{p_0} \right)^2 + w_m \left(\frac{e_m}{p_m} - \frac{e_0}{p_0} \right)^2 + w_h \left(\frac{e_h}{p_h} - \frac{e_0}{p_0} \right)^2 \right]}{\left(\frac{e_0}{p_0} \right)^2}}$$

where the w_i 's denote employment weights, e_i/e_0 and the subscripts l, m, and h refer to the level of educational attainment (low, intermediate and high) and $e_0 = e_l + e_m + e_h$. In Table II.6 e represents overall employment while second distribution involved (p) refers to the educational attainment of the population (columns 1 to 3), the unemployed (column 4) or the non-participants (column 5). Table II.7 reproduces the same type of exercise and decomposes the aggregate for the European Union as a whole by economic sector.

A first observation to note is that, measured in this way, the overall efficiency of the matching process between the supply of education and structure of labour demand in the European Union has been better than in the United States (see columns 1 and 2). With the exception of the two least performing countries in this respect (Ireland and Belgium), the difference between the skill composition of employment and that of the wider population (aged 15–65) was lower in the European Union than the United States in both 1995 and 2000. This can be taken to suggest that the educational attainment of (potential) labour supply was more closely associated with the skill content of labour demand in most EU Member States than in the United States[33]. Since 1995, however, the United States has seen a more pronounced improvement in the employment efficiency of education output than the European Union as a whole (the coefficient has declined from 24.5 to 22.4 in the case of the United States but only by 0.4 points to 19.1 in the case of the European Union).

The aggregate EU experience masks some important differences in the matching performance of individual Member States. The labour markets in Germany and Portugal, for example, have recorded considerable efficiency improvements in the matching of the supply of education to the structure of labour demand since 1995. In contrast, performance has worsened in the Netherlands, Greece, Italy, France, Austria and the United Kingdom. While most Member States' labour markets maintain a closer match between the skill composition of employment and that of the wider adult population than found in the United States, it

33 An alternative meaning would be that relatively more persons with high skills are able, or willing, to enter the labour force in the European Union than in the United States.

appears that these differences are narrowing. Japan records values, which are well below those of both the United States and the European Union.

For the European Union as a whole, closer examination of data for the youngest age cohort in work (column 3) shows that the distribution of educational attainment among those aged 25 to 34 is much closer to the skill composition of employment than is the case for the wider, adult population. This suggests that the matching performance for the European Union as a whole may improve in the future if this trend is sustained. A condition for the fulfilment of this potential, however, is an increased mobility of workers within the European Union (of which the younger generations are supposedly more mobile), as this aggregate relationship between the distribution of attainment for the young age cohort and skills demand does not hold equally strong across individual Member States. While the coefficient for the aggregate EU data is 8.2, it varies from a low of 3.8 in the case of Luxembourg to a high of 21.8 in the case of Finland. It is also important to note that this potential for an improved matching is even greater in the United States, where the educational attainment of the young cohort virtually matches the skills demand, while in Japan the young cohort skills distribution is substantially further from demand than is the case for the overall population.

The sixth column in Table II.6 illustrates the extent to which the young cohort's skills better match the respective demands. Below unit values depict a generational matching improvement while above unit values suggest that the acquisition of skills by the younger generation has moved further away from demand requirements. Portugal, Greece, Denmark, Spain and Sweden seem to have run in such a situation. For the other Member States — except Finland which display identical matching performances for the young cohort and the overall population — the younger generation seems to be closer to the needs of the labour market than older generations.

More alarming, however, is the variation between the skill composition of the unemployed and of those not participating in the labour market compared with those in employment in the European Union, the United States and Japan, as shown in columns 4 and 5 of Table II.6. The particularly high values for the European Union (34.1 and 59.5, respectively) and the United States (68.4 and 81.7, respectively) reflect the skill selectivity of the acceleration in employment growth in the latter half of the 1990s, while in Japan the coefficients are substantially lower reflecting the generally poor employment performance during the period. Employment growth in the second half of the 1990s has been skewed towards the employment of high-skill professionals in both the European Union[34] and the United States. Even so, the values for the EU, both at an aggregate level and for individual Member States, are well below those for the United States and may improve further following the development and implementation of policies and programmes to promote social inclusion and enhance labour market participation.

To conclude this part of the discussion, the data suggest that, at least with respect to general education, the difference in growth performance between the European Union and the United States in recent years cannot be attributed to matching effects in the output of general education and employment.

The considerable growth in service sector employment and the general upgrading of skills of the EU workforce between 1995 and 2000 is likely to be reflected in the matching performance of specific sectors. While the efficiency of the matching process has improved for the European Union as a whole, there have been some marked sectoral developments. More specifically, differences between the educational attainment of the adult population and that of the workforce in agriculture, manufacturing and utilities have fallen since 1995, as shown in columns 2 and 3 of Table II.7. In contrast, the degree of disparity between supply and demand generally increased in the knowledge intensive and high education sectors, including financial intermediation, general business services, and health and social work. However, the matching performance of all sectors is considerably better for the youngest age cohort, indicating that the educational attainment of those aged 25–35 is more closely matched to the structure of labour demand than the distribution of attainment in the wider, adult population. Manufacturing is the only notable exception here.

Similar trends are found when comparing the skill composition of the unemployed relative to skills in sectoral employment. In 2000, there were significant mismatches between the distribution of attainment amongst the unemployed relative to employment in high-tech manufacturing and high education sectors (financial intermediation, general business services, education, and health and social work). In contrast, the extent of divergence between the educational attainment of the unemployed relative to the workforce in construction and

34 See European Commission (2001b), especially chapter 2.

hotels and restaurants is very low, and more favourable than comparative indicators for the adult or 25–35 age populations. These results reflect the high incidence of self-employment and short-term contracts in construction and relatively high labour turnover in the hospitality industry.

II.4.3 Exploring tertiary skill gaps

In recent years, and as mentioned in the beginning of this chapter, increasing attention has been paid to the prevalence of skill gaps alongside high unemployment, and their impact on growth and productivity (Haskel and Martin, 1996). Skill gaps reflect poor availability of potential skilled employees within the existing workforce. The acceleration in the growth of high-skill employment across the European Union during the second half of the 1990s, particularly in high-tech, knowledge-intensive and high-education sectors has contributed to the emergence of skill gaps. As noted previously, the increased demand for skilled employees has coexisted with slow growth in tertiary attainment, and high-skill individuals have been the least likely to be unemployed. The combination of these factors — growth in high-skill employment, low levels of unemployment amongst the high-skill workers and relatively low growth in the attainment of tertiary education — suggests that tertiary-level skill gaps may emerge within Member States' economies as demand exceeds the supply of high-skill workers.

Table II.8 explores the extent of skill gaps within Member States' economies by comparing the presence of high skill workers in employment against the same in unemployment (panel A of the table) and in those in the age group 15–65 that do not participate in the labour force (panel B). The numerator of the data is, therefore, the number of employees with tertiary education in sector j and the denominator is the total number of unemployed with tertiary education (panel A) or those aged 15–64 that do not participate in the labour market (these ratios are also reported measured against the sum of unemployed and not participants in the labour market at the bottom of panel B). Since it is impossible to assign the unemployed or those not participating in the labour market by sector, these ratios are intended to suggest the potential recruitment pool from where employees could be drawn. In other words, skill gaps are here approximated by the tightness of the labour market for high skilled workers.

The data suggest that, in general, tertiary-level skill gaps are most significant in the fastest growing sectors of the economy — general business services, and health and social work — across the European Union, with particularly high values for Luxembourg, the Netherlands and the United Kingdom. Spain is the only country where this does not hold true, due to comparatively higher rates of unemployment amongst high-skill workers (relative to the other Member States). It is also clear that skill gaps are prevalent in manufacturing across all Member States, following significant structural changes in the skill content of jobs as production has been shifting to more high-tech, innovative manufacturing processes. The effect of this shift was particularly pronounced on tertiary-level skill gaps in Austria and the United Kingdom. In addition, it appears that public administration and defence may also face problems in the recruitment and retention of high-skill workers. Here, lagging adjustment and monopsony problems in wage formation in the (semi-) public sector appear to be crucial.

The degree to which skill gaps occur within wholesale and retail, transport and financial intermediation across Member States is much more varied, and appears to reflect more widespread gaps in high-skill workers. For example, significant tertiary-level gaps in these sectors are evident in Austria, Luxembourg, the Netherlands and the United Kingdom — countries exhibiting relatively high levels of tertiary-level skill gaps across all sectors of their economies. There is little evidence that skill gaps are emerging in agriculture, utilities, construction and hotels and restaurants. The first two sectors — agriculture and utilities — have witnessed significant job losses in recent years as their respective industries have undergone significant technological and structural change.

The most striking result from the data in Table II.8 is the relatively high occurrence of tertiary level skills amongst those individuals who are not participating in the labour market relative to those in employment compared against the incidence of tertiary level skills amongst the unemployed. This can be seen by noting that in Portugal, for example, for 12 high-skilled workers, there is one equally skilled adult not participating in the labour force. In all other Member States this ratio is more advantageous, ranging from around four in Luxembourg to roughly nine in Denmark (see line 'Total' in panel B). This indicates that there is a potential pool of skilled labour that is not currently active in the labour market and further measures to enhance participation may ease some of the pressures exerted by prevailing skill gaps.

What impact does the existence of these skill gaps have on Member States' comparative growth

Table II.8.a: An approximation of tertiary 'skill gaps' by sector and Member State

(ratios of highly skilled employees by sector relative to high skills in overall unemployment, 2000)

A. Proportions of those with tertiary attainment in employment/unemployment

	Austria	Belgium	Germany	Denmark	Spain	Finland	France	Greece	Italy	Luxembourg	The Netherlands	Portugal	Sweden	United Kingdom
Agriculture, fishing, mining	1.44	0.25	0.46	0.36	0.12	0.43	0.21	0.12	0.19	0.28	0.52	0.25	0.30	0.45
Manufacturing	6.76	4.54	4.38	4.31	1.19	2.90	2.19	0.88	1.43	4.99	4.81	3.04	3.58	5.24
Electricity, gas and water supply	0.45	0.25	0.22	0.24	0.07	0.17	0.13	0.12	0.05	0.63	0.19	0.12	0.29	0.42
Construction	1.98	0.69	1.49	1.16	0.38	0.59	0.31	0.23	0.31	1.22	0.73	0.82	0.64	1.36
Wholesale and retail trade, repair	3.63	2.91	1.78	1.71	0.91	1.72	1.52	1.26	0.91	5.43	2.98	1.46	2.09	2.62
Hotels, restaurants	0.83	0.34	0.22	0.15	0.19	0.24	0.23	0.22	0.12	0.84	0.39	0.35	0.36	0.57
Transport, storage, communication	1.78	1.53	0.68	1.36	0.41	0.85	0.69	0.43	0.38	1.80	1.62	1.35	0.99	1.52
Financial intermediation	1.50	2.27	0.82	1.01	0.36	0.65	0.83	0.60	0.77	12.97	2.83	2.13	0.70	1.85
Real estate, renting	4.74	5.24	2.51	5.41	0.96	2.52	2.64	1.67	2.60	12.17	10.98	4.27	5.69	7.04
Public administration, defense	2.80	3.04	2.43	3.04	0.78	1.50	1.41	1.61	1.60	5.68	5.58	4.05	2.73	2.95
Education	9.86	7.27	3.11	6.88	1.36	2.55	3.18	2.98	3.99	17.42	10.82	12.35	6.11	7.01
Health and social work	4.91	6.83	3.00	10.15	0.90	3.24	2.68	1.31	2.55	7.28	10.13	6.13	7.46	6.69
Other service activities*	2.91	1.38	1.37	1.71	0.36	0.80	0.96	0.40	0.62	9.66	3.28	1.14	1.82	2.34
Total	**43.58**	**36.54**	**22.47**	**37.50**	**7.98**	**18.16**	**16.98**	**11.83**	**15.50**	**80.36**	**54.87**	**37.48**	**32.75**	**40.06**

* includes private households with employees and extra-territorial organizations

Note: The underlying numbers of those unemployed are logically not defined by economic sector; accordingly, the proportions shown indicate the relative 'recruitment struggle' for each sector.

Source: Computed from Eurostat, *Labour force survey*, 2001.

Table II.8.b: An approximation of tertiary 'skill gaps' by sector and Member State

(ratios of highly skilled employees by sector relative to high skills in overall non-participants in the labour force, 2000)

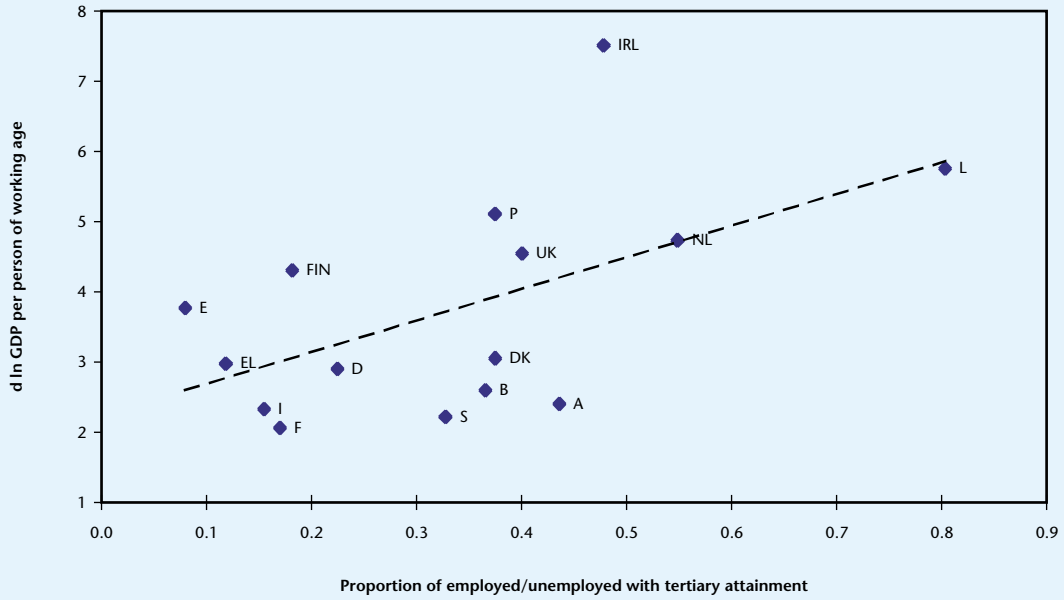
B. Proportions of those with tertiary attainment in employment/not participating

	Austria	Belgium	Germany	Denmark	Spain	Finland	France	Greece	Italy	Luxembourg	The Netherlands	Portugal	Sweden	United Kingdom
Agriculture, fishing, mining	0.23	0.05	0.13	0.09	0.07	0.18	0.06	0.07	0.07	0.01	0.06	0.08	0.05	0.10
Manufacturing	1.10	0.87	1.24	1.08	0.69	1.18	0.61	0.47	0.56	0.26	0.59	0.97	0.62	1.13
Electricity, gas and water supply	0.07	0.05	0.06	0.06	0.04	0.07	0.04	0.06	0.02	0.03	0.02	0.04	0.05	0.09
Construction	0.32	0.13	0.42	0.29	0.22	0.24	0.09	0.12	0.12	0.06	0.09	0.26	0.11	0.29
Wholesale and retail trade, repair	0.59	0.56	0.50	0.43	0.53	0.70	0.42	0.67	0.36	0.28	0.37	0.47	0.37	0.56
Hotels, restaurants	0.14	0.07	0.06	0.04	0.11	0.10	0.06	0.12	0.05	0.04	0.05	0.11	0.06	0.12
Transport, storage, communication	0.29	0.29	0.19	0.34	0.24	0.35	0.19	0.23	0.15	0.09	0.20	0.43	0.17	0.33
Financial intermediation	0.24	0.44	0.23	0.25	0.21	0.26	0.23	0.32	0.30	0.68	0.35	0.68	0.12	0.40
Real estate, renting	0.77	1.01	0.71	1.36	0.56	1.03	0.74	0.88	1.02	0.64	1.35	1.36	0.99	1.52
Public administration, defense	0.46	0.59	0.69	0.76	0.45	0.61	0.39	0.85	0.63	0.30	0.68	1.29	0.48	0.64
Education	1.61	1.40	0.88	1.72	0.79	1.04	0.89	1.58	1.56	0.91	1.33	3.95	1.07	1.51
Health and social work	0.80	1.31	0.85	2.54	0.52	1.32	0.75	0.69	1.00	0.38	1.24	1.96	1.30	1.44
Other service activities*	0.48	0.27	0.39	0.43	0.21	0.33	0.27	0.21	0.24	0.51	0.40	0.36	0.32	0.50
Total	**7.12**	**7.02**	**6.36**	**9.40**	**4.63**	**7.41**	**4.74**	6.28	6.06	4.21	6.73	11.97	5.72	8.62
Non-participants + unemployed	6.12	5.89	4.96	7.51	2.93	5.26	3.71	4.10	4.36	4.00	5.99	9.07	4.87	7.09

Note: The underlying numbers of those not participating in the labour force are logically not defined by economic sector; accordingly, the proportions shown indicate the relative 'recruitment struggle' for each sector.

Source: Computed from Eurostat, *Labour force survey*, 2001.

Graph II.5: Are skill gaps underlying differences in growth performance (1995–2000)?



Sources: Table II.8 ('skill gaps') and Eurostat, *National accounts* 1996–2001 (growth in GDP per person of working age, 1995–2000).

performance? Graph II.5 plots the extent of skill gaps, as 'measured' previously at the level of tertiary education, in Member States against their respective growth performance. The overall pattern indicates that relatively high tertiary-level skill gaps tend to be associated with higher rates of growth in GDP per person of working age. Ireland and Austria are notable exceptions to this. Ireland appears to enjoy particularly high growth relative to the prevalence of skill gaps amongst high-skill workers compared with all other Member States while Austria has experienced relatively low growth in GDP alongside significant tertiary-level skill gaps.

Skill gaps, in other words, would appear to be a by-product of the dynamics of labour demand accompanying strong economic performance rather than a possible cause of low economic growth in the European Union.

II.4.4 Human capital formation and economic performance

What is the role of the demand and supply effects discussed so far in national growth performance based on human capital formation? Table II.9 reflects an OECD attempt to decompose the **change** in growth rates between the 1980s and the 1990s for most of the EU nations and the United States with the use of national reduced-form growth regressions. The results confirm the 'stock' effect of human capital formation. That is, changes in factor intensity are reflected in that part of the change in growth rates that can be attributed to human capital accumulation.

A striking feature of the data is the prominent role of trade exposure in explaining the change in economic growth, which is particularly pronounced in the case of the United States. The contribution of this variable to Spain's growth acceleration is as large as that in the case of the United States while Greece and Portugal also display large values. A further clear difference between the EU economies and the United States consists of the lesser role that human capital plays in the change in economic growth in the latter. Finally, concerning the role of physical capital formation, the estimates vary substantially within the European Union whereas in the United States its contribution ranks second highest following that of trade exposure.

II.5 Policy and institutions

II.5.1 Introduction

The ongoing process of structural change towards a knowledge-based, ICT-intensive, economy in virtually all sectors of the OECD economies underlines the need for a clear understanding of the ways in which technology, education, labour market institutions, taxes and trade on the one hand, and comparative productivity performance on the other, interact. Taking into consideration the productivity

Table II.9: Decomposition of changes in annual average growth rates of GDP per capita
(contribution of change in explanatory variables over the period 1980s to 1990s in percentage points)

		Contribution from:					
	% change in output per capita growth rate	Investment share	Human capital	Population growth	Variability of inflation	Size of government	Trade exposure
Austria	- 0.23	0.37	0.31	- 0.07	0.12	- 0.02	0.37
Belgium	0.37	0.37	0.45	0.17	0.26	0.06	0.24
Denmark	0.34	0.10	0.20	0.03	0.07	0.01	0.22
Finland	- 0.90	- 0.91	0.44	- 0.03	0.05	- 0.13	0.33
France	0.04	0.01	0.35	0.27	0.23	- 0.02	0.42
Greece	- 0.06	n	0.57	0.09	- 0.12	- 0.05	0.54
Ireland	1.21	- 0.17	0.54	- 0.75	0.35	0.13	0.46
Italy	- 0.06	0.05	0.84	0.36	0.18	- 0.01	0.49
Netherlands	0.97	- 0.04	0.43	0.32	0.07	0.10	0.25
Portugal	- 0.15	0.25	0.32	0.02	0.42	- 0.20	0.53
Spain	0.46	0.33	0.90	0.46	0.25	- 0.12	0.67
Sweden	- 0.64	- 0.19	0.42	- 0.05	- 0.20	0.02	0.33
United Kingdom	0.01	0.08	0.44	0.05	n	0.03	0.25
United States	- 0.19	0.19	0.07	- 0.06	0.13	0.07	0.65

Note: The calculations are from decompositions of differences in growth rates based on the results of multivariate regressions. The sums of the contributions shown do not correspond to the change in output per capita growth rates because the estimated impact of initial levels of GDP per capita and the component unexplained by the regressions are not shown. Changes in growth are based on differences in average growth in GDP per person of working age over each decade. The 1980s include the period 1981 to 1989; the 1990s cover the period up to 1997. Government consumption as a percentage of GDP is used as a proxy for the size of government due to data availability. This variable is highly correlated in most countries with tax and non-tax receipts (as a share of GDP) for which, however, country coverage is more limited.

Source: OECD (2000b).

effects of human capital and the changing skill content of EU labour markets, this section discusses, in particular, problems related to fulfilling the Lisbon targets, and the measures that might be necessary to stimulate the accumulation of knowledge and skills, to improve the efficiency of their use and to enhance their social rates of return.

Despite the lack of direct evidence for an unambiguous relation between the accumulation of knowledge per worker and the pace of income growth, the empirical literature suggests five distinct mechanisms by which this link is rendered a complex and conditional one:

— First, the wage signals that — according to neo-classical theory — underlie the allocational efficiency and induced supply of human capital, are likely to be inadequately revealed by the labour market due to imperfect competition, bargaining institutions and signalling behaviour, causing the demand for education to be suboptimal.

— Second, the externalities of knowledge are imperfectly rewarded.

— Third, the acquisition of knowledge itself is beset by market failure due to poaching[35], externalities and coordination failure.

— Fourth, similar to other inputs and in combination with 'technology-gap' effects that generate temporary monopoly rents, the productivity effect of human capital endowments is subject to classic mechanisms of factor intensity and comparative advantage.

— Fifth, the efficiency of labour markets and education systems in matching skills to jobs is imperfect and likely to remain so, not only because of institutional influences, information asymmetries and spatial effects, but because adjustment in education is considerably less flexible than the more variable skill-content of labour demand.

Against the complexity of these relationships stands the EU economy in which rapid changes in the skill content of labour demand have given rise to a

35 Poaching externalities occur when the training offered by one firm can be of use to other firms and workers can easily switch jobs, leading to under investment in training.

lagging supply of skilled workers amidst persistently high unemployment. Moreover, the pace of human capital formation relative to the United States has been disappointing in recent years. As shown previously, differences in the matching efficiency of the distribution of schooling and the skill content of employment cannot account for the difference in the effectiveness of education inputs. What appears to have mattered, especially in strategic sectors, are the effects upon innovation of complementarity between human and physical capital formation, the latter of which has been decidedly lagging within the EU economy. Apart from this, institutional influences in wage bargaining and monopsony effects in public sector employment have given rise to lagging adjustment in the formation and allocation of high-level skills and even to explicit shortages of adequately skilled labour to fill existing vacancies. Finally, the European education catch-up with the United States has been primarily in the secondary, intermediate level.

Given these initial conditions, what measures, if any, could EU governments consider taking in order to realise Lisbon's knowledge-based growth?

It should be stressed that while endogenous growth theory has restored a more prominent role for policy in promoting socially optimal growth, it has also pointed to adverse welfare effects of 'creative destruction' and uncoordinated R & D programmes propped up by national interests. Moreover, skill gaps do not constitute evidence in favour of policy action, as current outcomes are the result of a wider set of labour market influences in which a multitude rather than a lack of institutions dominate bargaining outcomes. Nevertheless, the structural problems in the European Union in relation to the goal of knowledge-based growth appear to lie in a lagging supply of highly skilled labour in strategic sectors and the comparatively low social rates of return to human capital inputs. Clearly, the problem does not lie in the education of the European labour force as such, at least in a majority of Member Sates, but in labour markets, in inadequate investment in physical capital and in such issues as the incentives underlying early retirement.

II.5.2 The role of vocational training

Problems of skill shortages in Europe are predominantly in high-tech industries. Especially here, but possibly also in knowledge-intensive services, market failure in the acquisition of skills and matching problems might be alleviated through extended vocational training programmes. Within the European Union as a whole, vocational education is primarily at the upper secondary level. At the time of the last Unesco/OECD/Eurostat questionnaire (in 1994), 11 Member States had a greater number of pupils in vocational education programmes than in comparable general education alone. This was, and still is, a traditional feature of the education systems in both Germany and Austria, with some 78 % of students in upper secondary education participating in vocational training courses. In Italy, the Netherlands and in Belgium participation is comparably high, with 73, 70 and 80 % of upper secondary students being enrolled, respectively. Yet, it also holds for Denmark, France, Luxembourg, Finland, Sweden and the United Kingdom, with more than 50 % of their upper secondary students (ISCED 3) attending vocational education programmes. General education predominates in Spain, Greece, Ireland and Portugal with 41, 33, 23 and 23 % vocational enrolment rates respectively.

But how strong is the evidence that vocational training would actually help to improve the efficiency of job-matching procedures and provide young people with both the job contacts and the occupation-specific knowledge they need? Table II.10 shows to what extent unemployment for the age cohort 20 to 29 years of age is dependent on the use of vocational training programmes. With the exception of Spain, Greece and Portugal — where low investment in vocational training coincides with higher unemployment among those participating in vocational training — in all other Member States data suggests that vocational training decreases the likelihood of unemployment. It is clear that for the European Union as a whole, the rate of unemployment of those not participating in vocational training is twice as high as that of those who do (23.5 % against 11.5 %, respectively).

There can be no doubt that, on the whole, the specific vocational knowledge acquired by students and the information gained by employers on the ability of possible employees helps to overcome matching problems. However, as argued earlier, and more extensively by Broadberry and Wagner (1996), there is cause for some caution here, as a detailed investigation of vocational training programmes shows success to be greatly dependent on the economic structure of the industries involved. While extension of the traditional bonds of on-the-job training for those still in school to include different parts of business services may constitute a promising way of

Table II.10: The proportion of students in vocational training (ISCED 3) and rates of unemployment, 1994

	% of ISCED 3 students in vocational training	Unemployment non-vocational (20 to 29 olds)	Unemployment vocational (20 to 29 olds)	
	(1)	(2)	(3)	(3)/(2)
Germany	78	16.2	7.6	0.47
Austria	78	na	4.0	na
Italy	73	22.2	15.9	0.72
Netherlands	70	14.8	7.2	0.49
Belgium	68	24.3	19.7	0.81
Sweden	63	21.7	na	na
Luxembourg	63	5.7	na	na
United Kingdom	58	18.5	10.0	0.54
Finland	54	35.4	23.6	0.67
Denmark	54	17.7	8.5	0.48
France	53	30.0	17.1	0.57
Spain	41	33.9	34.9	1.03
Greece	33	14.3	20.0	1.40
Ireland	23	na	na	na
Portugal	23	11.2	16.2	1.45
EU–15	**59**	**23.5**	**11.5**	**0.49**

Source: Calculated from the Unesco/OECD/Eurostat (UOE) questionnaire (1994).

improving the matching performance of national labour markets, success is bound to be determined by the appropriateness of individual programmes[36].

As the largest discrepancies between educational attainment and the changing skill content of employment confronts not the younger but the older age cohorts, appropriate vocational training for people already in work is a crucial element in overcoming matching problems and preventing early depreciation of the employees' human capital. Therefore it is necessary to promote the paradigm of lifelong learning and related to it, the access for all to relevant vocational training after entering the labour market, including incentives to facilitate and stimulate the uptake of vocational training by the work force.

II.5.3 The private funding of education

Most models of investment in human capital find that unrestricted competition conditions would not lead to an efficient supply of skills (see Annex II.1). However, one might ask whether the private funding of education may contribute to the match between skills and jobs, as market incentives presumably would guide decisions so as to adjust curriculum choices.

Table II.11 presents data on the share of privately funded institutions in educational expenditure in 1998. Ranked on the basis of all levels of education, Greece heads the list followed by the United States and Japan, while Sweden, Denmark and Portugal rank lowest. Graph II.6 plots national shares of private funding (after deducting transfers and implicit subsidies) against the general measure of matching efficiency developed in section II.4.2 (where the distribution of the skill content of employment is measured against that of the educational attainment of the population of working age).

The data in Graph II.6 provide no evidence that private funding as such will help improve matching since, it is clear, no relationship between the two variables can be established. There is, of course, a compelling case for the private funding of education in cases where the accumulation of skills is specific to a given job or employer (specific human capital) or when it is part of individual efforts to prevent an untimely depreciation of human capital through lifelong learning. Therefore, no general argument can be made for a closer match and improved labour efficiency through private funding with respect to general education.

36 Also see European Commission (1997).

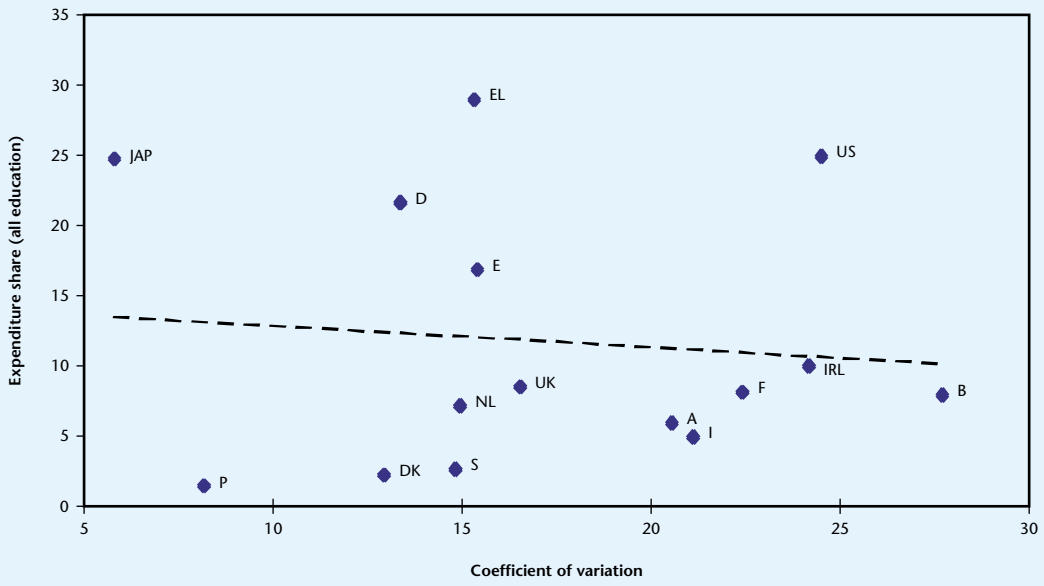
Table II.11: The share of privately funded institutions in educational expenditure by level of education, 1998
(final funds after public-to-private or private-to-public transfers)

	All levels of education	Primary through post secondary	Tertiary
Greece	29.0	33.0	15.0
United States	25.0	9.2	53.2
Japan	24.8	8.3	58.3
Germany	21.7	24.1	7.9
Spain	16.9	10.8	27.9
United Kingdom	8.6		37.3
France	8.2	7.3	14.5
Belgium	8.0	6.0	14.0
Netherlands	7.2	5.7	12.5
Austria	6.0	5.2	1.1
Italy	5.0	1.0	25.3
Sweden	2.7	0.2	10.7
Denmark	2.3	2.1	2.8
Portugal	1.5	0.1	7.7

Note: For Belgium, the United Kingdom and Greece the year of reference is 1997; for Denmark the incorrect alleged weighted average for all types of education of 5.0 (Education at a Glance, 2001, Table b.3.1) was replaced by the true weighted average according to enrolment.

Source: OECD (2000–01).

Graph II.6: The relation between education matching and private funding



Note: The horizontal axis shows the measure of variation calculated earlier in Table II.6; the vertical axis shows the share of private funding in education outlays (for all types of education) given in Table II.11.

Source: Tables II.6 and II.11.

II.5.4 Ageing, lifelong learning and fiscal incentives

In order to support human capital formation, which is essential for improving medium term growth prospects in the European Union, and to raise labour force participation of better educated workers and improve social inclusion, income taxation could be an instrument to encourage individual behaviour in this direction. However, fiscal systems in the European Union typically still reflect the fact that old-age pensions and housing investment, rather than human capital, are people's largest wealth components. At the same time, fiscal incentives in favour of private pensions make early retirement and an associated depreciation of human capital an attractive

option. As a result, workers are discouraged from investing in lifelong learning. While more research is needed as to the precise trade-off between leisure and income, a better balance in the fiscal treatment of the various sources of income will likely provide incentives for lengthening the time of active labour market participation while also leading to a more even distribution of education, work and leisure across the economic life cycle. All this is particularly important in view of the ageing problem in the European Union. Adjustment of these incentives in combination with fiscal deductions for lifelong learning, therefore, seems an important instrument in efforts to cope with demographic change while pursuing the objective of building a knowledge-based economy[37].

Savings accounts placed under a specific fiscal regime may provide a useful first step as workers would be able to devote such savings not only to an early depreciation of their human capital (as is the present case) but also to its maintenance. As a result, larger private funds will become available for adult education. Earmarked accounts for pupils and students with a government-provided initial capital to be taken up for schooling purposes at any moment in life constitute another possibility. In fact, such a proposal may be seen in relation to extending vocational training. Agreements to this effect may be made in collective bargaining, especially when profit sharing schemes are used in the acquisition of sector-specific skills.

II.5.5 Matching and mobility: the Lisbon/Barcelona strategy

Given the large scope for efficiency gains in the match between jobs and the education of especially younger workers in the European Union it is essential that wider investment in human capital be seen in relation to enhancing mobility of workers. Two years after Lisbon, European weaknesses in the areas of educational attainment, participation in training and geographic and occupational mobility have been recognised and a comprehensive Community policy response is starting to take shape.

The major building blocks for such policy have been laid out in late 2000 and throughout 2001, with the conclusions of the Stockholm European Council of March 2001 constituting a cornerstone. They include various Commission initiatives in the area of mobility such as the action plan on mobility[38], followed by the issuing of a recommendation on mobility[39], and the Commission communications on 'Making a European area of lifelong learning a reality"[40] and 'A mobility strategy for the European research area'[41]. From the point of view of addressing skill gaps, of particular relevance is the Commission's communication on the impact of e-economy on European enterprises[42]. The Stockholm European Council has also endorsed a report on common objectives of education and training systems[43], on the basis of which a detailed work programme is currently being developed jointly by the Council and the Commission.

Integrating, and building on the elements above, the Commission put forward an action plan on skills and mobility[44], destined to address the obstacles to mobility and skill development. It covers a wide variety of actions, from making education systems more responsive to the needs of the labour market to an EU-wide immigration policy. It also includes, notably, actions on the recognition of learning, the transferability of qualifications, the removal of administrative and legal barriers to geographic mobility — for example through a universal health card, the development of language and cross-cultural skills, the promotion of cross-border recognition of qualifications and better information related to cross-border mobility.

The Barcelona Council of March 2002 further endorsed the process begun at Lisbon by proposing a number of initiatives and agreeing to others in various areas having a direct bearing on the improvement of education and training, including lifelong learning and the use of ICT for teaching and learning, and a range of proposals to encourage greater flexibility and mobility of the European workforce. In order to achieve a competitive economy based on knowledge the European Council set the target of ensuring that education and training systems across the Union would establish themselves as the world standard by the year 2010. This will involve initiatives in the areas of qualifications and skills and the promotion of language learning and digital skills.

The Council endorsed a more integrated approach to education, training and research and innovation within a European knowledge area and called at

37 See Bovenberg (2001).
38 OJ 2000/C 371, 23.12.2000.
39 Recommendation of the European Parliament and of the Council (2001/613/EC).
40 COM(2001) 678 final.
41 COM(2001) 331 final, 20 June 2001.
42 'The impact of the e-economy on European enterprises: economic analysis and policy implications', COM(2001) 711 final, 29.11.2001.
43 Commission Report on 'Concrete future objectives of education systems', COM(2001) 59 final, 31.1.2001.
44 COM(2002) 72 final, 13.2.2002.

the same time for adoption of the related sixth framework programme by June of 2002. Providing evidence that such pedagogic initiatives are not being taken in a vacuum, the Council returned to the enhancement of human resources in the context of numerous policies; to reinforce the employment strategy it suggested setting a primary focus on lifelong learning, especially as this can increase opportunities for older workers to remain in the labour market. The Commission action plan to promote skills and mobility was welcomed, including those involved in education, research and innovation. Barriers to professional recognition of qualifications and non-formal learning should be lowered, all citizens should be equipped with basic qualifications, especially those linked to ICTs and particularly unemployed women.

Initiatives in the area of telecommunications are directly related to education and learning, including the request that the Commission draw up a comprehensive eEurope in advance of the Seville Council focussing on eLearning, and bring down the interconnect ratio for school PCs to one per 15 pupils. In the area of research and technical development, for example, the Council noted the Commission's proposal to better integrate innovation in the European knowledge area, which should presumably make considerable demands on teaching and learning systems.

The overall thrust of all these initiatives is to ensure that EU education and training structures and practices should set world standards by the end of the decade thus contributing to the maintenance of a high level of innovative and high value-added sustainable employment and output, ensuring that the Union should become a major world competitor across a range of such frontier activities.

II.6 Concluding remarks

Europe's productivity under-performance during the second half of the 1990s raises the question of whether the pace of human capital accumulation and the labour market process of matching educational characteristics and the skill content of labour demand have played a role in this development. The present chapter has reviewed some relevant evidence.

While the theoretical literature suggests that either the stock or the flow (rate of accumulation) of human capital can be a decisive variable in economic growth, the empirical literature does not support conclusively this conjecture. This is not entirely new since economic historians have already established that the role of human capital in 19th century industrialisation was at best a limited one[45]. There may be a variety of reasons for this lack of unambiguous evidence, one of which is, in addition to accumulation effects, the matching process between skills and jobs in the labour market (allocation effects). Thus, interest in human capital in this context is related to issues of structural change in the distribution of employment, of the pace and nature of technological progress and of complementarities between physical capital and skilled labour in the production processes of the modern economy.

It appears that differences in the structure, accumulation, and rates of return, of human capital are related to problems of labour market efficiency, thus placing human capital formation at the centre of a wider institutional debate. In a fundamental sense, the supply of skills concerns a decision by individuals about the type of human capital they are going to supply over the lifetime (as distinct from the decision of time allocation between work and leisure for a given profession). This decision depends crucially on expected pay and wage differentials, which, in turn, reflect employers' choices about techniques and the relative demand for skills that these choices imply. Labour market signals about shifts in the demand for particular skills are manifest in changes in relative wage rates and simultaneously in excess demand for particular types of human capital (or skill gaps). Clearly, technical change and the introduction of new techniques in the economy depend on and require new skills to realise the associated efficiency gains. The situation that has emerged regarding the use and diffusion of ICT in the European Union is a reflection of this process. Because in the context of rapidly changing technological and economic circumstances the stock of existing skills may quickly become obsolete, it is essential to have a mechanism through which the stock of human capital is adapted to these changes. Here, there is an important role that lifelong learning can play.

In this perspective, the situation in the European Union appears to be characterised by two features: first, by a sector specific under-investment in skill formation compared to developments in labour demand, giving rise to skill gaps in certain sectors; and, second, by institutional deficiencies preventing the exploitation of the full potential of knowledge-based growth. Nevertheless, productivity performance in the European Union in recent years does not appear to be determined by the matching efficiency of supply of general education skills and the skill structure of employment.

45 See the survey on British industrialisation by Mitch (1993).

EU labour markets appear to have been unsuccessful in fully creating market incentives for educated workers and in generating the resultant response from the supply of labour. Part of this problem may lie in the historical segmentation of the European economies, but perhaps the largest part must be attributed to mismatch and narrow wage differentials resulting from sectoral bargaining and monopsony elements in the case of the public sector (notably in health care and education). Labour immobility is also a crucial factor. Moreover, the slowdown in productivity growth in recent years has been reflected in comparatively low returns on human capital, thus blunting the incentives to pursue higher education, while a widening of wage differentials in favour of those skills for which there is excess demand has not developed sufficiently. Correspondingly, the supply of skilled graduates from the university system has also been slow. Finally, a poor record of job creation (until the end of the 1990s) has coincided with weak investment and diffusion of new technologies (ICT in particular) as well as weak innovation performance and spending on R & D. These considerations suggest that the European Union is experiencing institutional problems in developing incentives to an economic growth path that is intensive in skilled labour.

Several steps have already been taken towards building a policy framework, at both Member State and Community level, addressing the weaknesses identified in the previous sections, notably skill mismatches and shortages as well as mobility barriers. However, it becomes apparent that for the Lisbon strategy to be successful, its scope should clearly widen beyond concerns about the accumulation of knowledge and skills. It should seek to examine whether current European fiscal systems and labour market institutions are suited not only to accommodate but also to encourage economic growth based on new technologies and to support improvements in the stock of knowledge across the labour force cohorts. After all, as Keynes remarked in a 1944 address to the Marshall Society, in the final analysis, economic prosperity depends not on how brilliant a few people are, but on how large a scale you are able to produce competent people in all walks of life.

References

Barro, R. J. and Sala-i-Martin, X. (1995): *Economic Growth*, New York: McGraw-Hill.

Barro, R. J. and Lee, J.W. (1993): 'International Comparisons of Educational Attainment', *Journal of Monetary Economics*, 32-3: pp. 363–394.

Bils, M. and Klenow, P. (1998): 'Does Schooling Cause Growth or the Other Way Around?' NBER Working Paper No 6393.

Bovenberg, A. L. (2001): 'Vergrijzing en Menselijk Kapitaal' (The Ageing Problem and Human Capital) in: R. Gradus et al., *Nederland Kennisland?*, Ocfeb, Rotterdam.

Broadberry, S. and Wagner, K. (1996): 'Human Capital and Productivity in Manufacturing during the twentieth Century: Britain, Germany and the United States', in: B. van Ark and N. F. R. Crafts (eds.), *Quantitative Aspects of Postwar European Economic Growth*, Cambridge: Cambridge University Press.

de la Fuente, A. and Domenech, R., (2001): 'Educational Attainment in the OECD, 1960–95', unpublished manuscript.

European Central Bank (2002): 'Labour market mismatches in the euro area countries', March.

European Commission (1997): Key data on vocational training in the European Union, Directorate-General for Education, Training and Youth (with Eurostat and Cedefop), Brussels.

European Commission (2001a): European competitiveness report 2001, Directorate-General for Enterprise, Brussels.

European Commission (2001b): Employment in Europe 2001. Recent trends and prospects, Directorate-General for Employment and Social Affairs, Brussels.

Haskel, J. and Martin, Ch. (1996): 'Skill Shortages, Productivity Growth and Wage Inflation' in: A. Booth and D. Snower (eds.), Acquiring Skills. Market Failures, their Symptoms and Policy Responses, Cambridge: Cambridge University Press.

Krueger, A. and Lindahl, M. (2001): 'Education for Growth: Why and for Whom?', Journal of Economic Literature, December.

Layard, R. Nickell, S. and Jackman, S. (1991): *Unemployment, Macroeconomic Performance and the Labour Market*, Oxford University Press.

Mitch, D. (1993): 'The Role of Human Capital in the First Industrial Revolution' in: J. Mokyr (ed.), *The British Industrial Revolution. An Economic Perspective*, Boulder, Westview Press.

Mulligan, C.B. and Sala-i-Martin, X. (1995): 'Measuring Aggregate Human Capital' NBER Working Paper No 5016.

OECD (1998): Human Capital Investment. An International Comparison, Paris: OECD.

OECD (2000–01): Education at a Glance, OECD Indicators, Paris, OECD.

OECD (2000b): Economic Outlook, Paris, OECD.

OECD (2001): Employment Outlook, Paris, OECD.

Quah, D. (2002): 'Technology Dissemination and Economic Growth: Some Lessons for the New Economy', CEPR Discussion Paper No 3207, February.

Robert Huggins Associates (2002): The World Knowledge Competitiveness Index 2002, Robert Huggins Associates, Cardiff, United Kingdom, March.

Romer, P.M. (1996): Advanced Macroeconomics, McGraw–Hill.

ANNEX II.1
Schooling, income and economic growth: theory and evidence

Why does the level of human capital differ across nations and how do these differences affect the overall economic performance?

This annex reviews the literature on the demand for and supply of education at the micro-level and its impact on economic growth.

Schooling, earnings and labour supply

The essential premise of human capital theory is that individuals weigh the cost of education — forgone labour income and costs such as tuition fees — against the (time-discounted) benefits from the higher wage earned over their life-cycle.

Under the assumptions that wages are set according to the marginal product of labour, an efficiently working labour market, and of full flexibility in the supply of education, people acquire skills for as long as the resulting personal benefit and its social gain exceed the associated cost[46]. As a result, a wage structure that reflects changes in the skill composition of labour demand would lead to a matching change in the supply of adequately educated workers.

However, labour market institutions, limited information and bargaining under imperfect competition suggest that these assumptions are not a realistic description of the accumulation and allocation of human capital in market economies. Due to informational asymmetries, the education level may act as a signal of ability rather than as a productivity-enhancing factor[47]. Under these circumstances, educational wage differentials may merely reflect the value of educational qualifications as a signal of ability and growth in the economy's stock of education does not necessarily increase the productivity of the workforce. In general, empirical studies suggest that the 'signalling component' of educational qualifications accounts for only a relatively small part of the wage difference associated with education[48].

The basic empirical approach, in analysing the link between education and productivity at the micro-level, is to explain the variation in wages across individuals, using earnings functions applied to survey data[49]. The explanatory variables include years of schooling, age (or a different proxy for experience) and other personal characteristics. In most studies a semi-logarithmic form is used so that the coefficient on schooling can be read as the private return to education. The coefficients on schooling found in this way are typically robust and the finding of a positive association between earnings and schooling is uncontroversial. Table A1 reproduces OECD estimates of rates of return by country and level of attainment[50].

Standard micro-economic models of human capital formation disregard education externalities. These

46 The modern theoretical analysis , investment in human capital along these lines began in the late 1950s and early 1960s with seminal work by Mincer (1958, 1962), Schultz (1961) and Becker (1962). See Hartog (1992) for an overview of this literature.

47 If employers value certain characteristics of potential employees (such as ability, stamina or determination) that cannot be observed at the moment of hiring, but that are negatively correlated with the individual's cost of acquiring education, higher education levels may command higher wages even if education has no effect on individual productivity; see Arrow (1973) and Spence (1974); game-theoretic refinements were suggested by Riley (1975), Mailath (1987) and Cho and Kreps (1987).

48 Kroch and Sjoblom (1993) analyse the influence of both the number of years of schooling (human capital) and an individual's position in the distribution of education for his cohort (signalling) in an earnings function applied to two separate panel data sets, to find that only the former has a systematic positive effect on the wage gaps observed. Moreover, if signalling is the predominant effect, the observed earnings differential should decline with job tenure, as employers gain insight into workers' abilities. Although empirical evidence here is limited, this does not appear to hold.

49 The seminal work here is Mincer (1974).

50 Estimates produced in this fashion typically range between 5 and 15 % with relatively small standard errors, but with a dependency on time and place.

Table A1: Rates of return on education by level of educational attainment according to OECD estimates, 1999–2000

	Men		Women	
	Upper secondary education	Tertiary education	Upper secondary education	Tertiary education
Denmark	11.3	13.7	10.5	11.1
Germany	10.8	9.1	7.0	8.4
France	13.5	14.3	17.9	15.4
Italy	11.2	6.5	-	-
Netherlands	7.9	12.1	8.4	12.5
Sweden	6.4	11.4	-	10.8
United Kingdom	15.1	18.5	-	16.1
Canada	13.6	8.7	12.7	9.9
United States	16.4	14.9	11.8	14.7

Source: OECD, *Economic outlook* 2001.

externalities can emerge for a set of reasons. First, it is plausible that the extent of a worker's educational attainment will have a positive effect on the productivity of others — an effect that is not captured in the individual's own wages. Second, as Arrow (1973), Stiglitz (1975) and Huffman (1977) have argued, the provision of education may play a role in allowing a more efficient matching between workers and jobs through a wider diffusion of information. Finally — and probably the most fundamental flaw in the micro human-capital model with respect to external effects — these models see the stock of education as a mere factor of production rather than a source of technological innovation — a function that is essential to endogenous growth. Human capital represents not only the stock of workers' skills but also the embodied technological knowledge used in the innovation and diffusion of new products and production processes.

To the extent that technological knowledge is generated by the learning processes of skilled workers, the result creates an externality to other firms due to non-rivalry and the incomplete appropriability of knowledge. Improvement in the average level of educational attainment stimulates economic growth by facilitating the use of knowledge that is generated by learning elsewhere.

The most straightforward interpretation of the private returns is that education makes for more productive individuals, whatever their occupation. Yet in practice, tertiary education is likely to contribute little to productivity growth when employed in lower skilled jobs; thus, the importance of allocational efficiency is crucial. The balance of evidence seems to suggest that the contribution of education to productivity is likely to be real and substantial, even when educational attainment externalities are not taken into account.

Market failure and the acquisition of skills

Situations of imperfect competition or imperfect information in markets for training may lead to market failure in training provision and skills acquisition. If workers do not receive adequate compensation for the training they have acquired, private benefits from skills acquisition fall short of social benefits, and individual interests will lead to underinvestment in skills from the point of view of social welfare.

According to the conventional wisdom on human capital formation[51], people pay all the costs and receive all the benefits from education. In such conditions, the trainer and trainee share the costs of training in proportion to the benefit each receives, ensuring that a socially desirable amount of education will in fact be provided. In such a world, general training — that is, general education and off-the-job training — that is useful to all employers should be paid for in full by the prospective employees, since these are the ones to reap the full benefits from investing in their education. In the case of specific training — one that is useful only to a specific employer — the costs of schooling such as vocational training should be shared by firms and workers, so that workers internalise the cost of quitting and firms that of a dismissal. By extension, it is implicitly assumed that

51 See Becker (1962).

all training can be divided into general and specific components. And since the market is held to provide adequate incentives for optimal investment in each of these, it does as much for any combination of the two.

In reality, there is hardly any training which is useful to all employers, just as there is no training which is specific to one single employer, but rather to a limited class of employers. Because firms are imperfect competitors for labour and possess some market power, workers are paid less than their marginal products and, hence, do not fully reap the returns from training. As a consequence, too little time and effort will be spent in the acquisition of knowledge relative to the social optimum. Moreover, under-investment in training provided by employers may occur when the results of this training are of use to other firms and workers can easily switch jobs. The greater the mobility of workers and the greater the market power of firms, the larger this problem becomes.

Imperfect information and imperfect competition in the job matching process also lead to externalities. When applicants are not certain of getting job offers and employers of getting job applicants, wage negotiations will depend on the speed with which jobless workers and vacant jobs are matched, as well as on the wage which each party expects to negotiate with other firms or job applicants (the so-called 'outside opportunities'). Clearly, the more skilled workers are available, the faster firms can expect to attract job applicants. This then raises the firm's market power in negotiations, reduces the worker's returns from training and leads to lower than optimal investment in skills.

Finally, deficient investment in human capital due to some of the mechanisms described above will, in turn, have negative effects on other variables such as physical capital and innovation. When labour and capital are complementary production factors[52], sub-optimal investment in human capital will reduce the productivity of capital goods and thereby lead to deficient investment in physical capital. In the same vein, when firms do not innovate because the workforce is insufficiently skilled, workers in turn will not acquire sufficient skills because there is insufficient demand for them from innovating firms. As a result, a vicious circle where firms create few skilled vacancies and few workers acquire skills may lead the economy into a 'low-skill, bad-job trap'.

52 A presumption for which the evidence, especially in the case of skilled labour in manufacturing sectors, is strong.

Sectoral productivity, endowments and trade

Another strand of the literature on human capital theory and growth, focus on the effects of schooling on international competitiveness by looking at trade performance. Since the 1970s, considerable empirical work has aimed to explain the sectoral pattern of trade of various economies using a model with three factors of production: physical capital, labour and human capital. More recently, such analyses have been enhanced by models which, in addition to differences in factor endowments, allow for comparative technology differences and thus for the internal knowledge spillover effects of endogenous growth[53].

The empirical evidence suggests that the skill content of employment has an influence on trade performance[54]. Trade specialisation depends on factor content and thus on the distribution of the level of educational attainment. Moreover, specialisation also takes place according to the development of different skills at approximately the same level of education or vocational training.

Broadly speaking, there is strong evidence that, apart from classic factor intensity and resulting cost effects, cross-country differences in human capital formation, relative sectoral labour productivity, and technology (as proxied by such variables as relative R & D and patenting intensity) do, in fact, exert a significant influence on the volume and composition of trade flows.

Concerning the role of human capital on sectoral productivity, Cörvers (1999), covering 13 manufacturing sectors within the European Union, and using the distribution of low, intermediate and high skilled employment to measure the human capital stock of the workforce, confirms the effect of intermediate- and high-skilled labour on sectoral labour productivity[55], together with capital intensity and firm size. Only in the low-skill category of sectors, however, does there appear to be a research effect of high-skilled (R & D) workers on the development and use of new technologies, resulting in the kind of employment spillovers stressed in the recent European Union employment report[56].

53 See Baldwin (1971), Branson (1971), Harkness and Kyle (1975), Stern (1976), Branson and Monoyios (1977), Wolter (1977), Stern and Maskus (1981), Maskus (1983),Gavelin (1983), Baruh (1986) and Crafts and Thomas (1986) on the first type (mostly interpreting the non-homogeneity of labour into a stock equivalence) and Krugman (1986), Cimoli and Soete (1992), Verspagen and Wakelin (1993) on the second type of appraoch.

54 See Courakis (1991), Maskus *et al.* (1994). Also see Grossman and Helpman (1992).

55 Except for high-skilled labour in high-skill sectors.

56 European Commission (2001b), p. 29.

Skills, innovation and endogenous growth

Since the 1960s, economists have sought to account for the growth in aggregate output by measuring the rate at which factor inputs grow and analysing the extent to which this expansion may account for the change in income. In the original analysis, growth that could not be accounted for by changes in factor inputs was attributed to a residual held to represent exogenous technical progress (or the 'quality of labour'). The 1980s saw the emergence of a group of models seeking to recast the theoretical basis of growth analysis by explaining the change in output per head in an endogenous fashion[57]. By relaxing the assumption of diminishing returns and rendering the pace of technological progress endogenous to a specified form of human capital spillovers, productivity growth is no longer made to rely on exogenous technological progress. As a result, the pace of technological change is tied to changes in the stock of human capital, which, apart from serving as a production factor, plays a pivotal role in the innovation and diffusion process[58].

The fact that governments determine the institutional and economic environment in which knowledge is developed and diffused, suggests rethinking the role of policy intervention in determining the pace of growth. Complicating this is the character of knowledge as a largely non-excludable, non-rivalling good, causing it to approach the theoretical position of a public good. In the presence of knowledge spillovers, unfettered market forces do not produce optimal outcomes: first in the acquisition of skills already discussed, second in the diffusion of new ideas.

The empirical literature that has resulted from these insights can be divided in two complementary approaches: 'growth accounting' and 'growth regression'. Growth accounting attempts to distinguish the contribution to output growth of different factor inputs — measured changes in varying ranges and specifications of inputs are weighted by imputed factor shares to decompose the growth in income of economies over time. Growth regression proceeds by direct econometric estimation of the parameters in aggregate production functions, using panel data, so as to identify the common driving forces of growth across countries and over time.

57 See the textbook by Barro and Sala-i-Martin (1995), the origins of these models go back to Usawa (1965).

58 These new theories of economic growth were reviewed in European Commission (2001a), Annex II.2.

Growth accounting

Growth accounting decomposes output growth into a range of components that can be explained by the growth in factor inputs and a residual that captures efficiency change — which in turn is seen as the result of technological progress. In explaining total output growth, it weighs each input by its marginal product, proxied by its market remuneration. This basic approach can be extended to any number of inputs or used in disaggregation of the labour force into various categories (age, gender and skill). Thus, concerning the contribution of changes in skill levels, a decomposition of labour input by level of schooling is made where changes in the employment of each class of workers are weighted by the average income associated with the educational attainment of this group.

As summarised by Griliches (1997), the essential assumptions of growth accounting are twofold. First, it is assumed that differences in observed market rewards correspond to differences in marginal product. Second, the imputed factor contributions in the case of human capital are based on the premise that differences in market remuneration across schooling levels do indeed originate in schooling[59]. The advantage of the first assumption is that it allows for easily computable weights under the assumption of constant returns to scale and perfect competition. By the same token, however, growth accounting is unable to shed light on the importance of externalities, since output elasticities are computed based on market rewards. More generally, educational attainment may have other, indirect, effects on output through participation behaviour, investment, R & D and the growth of total factor productivity. Growth accounting captures none of these indirect effects and therefore may underscore the overall importance of educational attainment to growth by limiting its role to that of a production factor.

Evidence from growth regressions

Given the restrictive assumptions that underlie the methodology of growth accounting, the empirical literature has sought to test the productivity effects of schooling directly, by including it as a separate variable in econometric production functions. Contrary to the methodology of growth 'accounting'

59 Rather than in factors such as innate ability, which may be correlated with schooling.

described above, growth 'regression' provides a method of testing directly for the productivity effects of education. By extension, growth regressions are also an effective way of testing the significance of the signalling role of education.

The seminal and probably most influential contribution to this strand of empirical literature is Mankiw 'et al.' (1992). Taking, in the authors' words, 'Robert Solow seriously' it sought to test the explanatory power of the standard neo-classical growth model, with and without an extension accounting for the influence of the stock of human capital. Their parameter estimates[60] appear to suggest that the Solow model 'is consistent with the international variation in the standard of living'. Moreover, the 'augmented' model that includes the accumulation of human as well as physical capital, provides, according to the authors, 'an excellent description of the cross-country data'. As noted by Temple (2000: 16), the output elasticities that may be derived from those results suggest that a 10 % increase in human capital investment (as a share of GDP) will yield an increase in output per worker of between 5 and 6 % (result for the OECD sample); see Table A2 for a survey of parameter estimates.

Growth regressions in general are subject to a number of important statistical problems and specification issues. At the same time, the estimates do not allow for cross-country differences in human capital effects, and are in fact dominated by the presence within the sample of numerous less developed countries and concomitant income gaps (the fit obtained for the OECD sample, for example, is considerably less than that for the other two samples, see Table A2). Moreover, the likelihood of differences in the nature and quality of schooling across countries forms an obstacle to the proper understanding of the mechanisms at work. All present measures of human capital formation either rely on years of schooling (which makes graduation periods crucial), secondary enrolment (underlining the quality of education argument) or observed wage differentials (the implications of which were discussed previously)[61].

The empirical literature, which these criticisms prompted, has sought to correct some of these shortcomings. First, researchers have used alternative specifications in modelling the aggregate production functions. Initially, growth was regressed on control variables and 'starting levels' of accumulation in physical capital, labour and schooling (as proxied by secondary enrolment or average years of schooling). The idea was that the stock of human capital could affect subsequent growth in a number of ways, most notably by influencing the ability to adopt technology from abroad[62]. However, theoretically, the conventional earnings functions at the micro-level imply that one should expect to observe a correlation between the change in output per worker and the 'change' in educational attainment and other factor inputs[63]. Some studies have sought to incorporate human capital effects in standard production functions, while estimating them under the assumption of decreasing returns in the steady-state situation. The initial results for such specifications suggested that the sought-for association was, at best, a weak one. Most notably, the empirical study by Benhabib and Spiegel (1994) not only showed a relationship to be absent from scatters of income against schooling, but produced adjusted estimates for separate accumulation effects that appear to support the same conclusion[64]; see Table A2.

Measurement errors, data structure and estimation procedures have also been addressed in subsequent research. After careful re-examination and adjustment of the available data on average years of schooling, de la Fuente and Domenech (2001) produce estimates (for the OECD sample) which suggest that earlier 'counterintuitive' results on human capital and growth 'may be due, at least in part, to deficiencies in the data or inadequacies of the econometric specification'. In a recent effort, Bassanini and Scarpetta (2001) estimate human capital-extended growth regressions for a panel of 21 OECD countries over the period 1971–98[65]. Overall, the results corroborate a significant influence of human capital effects. However, in the words of the authors, these 'are not consistent with the human capital augmented version of the Solow model, but rather support an endogenous growth model à la Uzawa-Lucas, with constant returns to scale to 'broad' (human and physical) capital'[66]. Such conclusions rest on the relative size of the elasticity of human capital with respect to income and the pace of convergence derived from estimated long-run parameters. Since the Solow model, and its augmented version, provides exact predictions for these numbers, a higher value indicates the presence of externality effects.

60 Using the Summers-Heston data set, a non-oil producing sample of national economies and the OECD.
61 Also see OECD (1998), pp. 16–22.
62 See, for example, Barro (1991) and the estimates in Barro and Sala-i-Martin (1995), pp. 424-61.
63 See de la Fuente and Domenech (2001).
64 For similar conclusions see Pritchett (1996).
65 In addition, they use an estimation technique -the Pooled Mean Group estimator- which seeks to reconcile the theoretical premises of endogenous growth theory with the use of panel data
66 Bassanini and Scarpetta (2001) 2.

Table A2: A survey of derived production function parameters in growth regressions

Levels: ln GDP per person of working age

	Human capital	Physical capital	Conditional convergence	N	Period	Time dummies	Country dummies	R-square	Sample	Human capital data
MRW (1990)	0.280	0.310		98	1960–85	No	No	0.78	Summers-Heston., non-oil	secondary att. (Unesco)
MRW (1990)	0.300	0.290		75	1960–85	No	No	0.77	Summers-Heston, adjusted	secondary att. (Unesco)
MRW (1990)	0.370	0.140		22	1960–85	No	No	0.24	OECD	secondary att. (Unesco)
BES (1994)	0.050	0.853		80	1965	-	No	na	Kyriacou	years (Kyriacou, 1991)
BES (1994)	0.217	0.643		109	1985	-	No	na	Kyriacou	years (Kyriacou, 1991)
dlFD (2000)	0.112	0.560		126 (21)	1960–90	No	Yes	0.89	OECD	years (Barro and Lee, 1996)
dlFD (2000)	0.120	0.552		126 (21)	1960–90	Yes	Yes	0.98	OECD	years (Barro and Lee, 1996)
dlFD (2000)	0.269	0.516		126 (21)	1960–90	No	Yes	0.90	OECD	years (own, adjusted B&L)
dlFD (2000)	0.279	0.567		126 (21)	1960–90	Yes	Yes	0.98	OECD	years (own, adjusted B&L)
First differences: d ln GDP per person of working age										
BES (1994)	0.063	0.457		78	1965–85	No	No	na	Kyriacou	years (Kyriacou, 1991)
BES (1994)	- 0.059	0.545	- 0.190	78	1965–85	No	No	na	Kyriacou	years (Kyriacou, 1991)
BES (1994)	- 0.043	0.555	- 0.185	78	1965–85	No	No	na	Kyriacou	years (Kyriacou, 1991)
dlFD (2000)	0.493	0.493		126 (21)	1960–90	Yes	No	0.72	OECD	years (own, adjusted B&L)
dlFD (2000)	0.271	0.373	0.068	126 (21)	1960–90	Yes	Yes	0.81	OECD	years (own, adjusted B&L)
BS (2001)	0.820	0.130	0.140	521 (21)	1971–98	Yes	Yes	Logl, 1491	OECD	years (dlFD, 2000)

Note: 'Conditional convergence' denotes the parameter-value for initial income levels when included as a regressor.

Sources: MRW: Mankiw, Romer and Weil (1990); BES: Benhabib and Spiegel (1994); BL: Barro and Lee (1996); dlFD: de la Fuente and Domenech (2001); BS: Bassanini and Scarpetta (2001).

References

Arrow, K. (1973): 'Higher Education as a Filter', *Journal of Public Economics*, Vol. 2: pp. 193–216.

Baldwin, R. E. (1971): 'Determinants of the Commodity Structure of United States Trade', *American Economic Review* 61: pp.126–146.

Barro, R. J. and Sala-i-Martin, X. (1995): *Economic Growth*, New York: McGraw-Hill.

Barro, R. J. (1991): 'Economic Growth in a Cross-section of Countries' *Quarterly Journal of Economics* 106: pp. 407–443.

Baruh, J. (1986): 'Factor Proportions in Israel's Manufacturing Trade', *Journal of Development Economics* 24: pp. 131–139.

Bassanini, A. and Scarpetta, S. (2001): 'Does Human Capital Matter for Growth in OECD Countries? Evidence from Pooled Mean-Group Estimates', Economics Department Working Papers No 282, Paris: OECD.

Becker, G. S. (1962): 'Investment in Human Capital: a Theoretical Analysis', *Journal of Political Economy*, Vol. 70, supplement 9-49.

Benhabib, J. and Spiegel, M. (1994): 'The Role of Human Capital in Economic Development: Evidence from Cross-country Data', *Journal of Monetary Economics*, 34: pp. 143–173.

Branson, W. H. (1971): 'United States Comparative Advantage: Some Further Results', *Brookings Papers on Economic Activity* 3: pp. 754–759.

Branson, W. H. and Monoyios, N. (1977): 'Factor Inputs in United States Trade', *Journal of International Economics* 7: pp. 111–131.

Cho, I. K. and Kreps, D. (1987): 'Signalling Games and Stable Equilibria' *Quarterly Journal of Economics* 102: pp. 179–221.

Cimoli, M. and Soete, L. (1992): 'A Generalized Technology-Gap Model', *Economie Appliquée* XLV(3): pp. 33–54.

Cörvers, F. (1999): The Impact of Human Capital on International Competitiveness and Trade Performance of Manufacturing Sectors, Maastricht: Research Centre for Education and the Labour Market.

Courakis, A. S. (1991): 'Labour Skills and Human Capital in the Explanation of Trade Patterns', *Oxford Economic Papers*, Vol. 43: pp. 443–462.

Crafts, N. F. R. and Thomas, M. (1986): 'Comparative Advantage in United Kingdom Manufacturing Trade', 1910–1935', *The Economic Journal* 96: pp. 629–645.

European Commission (2001a): European Competitiveness Report 2001, Enterprise Directorate-General, Brussels.

European Commission (2001b): Employment in Europe 2001. Recent Trends and Prospects, Directorate-General for Employment and Social Affairs, Brussels.

de la Fuente, A. and Domenech, R. (2001): 'Schooling Data, Technological Diffusion and the Neoclassical Model' *American Economic Review*, Papers and Proceedings.

de la Fuente, A. and Domenech, R. (2001): 'Educational Attainment in the OECD, 1960–1995', unpublished.

Gavelin, L. (1983): 'Determinants of the Structure of Swedish Foreign Trade in Manufactures', 1968–1979', *Scandinavian Journal of Economics* 85: pp. 485–497.

Griliches, Z. (1997): 'Education, Human Capital and Growth: a Personal Perspective' *Journal of Labour Economics* 15(1): pp. 330–344.

Grossman, G. M. and Helpman, E. (1992): *Innovation and Growth in the Global Economy*, Cambridge MA: MIT Press.

Hartog, J. (1992): *Capabilities, Allocation and Earnings*, Boston: Kluwer Academic.

Harkness, J. and Kyle, J. F. (1975): 'Factors Influencing United States Comparative Advantage', *Journal of International Economics* 5: pp. 153–165.

Huffman, W. E. (1977): 'Allocative Efficiency: the Role of Human Capital' *Quarterly Journal of Economics* Vol. 91: pp. 59–80.

Kroch, E. A. and Sjoblom, K. (1993): 'Schooling as Human Capital or a Signal' *Journal of Human Resources* Vol. 29: pp. 156–180.

Krugman, P. (1986): 'A Technology-Gap Model of International Trade', in: K. Jungenfelt and D. Hague (eds.), *Structural Adjustment in Developed Open Economies*.

Mailath, G. J. (1987): 'Incentive Compatibility in Signalling Games with a Continuum of Types', *Econometrica* 55(6): pp. 1349–1366.

Mankiw, N., Romer, D. and Weil, D., (1992): 'A Contribution to the Empirics of Economic Growth', *Quarterly Journal of Economics*, Vol. 57: pp. 407–438.

Maskus, K. E. (1983): 'Evidence on Shifts in the Determinants of the Structure of United States Manufacturing Foreign Trade, 1958-76', *The Review of Economics and Statistics* 65: pp. 415–422.

Maskus, K. E. Sveikauskas, C.D. and Webster, A. (1994): 'The Composition of the Human Capital Stock and its Relation to International Trade', *Weltwirtschaftliches Archiv*, Vol. 130: pp. 50–76.

Mincer, J. (1958): 'Investment in Human Capital and Personal Income Distribution', *Journal of Political Economy*, Vol. 66: pp. 281–302.

— (1962): 'On the Job Training: Costs, Returns and Some Implications', *Journal of Political Economy* vol. 70: 50-79.

— (1974): *Schooling, Experience and Earnings, New York*: Columbia University Press.

OECD (1998): *Human Capital Investment. An International Comparison*, Paris: OECD.

Pritchett, L. (1996): 'Where Has All the Education Gone?', World Bank Policy Research Department working paper No 1581.

Riley, J. (1975): 'Competitive Signalling' Journal of Economic Theory 10: pp. 174–186.

Schultz, T. W. (1961): 'Investment in Human Capital' *American Economic Review* 51: pp. 1–17.

Spence, A. M. (1974): 'Job Market Signalling' *Quarterly Journal of Economics*, Vol. 87: pp. 355–374.

Stern, R. M. (1976): 'Some Evidence on the Factor Content of West-Germany's Foreign Trade', *Journal of Political Economy*, 84(1): pp. 131–141.

Stern, R. M. and Maskus, K. E. (1981): 'Determinants of the structure of United States Foreign Trade', *Journal of International Economics* 11: pp. 207–224.

Stiglitz, J. (1975): 'The Theory of 'Screening', Education and the Distribution of Income', *American Economic Review* 65: 283–300.

Temple, J. (2000): 'Growth Effects of Education and Social Capital in the OECD Countries', Economics Department Working Papers No 263, Paris: OECD.

Uzawa, H. (1965): 'Optimal Technical Change in an Aggregative Model of Economic Growth' *International Economic Review* 6: pp. 18–31.

Verspagen, B. and Wakelin, K. (1993): International Competitiveness and its Determinants, Research Memorandum MERIT No 93-008

Wolter, F. (1977): 'Factor Proportions, Technology and West German Industry's International Trade Patterns' *Weltwirtschaftliches Archiv* 113: pp. 250–265.

CHAPTER III
Productivity growth in EU services

III.1 Importance of services in the economy

The *European competitiveness report* 2001 included a study of innovation and productivity performance in the manufacturing sector[67]. It concluded that the European Union lags behind its main competitors, in particular the United States, in terms of innovative activity and R & D inputs. These weaknesses were in turn reflected in the EU's lower overall productivity growth. Sectoral productivity levels are in general higher in US manufacturing in comparison to the European Union. In addition, technology-driven high-productivity industries account for a larger share of total manufacturing in the United States, thus contributing to higher overall productivity.

The present chapter completes the analysis of productivity developments by focusing on services. Services are the main sector of economic activity in all modern economies[68], and the productivity and competitiveness of the services sector are a crucial determinant of growth and welfare. The role of many services as inputs in the production of industrial goods (e.g. business-related services, communications or financial services) also makes them an important component of competitiveness in the manufacturing sector[69]. Finally, as more and more services are becoming tradable, services play an increasing role in determining countries' trade performance[70].

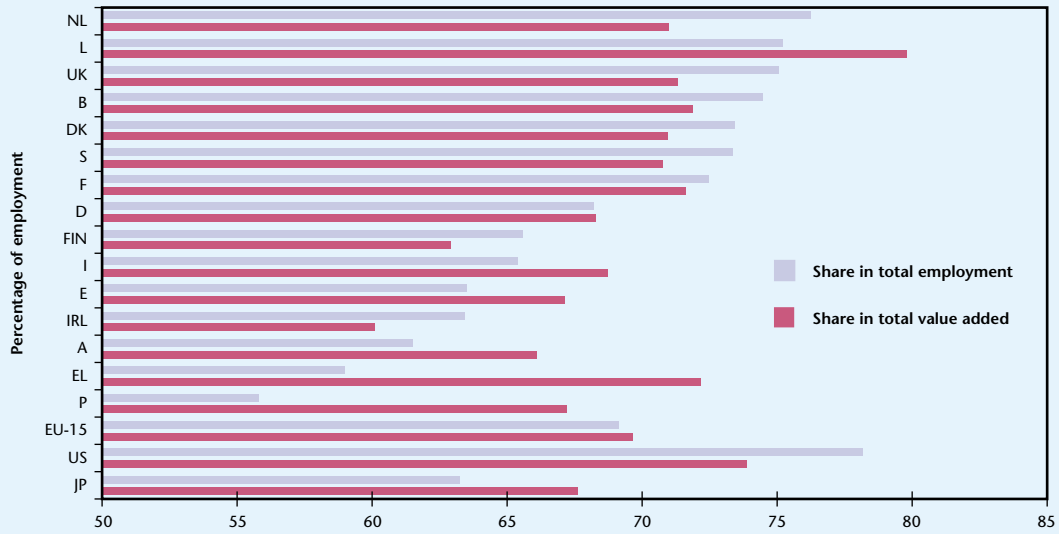
In the European Union, services account for 69 % of all jobs and 70 % of total output (see Graph III.1). The relative size of the services sector in the economy has continued to increase: in 1990, services represented 63 % of the Union's total employment and 64 % of total value added. The size of the services sector varies considerably across the Member States. The share of services in total employment ranges from 56 % in Portugal to 76 % in the Netherlands. In terms of value added, services represent between 60 % (Ireland) and 80 % (Luxembourg) of the total.

With the exception of Luxembourg, the share of services in the economy in all the Member States is smaller than in the United States. Until recently, European services were characterised by higher productivity growth but lower employment growth than in the United States. This was seen as a catch-up process in the European services sector. However, the recent acceleration of productivity growth in services in the United States has led to a renewed widening of the productivity gap between the United States and the European Union (see section III.2).

Economists often analyse the issue of productivity growth in a two-sector economy, consisting of services and manufacturing. Baumol's 'unbalanced growth model' (see Box III.1) starts from the assumption that the labour-intensity of many services makes it difficult to raise labour productivity by automation. In the manufacturing sector, a faster substitution of capital for labour will lead to continuously higher labour productivity growth than in the services sector. As the demand for services continues to rise despite their higher relative prices, reflecting the high income elasticity of demand, the share of services in total employment will increase, while, ceteris paribus, the employment share of manufacturing will decline.

67 See European Commission (2001a), especially chapter 4.
68 European Commission (2000a), chapter 4, provides a description of the evolution of service sector.
69 European Commission (2000a), chapter 4, describes the increasing penetration of external services and their impact on performance of client sectors.
70 Although the value of conventional cross border trade in services is only about one-fifth of the value of trade in goods in the EU, trade in services is expanding more rapidly than trade in goods. European Commission (2000a), chapter 5, describes the evolution of international services transactions.

Graph III.1: Size of the services sector in the economy, 2000



Notes: Employment shares for France, the United Kingdom, EU–15 and Japan: 1999, and for Portugal: 1998; EU–15 excludes Portugal. Shares in total value added for Ireland and Japan: 1999; EU–15 excludes Ireland.

Source: Commission services (national accounts statistics).

Sectoral employment and productivity in the European Union have developed in line with the predictions of Baumol's model. In the late 1990s, services employment expanded at annual rates of close to 2 %, while manufacturing employment declined (see Graph III.2). Productivity growth, in turn, was clearly higher in manufacturing: 1.8 % against 1.0 % in services.

The remainder of this chapter looks at productivity developments in services, in particular business sector services, and investigates possible causes behind the productivity growth differentials against the United States. The next section III.2 presents empirical evidence on productivity growth in business sector services, and the link between productivity growth and employment growth; the following section III.3 looks at some determinants of productivity growth in services, in particular the use of ICT, innovation and market liberalisation; the final section III.4 concludes.

III.2 Productivity developments in business sector services

III.2.1. Market services in the EU

This section presents data on productivity growth in market services (or, as called in official statistics, 'business sector services'). Market services account for over a half of GDP, and almost one half of total employment in EU–15 (Table III.1). In both the United States and Japan, market services represent a slightly higher share of total output and a clearly higher share of total employment than in EU–15.

The exclusion from the analysis of most public sector services (such as health and education) is due mainly to lack of comparable data. This does not mean that the scope for productivity increases in those services is any less relevant for the economy; on the contrary, it may even lead to several secondary benefits, such as a reduced overall tax burden.

More detailed OECD data on market services (OECD's 'business sector services') are available for eight Member States[71], allowing an analysis of productivity growth by sector[72]. Annex Tables III.A1 and III.A2 show by country the GDP and employment shares of each sub-sector of business sector services[73]. Business sector services account for between two-fifths and half of GDP in the EU Member States for which data are available. Their share in total employment is typically around 10 percentage points lower[74].

71 EU–15 excluding Belgium, Greece, Spain, Ireland, Luxembourg, Portugal and Sweden.

72 Colin Webb (OECD) kindly provided the unpublished data from the STAN database.

73 Due to definitional differences and the different base year, the data may differ from those presented in Table III.1.

74 This difference can be explained largely by Real Estate Activities. A significant proportion of its value added consists of 'Imputed Rent of Owner-occupied Dwellings'. Since there is no labour input associated with owner-occupied dwellings, the inclusion of 'Real Estate Activities' can distort productivity measures; particularly as volume growth of owner-occupied dwellings is generally slower than that for other business services.

Box III.1: Baumol's unbalanced growth model

The work of Baumol (1967, 1985, et al. 1985) provides an important foundation of the current understanding of productivity in services, and of the implications of the increasing size of the services sector for growth and productivity in the economy as a whole. Baumol, together with Fuchs (1968), pointed to the highly labour intensive nature of many service activities as a central element behind the observation that aggregate productivity growth in the services sector generally lagged behind that of the goods sector. The basic argument is that it is often difficult to reduce the labour input into many service activities (e.g. through automation or technological progress) and so there may be little scope to increase efficiency (e.g. through capital accumulation, innovation, or economies of scale). Consequently, low productivity growth may be seen as an innate feature of some — but not all — services.

Baumol provides a stylised model to explain the causes and consequences of the increasing size of the services sector. In the simplest representation of the model, the economy consists of two industries: a technologically progressive industry which has a permanently higher growth rate of productivity (initially equated with manufacturing), and a technologically stagnant industry with zero (or low) productivity growth (initially equated with services).[i] Further, the model assumes that labour is the only input, that total employment is fixed, and that wages move in line across the two industries — driven by productivity growth in the progressive sectors. Over time, less labour is required to produce outputs in the high productivity growth industry, while labour input remains unchanged (or falls more slowly) in the low productivity growth industry. As wages, and hence prices, cannot adjust to the lower productivity in the stagnant industry, the relative price of its outputs will rise. At the same time, however, incomes will also be rising because there is productivity growth at least in the progressive industry. Two outcomes for the low productivity growth industry are possible:

— Unless the low productivity growth industry is characterised by a high income elasticity of demand, demand for its output will fall as prices rise and eventually the industry will vanish, provided that it is not subsidised or otherwise maintained.

— If the low productivity growth industry is characterised by a high income elasticity of demand, rising incomes will increase the demand for its output and, since there is little or no scope for productivity improvements, the industry will absorb an increasing proportion of employment to meet this increase in demand. This will be possible because productivity improvements in the progressive industry will allow labour to shift to the stagnant sector while still meeting the growing demand for its own output.

This second outcome provides an explanation for the increasing share of services — typically associated with a high income elasticity of demand and low productivity growth — and the declining share of manufacturing in total employment. Further, the aggregate economy-wide productivity growth rate will diminish as the employment share of less productive service sectors increases, since aggregate productivity is given by the sum of employment-share weighted sector productivity growth rates. Thus, it follows from Baumol's analysis that:

— Relative prices in low productivity growth sectors will rise faster than in high productivity sectors.

— The share of employment in low productivity growth sectors will increase.

— Economy-wide productivity growth will decline as employment shifts to low productivity growth sectors[ii].

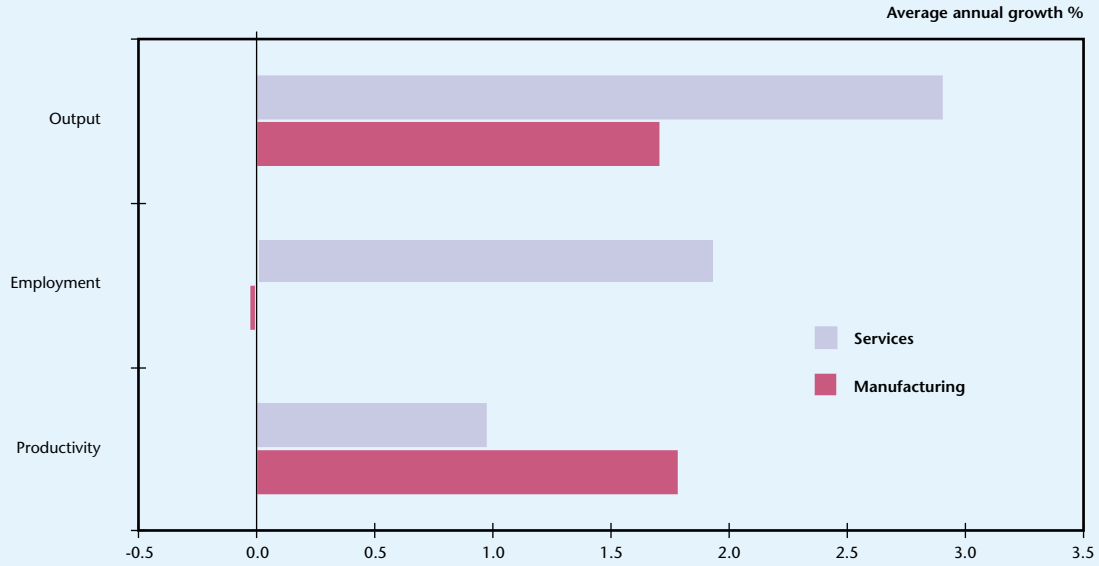
In a broader context, the historically observed pattern of strong productivity growth and low employment growth in European services has been seen to reflect a 'catching-up' process towards US productivity levels. As European productivity levels approach those of the United States, their rate of growth should slow and, as predicted by Baumol's model, the share of employment in services will increase.

Notes:

[i] In an extension to the basic model, Baumol (1985) expands his analysis to allow for service sectors that may show rapid growth of productivity in the short or medium term. Even here, however, if productivity improvements are ultimately bounded by a fixed labour input, productivity growth will eventually diminish to some low level.

[ii] Oulton (2001) demonstrates that this conclusion does not necessarily follow if stagnant industries are producers of intermediate inputs (e.g. business services) rather than producers of final goods and services. Under certain conditions it is possible that transferring resources to low productivity growth sectors that are producers of intermediate inputs may raise aggregate productivity.

Graph III.2: Output, employment and productivity in manufacturing and in services in EU–15, 1995–99



Note: Productivity is defined as value added per employed person. Manufacturing output and productivity excluding Ireland. Services employment and productivity excluding Portugal.

Source: Commission services (national accounts statistics).

Table III.1: Market services in total value added and employment in EU–15, US and Japan (1997)

	Value added (ECU 1 000 Million)			Employment (millions)		
	EU [a]	US [b]	Japan	EU [a]	US	Japan
Market Services	3 485	3 299	2 060	66.9	68.3	34.6
Share of total (%)	52.3	54.8	54.5	46.1	53.7	52.4
Of which (%):						
Wholesale and retail trade	12.9	14.2	13.1	14.8	18.7	17.6
Hotels and restaurants	2.9	3.1	6.8	4.0	5.4	9.7
Transport	4.2	3.5	5.2	4.7	3.8	4.7
Communication	2.4	2.7	1.3	2.0	1.0	1.2
Financial services	5.5	5.0	3.5	3.6	3.2	2.2
Other market services	24.3	26.4	24.6	17.0	21.7	17.1

Notes: (a) Earlier years used for some countries for the breakdown of market services
(b) 1996 data.

Source: European Commission (2000b); based on national accounts statistics.

Within the European Union, the United Kingdom and the Netherlands display the largest GDP shares in business sector services, Finland the smallest. In the United Kingdom and the Netherlands, business sector services account for an even larger share of total employment than in the United States, while Italy, Finland and Sweden have the smallest employment shares in business sector services in the European Union.

Within business sector services, the most important sub-sector is wholesale and retail trade. In all the countries covered by the data, the trading sector accounts for nearly one quarter of the total value added in business sector services, and its employment shares are even higher (Annex Tables III.A1 and III.A2). Financial intermediation (which is clearly more important in terms of GDP than in terms of employment), and transport and storage are the next most important sectors within business sector services.

III.2.2 Measurement of productivity in services

Comparisons of productivity levels across countries are made difficult by the lack of appropriate sectoral price indexes and by different national approaches to measuring real output in the services sector. Measurement problems have been quoted as a cause of the so-called 'productivity paradox', whereby during much of the last quarter of a century, considerable investment in new information technologies, research and development, and rapid technological change failed to show up as higher productivity growth in official statistics. Failure to accurately measure the output of service sectors has been linked, for example, with the growing heterogeneity of service outputs (i.e. greater variety of products), the multi-product nature of service outputs, and problems of measuring changes in the quality of service outputs (see Box III.2).

Box III.2: Measurement problems for services productivity

It is well known that there are a host of problems related to the measurement of services' output in terms of distinguishing the changes in the quality, prices and quantities of services. As it is necessary to distinguish these elements in order to measure real output and in turn productivity, estimates of productivity in services are subject to a great deal of uncertainty. Among the many, often interrelated, measurement issues that have been raised, the following may be mentioned:

— **Defining the output of services**. It is often difficult to define exactly what constitutes the output of a service in sectors such as banking and insurance, retail distribution and many business services.

— **Aggregation problems**. Where a range of services are offered, it may be difficult to aggregate them to arrive at an overall measure of a firm's or sector's output. Typically there is a greater degree of heterogeneity in the output of services than, say, in manufactured goods. Moreover, outputs may often be customised so that the service offered may be unique to the individual consumer and hence difficult to aggregate.

— **The role of the consumer**. It may be difficult to separate the service output from the role of the consumer in soliciting the output. The 'results' from the service output may depend on the extent and quality of the participation of the consumer in the service transaction and not of the service provider alone. There is also a question of apportioning productivity gains between the supplier and consumer of services; for example, should productivity gains made by the user of business services be attributed to the supplier of the services or to the user?

— **Adjusting for quality**. For many services, output may be measured either on the basis of the number of transactions performed or on the basis of the outcomes achieved. For example, in legal services output may be considered in terms of the number of hours billed to clients or according to outcomes of the advice offered in terms of the successfulness of legal proceedings. More broadly, it may be possible to observe the 'characteristics' of services' outputs, but very difficult to measure the quality of these 'characteristics'. Consequently, changes in prices that may reflect changes in quality may not be appropriately taken into account and hence lead to overestimates of price inflation.

— **The impact of technical change**. Technical change brings about changes in the characteristics of services. Typically, basic statistics on output capture poorly such changes, and in periods of rapid technological change an increasing proportion of output may not be captured in statistical measures.

Essentially, volumes and prices for services are harder to measure than for goods. Often statistical agencies are required to rely on relatively crude indicators to measure output and prices (e.g. changes in output may be extrapolated from changes in labour inputs, while wages and consumer prices may be used to proxy changes in prices). Unfortunately there are no quick fixes for improving measurement of volumes, prices and quality that could be applied across service sectors. Rather, given the heterogeneity of services, improvements in price and output measures require proceeding on an industry by industry basis.

Sources and further information:

OECD (2000), '*The service economy',* Business and Industry Policy Forum Series, OECD, Paris.
OECD (2001), '*Innovation and productivity in services',* OECD Proceedings, OECD, Paris.
OECD (2001), 'OECD productivity manual: a guide to the measurement of industry-level and aggregate productivity growth', OECD, Paris.
Schreyer, P. and Pilat, D. (2001), 'Measuring productivity', *OECD Economic Studies*, No 33.
Tripplet, J. and Bosworth, B. (2000), '*Productivity in the services sector',* Brookings Institution, Washington, D.C.

Hard-to-measure services (e.g. construction, trade, financial sector, 'other' market services and government) account for a growing share of GDP and have frequently undergone rapid technological change, which exacerbates the problem of pricing the outputs of these sectors. On balance, the available evidence on measurement 'bias' for services points to an understatement of real output growth and, therefore, real productivity growth by official measures (Van Ark 2001). What remains unclear, however, is the extent to which measurement problems *per se*, and differences across countries in the way that official measures of productivity are calculated, can explain differences in output and productivity growth between countries.

III.2.3 Productivity growth in the 1990s

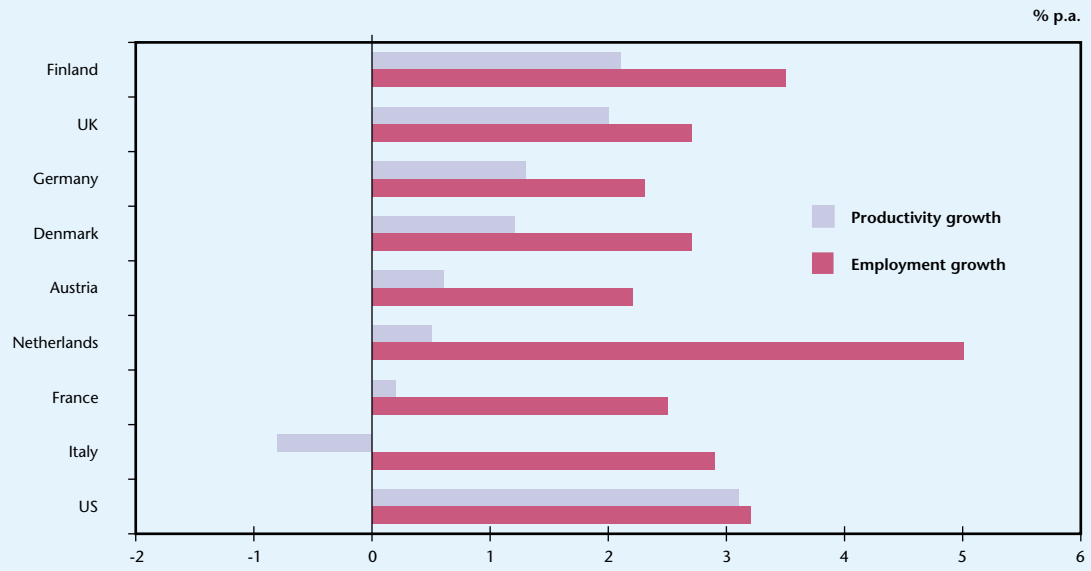
Analysing productivity growth rates instead of productivity levels eliminates some of the above-mentioned problems, such as the need to find appropriate currency conversion factors. Available data on business sector services suggest that in the latter half of the 1990s, EU countries generally lost out to the United States both in terms of productivity growth as well as job creation (Graph III.3). In each of the eight Member States for which data are available, productivity growth was significantly weaker than in the United States. The United Kingdom and Finland achieved growth rates closest to those in the United States, with annual productivity growth at some 2 % against 3 % in the United States[75]. In terms of job creation, only the Netherlands and Finland registered higher growth than the United States. In Italy, productivity in business sector services declined.

The superior US performance in the late 1990s marked a reversal of earlier developments. The productivity growth rate more than doubled in the United States in the second half of the 1990s in comparison to the first half. In contrast, of the eight EU countries covered by the data, productivity growth slowed down in all but the United Kingdom and France, which registered a marginal acceleration.

At the more detailed sector level, one notes that across the Member States, the telecommunications sector stands out as having registered by far the highest productivity growth in the late 1990s (Table III.2). Finland, Germany and Denmark also recorded high productivity growth in financial intermediation, while in the other Member States productivity growth in this sector was relatively low or even negative. In the hotels and restaurants sector, productivity growth was negative in all the countries covered except Finland and the Netherlands, which registered moderate positive growth.

75 The picture relative to the United States improves somewhat when labour productivity is measured on a value-added per hour basis rather than on an employee basis. For the US, growth rates on an 'hours' basis are broadly unchanged when compared to an 'employee' basis. For France, Austria and Finland (i.e. where comparable hours and employee data are available), labour productivity growth rates are typically higher when measured on a 'hours' basis, reflecting falls in average hours worked.

Graph III.3: Growth of labour productivity and employment in business sector services, 1995-99



Note: Labour productivity is defined as output per employed person.

Source: Calculations based on the OECD STAN 2001 database.

Table III.2: Labour productivity growth in business sector services, 1995–99
(percent per annum)

	Denmark	Germany	France	Italy	The Netherlands	Austria	Finland	United Kingdom	United States
Wholesale and Retail Trade; Repairs	- 0.1	- 0.3	0.1	- 1.0	1.5	1.8	1.8	0.9	5.9
Hotels and Restaurants	- 1.4	- 5.9	- 1.2	- 0.9	1.3	- 0.6	0.5	- 0.1	- 0.7
Transport and Storage	4.5	3.7	2.9	- 2.6	1.5	2.8	1.7	1.8	1.7
Post and Telecommunications	6.2	16.4	9.9	8.9	8.9	4.5	14.1	8.5	3.8
Financial Intermediation	4.7	6.8	- 1.4	1.4	- 1.2	1.6	12.6	1.9	4.5
Renting of M&Eq. and Other Business Activities	2.2	- 1.6	- 0.5	- 0.4	0.0	- 4.3	- 0.9	2.9	0.6
Total Business Sector Services	**1.2**	**1.3**	**0.2**	**- 0.8**	**0.5**	**0.6**	**2.1**	**2.0**	**3.1**

Note: Labour productivity is defined as output per employed person.

Source: Calculations based on the OECD STAN 2001 database.

The higher productivity growth in business sector services in the United States as a whole is the result of stronger productivity growth in the sub-sector of wholesale and retail trade (see also Box III.4). In the post and telecommunications sector[76], where the EU countries recorded remarkably high productivity growth, growth in the United States remained below that in the European Union throughout the 1990s. In the other sub-sectors, productivity growth in the United States was close to the EU average.

III.2.4 Productivity vs. employment growth

It is interesting to consider the relationship between labour productivity growth and employment growth in the context of what it may tell us about supply side and demand side conditions. Looking at the supply side, a negative relationship between labour productivity growth and employment growth is consistent with decreasing returns to scale, whereas a positive relationship would imply increasing returns to scale (see Box III.3). Shifts in the trade-off between employment growth and productivity growth will be brought about either by changes in the rate of disembodied technical change (and/or improvements in efficiency[77]), or changes in the rate of growth of capital intensity, or a combination of the two.

Looking at the demand side, there will be a positive relationship between labour productivity growth and employment growth if demand — and hence output — grows more quickly than labour productivity, and a negative relationship if the opposite occurs. The price elasticity of demand determines the extent to which price reductions and improvements in quality lead to increases in demand. The scope for price reductions in turn depends largely on productivity growth, though the extent to which cost reductions are passed on to final prices is influenced by the degree of competition on the market.

If an increase in competition, for example as a result of market liberalisation, leads to a greater proportion of gains in productivity being passed on to final prices, this will be observed as an outward shift in the trade-off between employment and productivity growth. That is, higher rates of growth in output (demand) and, hence, employment growth would be consistent with a given level of labour productivity growth.

76 Note that the postal service and telecommunications services are conventionally grouped together at the same NACE 64 level, due to historical reasons and to lack of detailed data (for example, former PTT monopolies). However, these two activities are very different; the postal sector is labour intensive while the telecommunications sector is capital intensive characterised by rapid technological progress and innovation, and has been fully liberalised. This ought to be kept in mind when discussing developments in the group aggregate.

77 It may be noted that efficiency relates to improvements made using a given technology. Conceptually productivity relates to the quantity of output produced for a given set of inputs irrespective of the efficiency of use of these input. However, for measured productivity it is difficult to separately identify gains in efficiency from improvements made as a result of technological change.

Box III.3: Labour productivity growth and employment growth

Given a production function H, gross output Y is produced using a combination of labour (L), capital (K) and intermediate inputs (M) and will depend (over time) on the level of efficiency and technical change (A); such that:

$$Y = H(A, K, L, M) \quad (1)$$

Assume for simplicity that this can be approximated by the Cobb-Douglas functional form and that, in terms of value added (V), this can be written:

$$V = a_0 L^{b1} K^{b2} \quad (2)$$

Then the rate of growth of real value added (v) can be derived from total differentiation as:

$$v = a + b_1 l + b_2 k \quad (3)$$

where a is growth rate of (disembodied) technical change and/or efficiency improvements, l and k are the rates of growth of labour and capital, and b_1 and b_2 are the labour and capital exponent in the production function, all adjusted for the share of value added in gross output.

Rearranging (3), value added labour productivity growth (v — l) is given by:

$$v - l = a + b_2(k - l) + (b_1 + b_2 - 1)l \quad (4)$$

Thus, growth in value added labour productivity depends the rate of technical change (a), growth in capital intensity (k — l) and employment growth (l).

It follows that, the relationship between labour productivity growth and employment growth is positive if there are increasing returns to scale in value added (i.e. $b_1 + b_2 > 1$) and negative if there are decreasing returns to scale (i.e. $b_1 + b_2 < 1$). If either the rate of technical change or growth of capital intensity increase then there will be an upward shift in the relationship between productivity growth and labour growth.

Looking at the empirical data for our country sample of eight Member States and the United States, one finds no systematic trade-off between employment growth and productivity growth for aggregate business sector services during the late 1990s (Graph III.4)[78]. At the level of individual sectors, however, the data do indicate a distinct trade-off between labour productivity and employment growth in the sectors 'hotels and restaurants', 'transport and storage', and 'post and telecommunications'. Across countries higher (lower) rates of labour productivity growth are associated with lower (higher) rates of employment growth[79].

The three sectors for which the data indicate a trade-off between productivity and employment — 'hotels and restaurants', 'post and telecommunications', and in most countries also 'transport and storage' — have a second common feature: they all have low labour productivity levels. In the remaining sectors of business sector services, labour productivity is higher than the average for the whole economy[80].

Comparison between the first and the second half of the 1990s reveals an apparent upward shift in the trade-off between productivity and employment in sectors where such a trade-off existed. Labour productivity growth rates in the second half of the 1990s seem to be associated with higher rates of employment growth in most sub-sectors as well as for aggregate business sector services, probably as a consequence of the strong cyclical upswing during this period.

III.3 Factors influencing productivity growth in services

III.3.1 Introduction

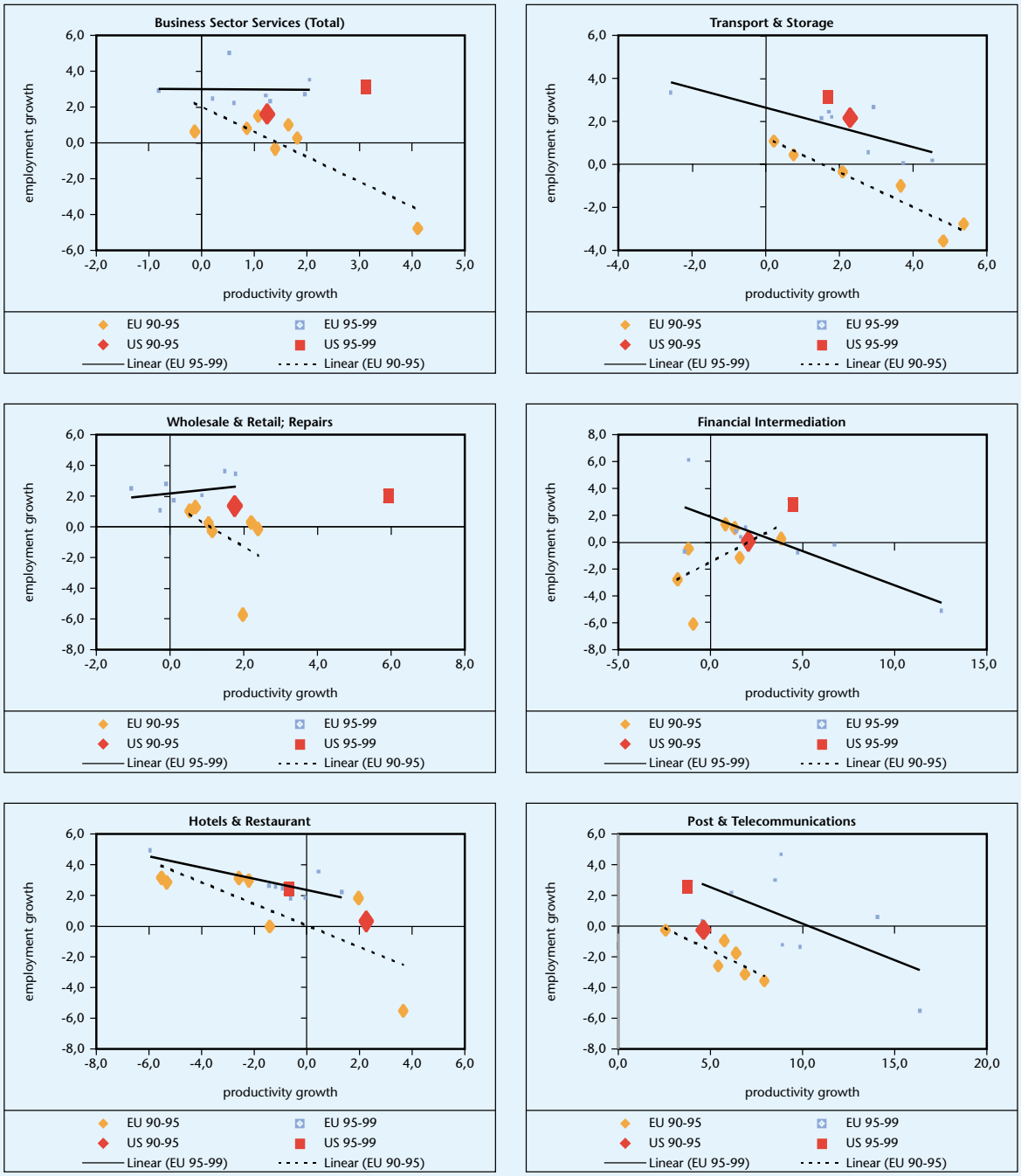
Various causes have been identified to explain the divergence of productivity performance in the

78 After excluding the 'outlier' Finland from the analysis for 1990-95, there is only weak negative correlation for both periods 1990-95 and 1995-99 between labour productivity growth and employment growth.

79 The correlation coefficients for 'hotels and restaurants', 'transport and storage', and 'post and telecommunications' were –0.740, -0.828 and -0.831 respectively for the period 1990-95, and –0.760, -0.751 and –0.619 for the period 1995-99. The sample included Denmark, Germany, France, Italy, the Netherlands, Austria, Finland, Sweden, the United Kingdom and the US.

80 Sectors which have a larger (smaller) share in total value added than in total employment have an above-average (below-average) labour productivity; see Table III.1 and Annex Tables III.A1 and III.A2.

Graph III.4: Relationship between employment growth and productivity growth (%) in business sector services



Note: Labour productivity is defined as output per employed person

Source: Calculations based on the OECD STAN 2001 database

service sector. Among the explanatory factors that have been pointed to are different growth rates in investment; the impact of new technologies, in particular information and communication technologies (ICT); the pace of structural reforms on labour, product and capital markets; R & D and differences in innovation regimes; human capital; organisational change; and intellectual property rights (see e.g. Pilat (2001)).

The relative importance of the different productivity-enhancing factors varies across sectors and

Box III.4 Productivity growth in retail and wholesale trade in the United States

In a study of productivity performance of the United States, McKinsey Global Institute (2001) examines the causes of the acceleration of labour productivity in the second half of the 1990s. They note the considerable contribution of wholesale and retail trade to the acceleration in aggregate productivity growth and examine some possible causes.

With regard to wholesale trade, McKinsey focused on pharmaceutical wholesaling as an illustration of developments in the sector. They argue that labour productivity growth was partly driven by consolidation, which resulted from the squeeze of profit margins brought about as a result of increased retailer bargaining power. At the firm level, consolidation stimulated warehouse automation and the optimisation of workforce and warehouse layout. Another important factor was the increase in the value of the wholesalers' intermediation role associated with the higher value drugs they distribute. McKinsey estimated that trends such as the move to higher-value-added services, consolidation, warehouse automation and substitution to higher-value goods also occurred in other parts of wholesaling.

With regard to retail trade, McKinsey focused on general merchandise retailing. Here, they found that the higher productivity growth resulted from an increase in the intensity of competition (attributed largely to the continued growth of Wal-Mart) and from consumer substitution toward higher-value goods (macroeconomic factors such as GDP growth, a consequent rise in the disposable income of consumers and growing consumer confidence stimulated consumers to buy more expensive goods). Wal-Mart is credited with directly causing the acceleration of labour productivity acceleration by developing a successful format based on ongoing managerial innovations and intensive use of information technology. The large store format adopted by Wal-Mart generated scale economies, whilst the company continuously competed aggressively on prices in order to gain market share, additional scale advantage and increased negotiating power vis-à-vis suppliers. It also appropriated its own distribution in order to achieve efficiency gains in logistics operations. The resulting increase in competitive pressure as the result of Wal-Marts continuous improvements in the business process and cost cutting forced competitors to copy Wal-Marts best practice.

Source: McKinsey Global Institute (2001), '*United States productivity growth, 1995–2000',* Washington D.C., October.

countries. Box III.4 discusses the causes behind the rapid acceleration of productivity growth in the retail and wholesale trade sector in the United States in the late 1990s (which was the main reason behind the faster overall growth in services productivity in comparison to the European Union). Factors such as strengthened competitive pressures, increased use of information technology and new working methods were found to have been associated with the acceleration of productivity growth in the retail and wholesale trade sector in the United States. The remainder of this section will take a closer look at three productivity-enhancing factors in the services sector: use of ICT, innovation and market liberalisation.

III.3.2 Use of ICT

Many service sectors are major users of ICT, and collectively services account for the majority of IT investment. In a recent analysis of the comparative productivity performance of OECD countries, McGuckin and Van Ark (2001) find that most of the acceleration in US productivity in the second half of the 1990s can be traced to industries that produce or intensively use ICT. The group of ICT-*using* industries that they identify is dominated by service sectors[81]. They conclude that in many European countries limited productivity growth in industries that use ICT intensively suggests under-investment in ICT.

Measurement issues lie at the heart of the debate on the 'productivity paradox' (see also Box III.2 above), and are highly relevant for productivity analysis in ICT-using services. The adoption of ICT or e-commerce can lead to improvements in the quality of service products (e.g. flexibility to adjust products to customer needs, user friendliness, temporal and spatial availability) and in the processes through which services are produced and delivered. Nevertheless, such improvements may not be reflected by an increase in the price of the output, or in output per employee. If the increased utility to the service user of an improvement in service delivery (quality) is not appropriately accounted for in measured output, productivity growth statistics may fail to capture the improved performance. When services are used as inputs in other industries, improvements in service delivery may however be captured as improvements of measured productivity in the client sector.

81 Wholesale trade, financial intermediation, insurance and pension funding, activities related to financial intermediation, renting of machinery and equipment, research and development, and other business services.

Achieving the best results from the introduction of new technology can depend on the capacity of firms to undertake accompanying organisational change. Investment in human capital may be necessary to provide the skills required to take advantage of the extensive and increasing use of ICT. More generally, human capital is an important component of service sector performance (Pilat 2001). The labour-intensive nature of many services, the high degree of interaction with consumers, the high-knowledge intensity of the services provided, and the importance of tacit knowledge and experience for innovation in services, are all factors that point to the need for service firms to invest in human capital.

III.3.3 Innovation

Innovation is a much broader concept than the introduction of a new product or service. It can cover applying a new technology to the production of an existing product/service, changes to production processes and organisational structures, or penetration of new markets with an existing product/service. The importance of innovation for productivity growth in manufacturing industries was analysed in the 2001 *European competitiveness report* (European Commission 2001a). The present section will focus on the specific aspects of innovation in services which distinguish them from manufacturing.

The traditional distinction between manufactured products and services outputs is becoming increasingly blurred. The increased use and interoperability of ICT, as well as the growth of electronic commerce has diminished the relevance of certain commonly identified characteristics of services, such as the difficulty to store and transport services and the need for direct supplier-customer interaction for service delivery. Moreover, there are good grounds for thinking that just as service firms in some sectors are 'industrialising' production and acquiring characteristics more typical of manufacturers, so are the activities of many manufacturing firms becoming more like services (Coombs and Miles 2000).

Notwithstanding the above, there remain important characteristics of service industries that distinguish them from manufacturing and, ultimately, influence innovation. Among these, the following are frequently identified:

— ***The intangibility and information intensity of service products***. Many service products cannot be stored or embodied in physical products and, as a consequence, production and consumption must take place simultaneously. The intangibility of many services draws much greater attention to activities such as design and customisation of services. By implication, innovation in services is often more closely associated with the way in which services are delivered than with the development of new services, or process improvements which increase output or decrease inputs (Licht and Moch 1999).

— ***The client-intensity of services***. Many services sectors rely on a high degree of interaction between the producer and consumer. Innovations may take place on an ongoing basis, involving both the producer and the customer, and be reflected in incremental changes to service products, processes and delivery. Innovations may only be 'discovered' when a service product is sold to a new client. Alternatively, the incremental nature of innovations may make it difficult to trace and identify specific innovations. Arguably, these types of innovation are poorly captured, if at all, by conventional innovation indicators and measures and so lead to a misrepresentation of services' innovation.

— ***Research and development activity***. R & D activity by services has grown rapidly over the past two decades and accounts for an increasing share of total business spending on research and development. Nevertheless, in many service sectors R & D intensity remains low when compared to manufacturing. Service firms rarely have R & D departments and tend to set up product and project development teams on an ad hoc basis (Coombs and Miles 2000). Services are often less closely associated with technological change resulting from their own direct investment in the development of new technology. Innovation in many services is brought about primarily through acquired technology (e.g. ICT), organisational change and human capital, rather than R & D per se[82]. As a result, identifying and measuring the scope and intensity of R & D efforts in services is often more difficult than for manufacturing.

— ***Networking and cooperation***. A further factor that may contribute to low levels of observed technological innovation in services is the presence in many services sectors of an overwhelming proportion of SMEs. In general, smaller firms have less financial means to invest

82 As major customers of technology, or as a result of their role in the distribution of new products (for example, retail distribution), service firms are increasingly seen to be instrumental in influencing the orientation of R & D effort (Pilat 2001). Howells (2001) provides a brief overview of studies highlighting the role of services in innovation processes.

in R & D activities and may be more risk averse in respect to such investments. In an environment where there can be considerable economies of scale in R & D activities, cooperation and networking may be extremely important for cost sharing and acquiring knowledge[83]. Furthermore, cooperation within the sector is important for establishing and implementing technological standards, which in themselves are necessary for innovation to take place and be adopted (Pilat 2001).

To date, very little comparable cross-country data exist on innovation. The Second Community Innovation Survey (CIS2)[84] provides one of the few sources of information on innovation in services for the EU Member States[85]. Overall, CIS2 data indicate that 51 % of manufacturers can be classified as innovators[86], against 40 % of all service enterprises.

The proportion of innovating firms varies considerably across service sectors, with enterprises in 'high-tech' service sectors such as 'computer services', 'telecommunications', 'engineering services' and 'financial intermediation' being more likely to have engaged in innovative activities than enterprises in 'low-tech' service sectors such as 'wholesale distribution' and 'transport' (Graph III.5).

Comparing the proportion of innovators across sectors with labour productivity growth rates for individual countries, it appears that productivity growth rates are generally higher in sectors with a higher share of innovators (Annex Table III.A3). For all countries there is a positive correlation between the ranking of sectors in terms of the share of innovators and labour productivity growth rates. Although this finding does not tell us anything about the direction of causality, it is consistent with the general notion that productivity growth should be higher in sectors that innovate more.

Policies stimulating innovation and R & D should aim towards reducing the barriers faced by enterprises undertaking or seeking to undertake such activities. Barriers to innovation found in innovation surveys include: insufficient access to finance and risk capital, lack of internal capacity to innovate, insufficient expertise in applying ICT and high risks

83 This is also true for manufacturing. It is increasingly the case that innovation is undertaken within networks that bring together both manufacturing and service firms, often in collaboration with public research and educational institutions.

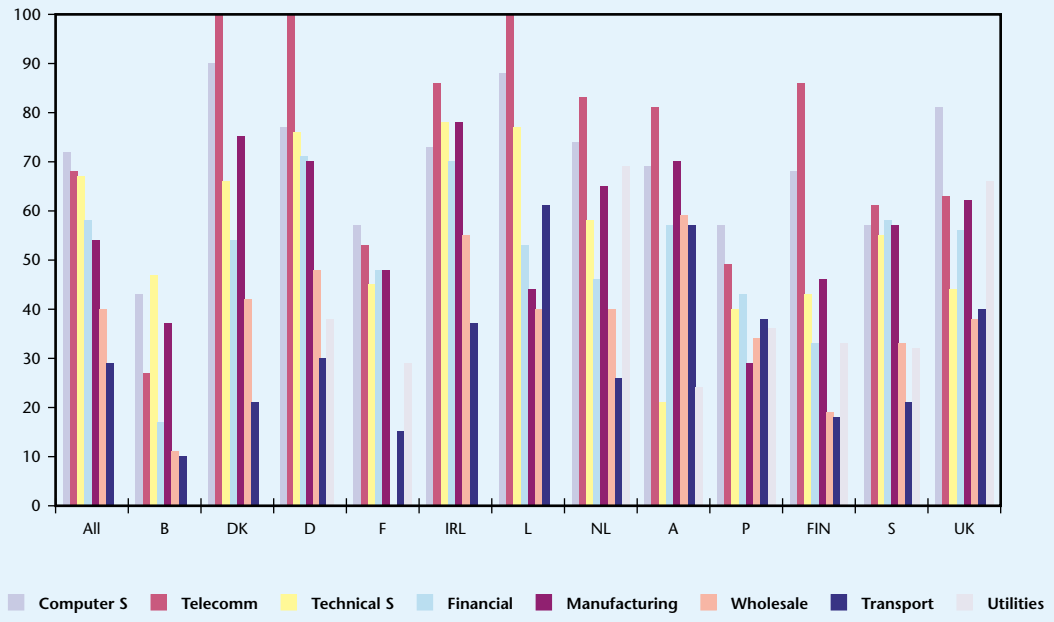
84 See EIMS (2001) and European Commission (2001b). The second Community Innovation Survey (CIS2) took place in 1997 and covered the period 1994–1996; currently, data for the preparation of the third survey (CIS3) are being collected..

85 Comparable information for the United States is not available.

86 Enterprises are classified as innovators if they engaged in innovating activities in the three years covered by the survey (1994–1996). The proportion of innovators only measures the presence of innovative activity and gives no indication of the quality of the innovation or whether the innovation was incremental or groundbreaking.

Graph III.5: Share of firms with innovative activity

(percent of all firms)



Note: The average figure 'All' also includes Norway

Source: Based on data from EIMS (2001).

associated with innovation (Pilat 2001). To the extent that these barriers to services innovation are similar to manufacturing, generic policies strengthening the general framework for R & D and innovation[87] benefit the innovation environment for service enterprises.

However, the special characteristics of services compared to manufacturing suggests that some barriers to innovation present a greater challenge to services than manufacturing:

— ***Trade and investment barriers.*** The intangible and client-intense nature of services implies that service products cannot normally be traded in the conventional sense. Although these characteristics are losing importance due to increased use of ICT and electronic commerce, it remains the case that exporters of services are more likely to supply their products through the establishment of a commercial presence in foreign markets. Therefore policies aimed at a reduction of trade and investment barriers would benefit the service sector as internationalisation increases the market for domestic firms, promotes the diffusion of ideas and innovative concepts, and allows further specialisation of production along the lines of comparative advantage.

— ***Access to finance and risk capital.*** Many service firms depend on intangible assets, such as human resources, brands and trademarks, and know-how which is not protected by intellectual property rights, and may possess little in the way of tangible collateral. Intangible assets are difficult to value and generally are not properly valued by most accounting standards, which in turn creates difficulties for service firms when raising capital. Policies aiming to include intangible capital in accounting standards and policies stimulating the availability of venture capital would benefit innovation in services.

— ***Protection of intellectual property rights.*** The ease of imitation and lack of appropriate protection of intellectual property (IP) has often been identified as an impediment to R & D and innovation in services. However, innovation surveys show that the risk of imitation is not regarded to be a more serious barrier to innovation in services than it is in manufacturing. The alleged problems associated with ease of imitation may only apply to non-technology intensive services or to the secondary 'design features' of services. Nonetheless, there remains an issue as to whether existing IP regimes[88] require reform so as to better accommodate R & D and innovation in services, particularly for non-technology-intensive service sectors.

III.3.4 Market liberalisation

A general consensus is that liberalisation, and accordingly greater reliance on market mechanisms, has a positive effect on economic performance. Price liberalisation should enable companies to produce more efficiently by more effectively utilising factors of production and through the adoption of cost-based pricing. Removing barriers to entry should encourage new entrants and, hence, combat x-inefficiency (of incumbent firms), increase productive and allocative efficiency and stimulate demand. The beneficial effects of liberalisation often take place through the adoption of new technologies, product diversification, innovation and encouragement to productivity enhancing investments.

The relatively early and broad reforms are argued to have given the United States a head start in comparison to the European Union: by creating opportunities for profits, deregulation enhanced investment, led to an expansion of output and increased productivity. To the extent that it is possible to generalise given the diversity of national institutional structures, the pace of regulatory reform in Europe has been slower and markets continue to be fragmented[89]. McKinsey Global Institute (2001) finds that the net acceleration in labour productivity growth in the United States can largely be attributed to services sectors[90]. Their analysis places a great emphasis on the role of high or increasing competition in bringing about the diffusion of managerial and technological innovations (including ICT).

Historically, many service sectors have been highly regulated, but over the last two decades there has been a general trend towards extensive liberalisation and regulatory reform[91]. These reforms have encompassed both sectors characterised by struc-

87 Principal policy elements to strengthen the general innovation framework are policies to build an innovation culture, to enhance technology diffusion throughout the economy, to promote networking and clustering, to leverage R & D better, and to strengthen the innovation system's capacity to respond to globalisation (Pilat 2001).

88 IP regimes used in the service sector are mostly copyrights and trademarks. Patents are rarely used to protect service innovations.

89 OECD (2001c) provides a comparison of the burden of different forms of economic and administrative regulations across countries.

90 Their analysis identifies six sectors which account for 99 % of the net acceleration of overall US labour productivity growth (and 74 % of the sum of all positive sectors). The six sectors are retail trade, wholesale trade, securities and brokerage, electronics, industrial machinery, and telecommunications.

91 See OECD (2001) for a recent review of the effects of regulation and market structure on performance in telecommunications, electricity supply, air passenger transport, road freight and retail distribution.

tural market competition (e.g. road freight, retail distribution) and those, often network industries, where market competition has traditionally been less prevalent or present only in certain segments (e.g. rail transport, telecommunications).

To date, empirical analysis drawing on cross-country comparisons of the effect of regulations and regulatory reform on the performance of service sectors is limited. The available empirical evidence strongly suggests that liberalisation and regulatory reform in service sectors makes a positive contribution to economic growth. Nicoletti (2001), reviewing available empirical evidence, finds that regulatory reforms in services can contribute substantially to improved economic performance and, where competition-enhancing reforms have gone furthest, the share of services, employment rates and the catch-up in productivity growth have been higher. Further, he points out that regulatory reform has been associated with technical progress, innovation and product diversification and that increased competitive pressure has encouraged productivity-enhancing investments.

Gönenc *et al* (2001) provide a review of the empirical analysis on the impact of liberalisation at macroeconomic level and for selected service sectors. They find that the limited available evidence on the impact of market liberalisation on performance at macroeconomic level tends to indicate significant and positive effects on levels and growth rates of GDP. Further, with regard to the more numerous studies of deregulation on industry performance, they find overwhelming cross-industry evidence of liberalisation of entry and prices improving static and dynamic efficiency, enhancing quality and lowering consumer prices.

Wholesale and retail trade services have traditionally been supplied in competitive markets, characterised by low entry barriers, high entry and exit rates and a large number of competitors of relatively small size. Over the last decade the sector has been marked by a rising concentration in some segments of the market and by a rapid emergence of new forms of competition, such as e-commerce (Dobson and Waterson 1999; Boylaud and Nicoletti 2001a). Moreover, traditional distinctions between wholesale and retail distribution are being erased as the two activities become more integrated and cooperation throughout the chain from the manufacturer to distribution increases, particularly with respect to logistics.

The regulatory restrictions in the wholesale and retail trade sector relate mainly to the requirements for setting up and opening a business, shop opening hours and the freedom to set prices. The degree of concentration in retail markets tends to be inversely related to the overall degree of regulation (Boylaud and Nicoletti 2001a) Høj *et al* (1995) conclude that restrictions on large-scale stores have a negative effect on efficiency. Restrictions on large outlets, especially in Italy and to a lesser degree in France, have led to a higher outlet density and a smaller average store-size than the structural characteristics of the markets would predict. The strong positive link between the average size of stores and the efficiency of the distribution system (Pilat 1997) suggests that the restrictions on large stores are likely to have contributed to the low productivity levels in these countries[92].

In the European Union, progress in achieving greater liberalisation of shop opening hours has been accompanied by a more restrictive stance on the expansion of large retail outlets. Restrictions on opening hours have been relaxed in countries such as Denmark, Austria, the Netherlands and Germany whilst at the same time there is an increasing tendency to tighten retail planning rules in traditionally more liberal countries (European Commission 2000c).

Empirical research on ***transport services*** indicates a positive relationship between liberalisation (or regulatory reform) and labour productivity growth. Boylaud and Nicoletti (2001b) conclude on the basis of the findings of several empirical studies that liberalisation of road freight promoted efficiency, reduced freight rates and enhanced productivity; countries with a (relatively) liberal market environment demonstrate higher productivity levels. Gönenc and Nicoletti (2001) find that the efficiency of the airline industry and the rate of occupancy of aircraft seats tend to increase and fares tend to decline if the regulatory and market environment is more sensitive to competitive pressures.

Marin (1998) documents the implications of airline competition for efficiency and airfares in the European internal market. He concludes that countries which signed liberal bilateral agreements and deregulated the airline industry early on became more productive due to more intensive competition and the implementation of tough adjustment processes by airlines. He also finds that the introduction of deregulatory measures is initially followed by short run reductions in efficiency but eventually leads to long run efficiency improvements.

92 European Commission (2001c) finds that countries having a high proportion of supermarkets in the distribution system tend to have higher prices.

Changes in demand, technical progress and regulatory reform have brought about a radical transformation of the ***telecommunications*** industry[93]. In an examination of the impact of regulation and market structure on productivity, Boylaud and Nicoletti (2001c) conclude that the liberalisation of entry, and even the announcement of liberalisation, has beneficial effects on productivity and prices in telecommunications.

The ***business services*** sector (here referring to services supplied to other firms, such as legal counselling, accountancy, consulting, computer services and marketing) in the European Union is highly fragmented along national borders and tends to retain a national identity. The fragmentation is amplified by obstacles to integration in the internal market, such as licensing regimes, prudential rules, company laws, access to financial services, employment law, professional qualifications, advertising laws etc. These restrictions on market access inhibit competition and lead to lower productivity and high relative prices.

III.4 Summary and conclusions

Services are the most important sector in our economies, accounting for some 70 % of all jobs and of GDP. The demand for services tends to rise faster than incomes, indicating a continuous increase in the share of services in the total economy. Many service industries are highly labour-intensive, with allegedly limited scope for raising productivity through investments in physical capital. Traditionally, productivity growth in services has indeed been slower than in manufacturing industries — though sectoral differences across service industries are large. Simultaneously, employment in services has increased at a faster rate than in other sectors.

Services will be the key to how overall productivity, employment and output develop in the future. Looking at market services only, one notes that between the first and the second half of the 1990s productivity growth decelerated in EU countries, while the United States recorded a strong acceleration of productivity growth. Similarly, in terms of employment growth, the US performance in market services was clearly superior to most of the EU countries.

Analysis of the individual sectors within market services in the European Union reveals very strong productivity growth in telecommunications in the late 1990s. In financial intermediation and in the transport sector, some — but not all — EU countries also recorded solid productivity growth rates. Productivity developed very weakly, and even declined in some countries, in the hotel and restaurant sector as well as in the wholesale and retail trade sector. The stronger performance of the United States in the aggregate market services productivity results from their very strong productivity gains in the wholesale and retail trade sector, which compare with weak growth on the European side.

For three sectors within market services, productivity growth seems to be negatively correlated with employment growth: hotels and restaurants, post and telecommunications, and transport and storage. For the other sectors, the evidence of correlation is less clear. For the sectors where a trade-off between employment and productivity growth seems to exist, one finds an upward shift in this relationship between the first and the second half of the 1990s: in the late 1990s, a given productivity growth rate seems to be associated with higher employment growth. This is likely to be result of the strong cyclical upswing in the second half of the decade.

To explain differences in productivity growth rates, many factors have been put forward. These include differences in the growth rates of investment, the adoption of ICT, organisational changes, human capital, liberalisation of product, labour and capital markets, R & D and innovation, and intellectual property rights. Many service industries are intensive users of ICT, and the introduction of the new technologies has led to fundamental changes in the production and delivery of services. Such changes are likely to led to increased productivity in the relevant services sectors, but problems in correctly measuring the output of those sectors may have hidden part of the productivity gains.

Innovations — introduction of new products, application of a new technology, organisational changes etc. — are an important way of boosting productivity. Innovation in services may be poorly captured by traditional measures such as R & D spending, since services innovations tend to be closely linked with the way in which the services are delivered, and may result from the interaction between the service supplier and the customer. Survey data nonetheless indicate that high-technology service firms, such as computer services and telecommunications, carry out innovative activities even more often than manufacturing firms.

93 For an overview of the implementation of regulatory reforms in the telecommunications sector in the EU, see European Commission (2001d).

Evidence on market liberalisation points to enhanced productivity and higher growth following liberalisation measures. Liberalisation, by increasing competition and making markets more responsive to change, tends to increase the speed of diffusion of new productivity-enhancing innovation across the economy. Many services sectors have traditionally been highly regulated, but the general trend in the past two decades has been towards extensive liberalisation and regulatory reform. Structural reforms put forward at the European Council meeting in Lisbon in March 2000 call for a continuation of this process. The creation of a genuine internal market in services is a major challenge for the European Union.

References

Baumol, W. J. (1967): 'Macroeconomics of unbalanced growth: the anatomy of urban crisis', *American Economic Review*, 57, pp. 415–426

Baumol, W. J. (1985): 'Productivity policy and the service sector', in R. P. Inman (ed.), *Managing the service economy: prospects and problems*, Cambridge University Press, Cambridge

Baumol, W. J., Blackman, S. and Wolf, E., (1985): 'Unbalanced growth revisited: asymptotic stagnancy and new evidence', *American Economic Review*, 86, pp. 806–817.

Boylaud, O. and Nicoletti, G. (2001a): 'Regulatory reform in retail distribution', in OECD *Economic Studies*, No 32, pp. 253–274

Boylaud, O. and Nicoletti, G. (2001b): 'Regulation, market structure and performance in telecommunications', in OECD *Economic Studies*, No 32, pp. 99–142.

Boylaud, O. and Nicoletti, G. (2001c): 'Regulatory reform in road freight', in OECD *Economic Studies*, No 32, pp. 229–252

Coombs, R. and Miles, I. (2000): 'Innovation, measurement and services: the new problematique' in J. Metcalf and I. Miles, (eds.), *Innovation systems in the service economy*, Kluwer Academic Publishers.

Dobson, P. and Waterson, M. (1999): 'Retailer power: recent developments and policy implications', *Economic Policy*, April, pp. 135–166.

EIMS (2001): Analysis of the CIS–2 data on innovation in the service sector, final report.

European Commission (2000a): European competitiveness report 2000.

European Commission (2000b): Services in Europe.

European Commission (2000c): Report on the functioning of Community product and capital markets, COM(2000)XXX, 24 January 2000

European Commission (2001a): European competitiveness report 2001.

European Commission (2001b): Statistics on Innovation in Europe.

European Commission (2001c): Report on the functioning of Community product and capital markets, COM(2001)736

European Commission (2001d): Seventh Report on the Implementation of the Telecommunications Regulatory Package, COM(2001)706

Fuchs, V. (1968): 'The Service Economy' *NYC*, Columbia University Press.

Gönenc, R., Maher, M. and Nicoletti, G. (2000): 'The implementation and the effects of regulatory reform: past experience and current issues', OECD Economics Department Working Papers No 251.

Gönenc, R. and Nicoletti, G. (2001): 'Regulation, market structure and performance in air passenger transportation', OECD *Economic Studies*, No 32, pp. 183–228, Paris.

Høj, J., Kato, T. and Pilat, D. (1995): 'Deregulation and privatisation in the service sector', in OECD *Economic Studies*, No 25

Howells, J. (2001): 'The nature of innovation in services' in 'Innovation and productivity in services', OECD proceedings, pp. 55–79

Licht, G. and Moch, D., (1999): 'Innovation and information technology in services', *Canadian Journal of Economics*, Vol. 32, No 2.

Marin, P.L. (1998): 'Productivity differences in the airlines industry: partial deregulation versus short run protection', *International Journal of Industrial Organization*, Vol. 16, pp. 395–414

McGuckin, R. and Van Ark, B. (2001): 'Making the most of the information age: productivity and structural reform in the new economy', The Conference Board, New York.

McKinsey Global Institute (2001): 'United States productivity growth, 1995–2000', Washington D.C., October 2001.

Nicoletti, G. (2001): 'Regulation in services: OECD patterns and economic implications', OECD Economics Department Working Papers No 287.

OECD (2000): '*The Service Economy',* Business and Industry Policy Forum Series, OECD, Paris.

OECD (2001): 'Regulatory Reform', OECD *Economic Studies* No 32.

Oulton, N. (2001): 'Must the growth rate decline? Baumol's unbalanced growth revisited', Oxford Economic Papers, 53, pp. 605-627

Pilat, D. (2001): 'Innovation and productivity in services: state of the art', in Innovation and productivity in services, OECD Proceedings, pp. 17–54.

Van Ark, B. (2001): 'The renewal of the old economy: an international comparative perspective', University of Groningen/The Conference Board (mimeo)

ANNEX III.1
Annex tables

Table III.A1: Sector composition of GDP, nominal value added at basic prices in 1999 (% of total)

	DK	D	F	I	NL	A	FIN	S	UK	US
			(a)	(b)				(c)	(d)	(e)
Agriculture	2.6	1.2	2.9	3.0	2.7	2.1	3.7	2.0	1.2	1.6
Industry	20.0	24.7	20.7	23.3	20.2	23.0	26.9	24.3	23.2	19.9
Construction	4.6	5.5	4.5	4.8	5.7	8.4	5.4	4.1	5.0	4.7
Business sector services	46.5	47.3	48.7	49.5	48.7	46.0	42.6	43.9	49.0	51.3
Wholesale and retail trade; repairs	12.9	10.4	10.0	13.3	12.9	12.8	10.4	10.2	11.7	15.1
Hotels and restaurants	1.8	1.3	2.7	3.4	2.0	4.0	1.4	1.5	3.1	0.9
Transport and storage	6.1	3.4	4.2	5.2	4.9	4.9	7.2	5.1	5.1	3.3
Post and telecommunications	2.4	2.4	2.2	2.2	2.5	2.2	3.0	2.8	2.8	3.5
Financial intermediation	5.0	5.0	4.6	5.8	6.2	6.4	3.1	3.5	5.9	8.3
Real estate, renting and other business activities	18.3	24.8	25.0	19.6	20.2	15.7	17.5	20.8	20.4	20.3
— of which, real estate activities	*10.7*	*12.1*	*12.3*	*10.9*	*8.2*	*8.7*	*11.5*	*12.3*	*9.1*	*10.1*
p.m. Business sector services excluding real estate	*35.8*	*35.2*	*36.4*	*38.6*	*40.5*	*37.3*	*31.1*	*31.6*	*39.1*	*41.2*
Community, social and personal services	26.2	21.4	23.2	19.3	22.7	20.4	21.4	25.6	21.6	22.6

Notes: (a) Other business activities includes 'sewage and refuse disposal'
(b) Real estate activities includes renting of machinery and equipment (M&Eq.)
(c) Data for 1998
(d) Data for 1998
(e) Excluding adjustment for statistical discrepancy; agriculture, forestry and fishing includes veterinary activities; industry includes 'sanitary and similar services'; wholesale and retail trade includes restaurants

Source: Calculations based on OECD STAN 2001 database.

Table III.A2: Sector composition of employment, number of employees in 1999 (% of total)

	DK	D	F	I	NL	A	FIN	S	UK	US
			(a)	(b)				(c)		(d)
Agriculture	1.8	1.4	1.7	3.3	1.6	0.9	2.0	2.8	1.3	1.7
Industry	18.1	23.9	18.0	26.8	15.8	21.6	23.1	19.0	17.6	14.6
Construction	5.8	7.2	5.5	5.3	6.1	8.6	6.5	5.1	4.6	4.9
Business sector services	36.8	38.0	39.5	30.9	47.3	41.7	33.5	33.8	47.4	46.2
Wholesale and retail trade; repairs	16.0	15.1	13.1	11.0	17.1	16.5	12.5	12.8	17.1	23.6
Hotels and restaurants	2.8	3.8	3.1	3.2	3.5	6.2	3.0	2.7	5.5	1.4
Transport and storage	4.5	4.1	4.7	3.8	4.3	5.7	5.1	4.5	4.1	3.3
Post and telecommunications	2.1	1.4	1.8	1.5	1.8	1.6	2.3	2.0	2.0	1.9
Financial intermediation	2.9	3.3	3.4	3.5	4.2	3.7	2.0	2.2	4.3	4.5
Real estate, renting and other business activities	8.4	10.2	13.3	7.7	16.4	7.9	8.5	9.4	14.3	11.5
— of which, real estate activities	*1.1*	*0.9*	*1.6*	*0.7*	*0.9*	*1.0*	*1.3*	*1.4*	*1.2*	*1.1*
p.m. business sector services excluding real estate	*35.7*	*37.1*	*37.9*	*30.2*	*46.4*	*40.7*	*32.2*	*32.4*	*46.2*	*45.1*
Community, social and personal services	37.6	29.4	35.3	33.7	29.2	27.1	35.1	39.3	29.2	32.6

Notes: (a) Other business activities includes 'sewage and refuse disposal'
(b) Real estate activities includes renting of machinery and equipment
(c) Total number engaged
(d) Agriculture includes veterinary activities; industry includes 'sanitary and similar services'; wholesale and retail trade includes restaurants

Source: Calculations based on OECD STAN 2001 database.

Table III.A3: Ranking of the share of innovators and labour productivity growth rates in 1995–99

	Post and telecoms[1]	Electricity, gas and water supply	Financial inter-mediation	Transport and storage	Wholesale and retail trade; repairs[2]	Rank correlation
GERMANY						
Productivity growth	1	3	2	4	5	0.70
Innovative activities	1	4	2	5	3	
FRANCE						
Productivity growth	1	2	4	3	-	0.40
Innovative activities	1	3	2	4	-	
UNITED KINGDOM						
Productivity growth	1	2	3	4	5	0.90
Innovative activities	2	1	3	4	5	
AUSTRIA						
Productivity growth	1	2	5	3	4	0.11
Innovative activities	1	5	3	3	2	
DENMARK						
Productivity growth	1		2	3	4	0.80
Innovative activities	1		2	4	3	
FINLAND						
Productivity growth	1	3	2	5	4	0.96
Innovative activities	1	2	2	5	4	
THE NETHERLANDS						
Productivity growth	1	2	5	3	4	0.60
Innovative activities	1	2	3	5	4	

(1) Innovation data are for telecommunications only

(2) Innovation data are for wholesale trade only

Source: Calculations based on OECD STAN 2001 database and on the Second Community Innovation Survey (EIMS 2001)

CHAPTER IV
Increasing synergy between the EU's enterprise and competition policies

IV.1 Introduction

Competition and modern enterprise policy are complementary parts of economic policy as a whole. Indeed, they are mutually reinforcing: a regulatory framework that upholds effective competition induces firms to enhance their efficiency and thus enables them to better survive in their markets. At the same time, measures aimed at further increasing competitiveness render possible a rise in the level of competition between independent market players. As a result, everyone, including consumers, benefits in many ways. First, competition at any point in time reduces price differentials, avoids waste of resources and ultimately leads to welfare maximisation. Second, dynamic competition between competitive firms increases the rate of innovation, creates product diversity that can better match consumers' preferences and raises the economy's rate of growth.

This chapter discusses the nature and the strength of the links between competition and enterprise policies and gives an overview of current issues and questions in debate. At the outset, Section 2 summarises the legal framework of the links between the two policies. Section 3 then assesses these links from an economic perspective. In particular, this analysis discusses the need to take into account a dynamic view. Section 4 compares the United States to the European approach and identifies a number of differences.

Building on these legal, economic and comparative considerations, Section 5 then discusses current issues in the three main areas of competition law: merger control, antitrust and State aid. A few concluding remarks complete the chapter (Section 6).

IV.2 Legal aspects of the link between the EU's competition and enterprise policies

IV.2.1 Principles embedded in the Treaty

Article 2 of the EC Treaty sets the overall objectives of the European Community by stating that:

'The Community shall have as its task … to promote throughout the Community a harmonious, balanced and sustainable development of economic activities … (and) a high degree of competitiveness'.

Article 3/EC sets out the common policies which should serve to accomplish this task. They include:

'*a system ensuring that competition in the internal market is not distorted (point (g)) … (and) the strengthening of the competitiveness of Community industry (point (m)).'*

Article 4/EC describes the principles on which the Community's economic policy shall be based. It mentions in particular that this policy shall be '*conducted in accordance with the principle of an open market economy with free competition.'*

The Treaty then goes on to postulate special contents for each of the two fields. As regards competition policy, the framework is set out in Articles 81 to 89/EC. In summary, it unconditionally outlaws cartels and abuses of a dominant position. However, other infringements of competition rules can be exempted if they deliver certain benefits to the economy. This possibility which exists both under Article 81(3) and Articles 87(2) and 87(3) reinforces the clear link between competition and enterprise policies.

Indeed, Article 81(3) provides that agreements can be exempted if these contribute to improving the production or distribution of products or to promoting technical or economic progress and allows consumers a fair share of the resulting benefit. Similarly, Article 87(3) gives the Commission the power to declare aid compatible if it enhances other Treaty policy objectives, such as regional development and industrial competitiveness.

The framework of enterprise policy is outlined in Article 157/EC under the title 'Industry'[94]. This article forges a structural link between the EU's enterprise and competition policy goals. Article 157(1)/EC expressly states that:

'*the Community and the Member States shall ensure that the conditions necessary for the competitiveness of the Community's industry exists'.*

It further states that their action must be '*in accordance with a system of open and competitive markets*'. Article 157(3)/EC on the one hand points out that all other EU policies shall contribute to the achievement of enterprise policy objectives and, on the other, that no enterprise policy measure should be introduced '*which could lead to a distortion of competition*'.

From a Treaty perspective, enterprise and competition policies are thus separate but interdependent policies which both contribute to the overall objectives of the European Community. In accordance with the Treaty the Commission should optimise the synergies between the two policies by contributing to achieving the objectives of enterprise policy in all of its other policies while refraining from measures which could lead to distortion of competition.

IV.2.2 The role of secondary legislation in influencing the link between competition and enterprise policies

Antitrust block exemptions based on Article 81(3)/EC

Article 81(3)/EC served as the legal basis for the adoption of individual exemptions as well as for the adoption of block exemption regulations, which were recently replaced or are currently under review[95]. These block exemption regulations provide for automatic exemptions of agreements between companies whose combined market share is below a percentage fixed in each block exemption, provided the other conditions set forth in these regulations are fulfilled. The Commission assumes that agreements, fulfilling the criteria of these block exemptions, can benefit from the exemption set out in Article 81(3)/EC. Companies therefore do not need to demonstrate that the positive effects on competitiveness compensate for any possible anti-competitive effects.

Merger regulation[96]

The merger regulation was adopted in 1989 in order to create a 'one-stop shop' that would facilitate the restructuring process of European industry and increase its competitiveness. This is expressed in Recitals 3 and 4 of the merger regulation:

'*Whereas the dismantling of internal frontiers is resulting and will continue to result in major corporate reorganisations in the Community, particularly in the form of concentration.' (Recital 3)*

'Whereas such a development (corporate reorganisations) must be welcomed as being in line with the requirements of dynamic competition and capable of increasing the competitiveness of European industry.' *(Recital 4)*

These considerations link the attainment of competition policy and enterprise policy goals. To achieve these goals, while maintaining '*effective competition in the common market',* the merger regulation provides for a strict competition test, inspired by Article 82/EC prohibiting abuses of dominant position. Article 2(3) of the merger regulation provides that a concentration needs to be assessed under the test of creation or strengthening of a dominant position as a result of which effective competition would be significantly impeded. In making this appraisal, the Commission shall according to Article 2(1)(b) of the merger regulation take into account *inter alia*:

94 Industrial policy was introduced in the EC Treaty in 1992. The detailed content of this policy had been outlined in a 1990 Commission Communication on 'Industrial Policy in an open and competitive environment' (European Commission 1990). This document explained that in a market economy, the pursuit of industrial competitiveness is a responsibility of companies. Public authorities should restrict themselves to the creation of a stable and predictable environment favourable to industrial activity.

95 Commission Regulation (EC) No 2790/1999 on 'vertical agreements', Commission Regulation (EC) No 2658/2000 on 'specialisation agreements', Commission Regulation (EC) No 2659/2000 on 'research and development agreements', Commission Regulation (EC) No 240/96 on 'technology transfer agreements', Commission Regulation (EC) No 1475/95 on 'motor vehicle distribution' and Commission Regulation (EEC) No 3932/92 on 'the insurance sector' are currently under review.

96 Council Regulation (EEC) No 4064/89 as complemented by Council Regulation (EC) No 1310/97.

'…the development of technical and economic progress provided that it is to consumers' advantage and does not form an obstacle to competition.'

In addition, Recital 13 states that:

'*Whereas it is necessary to establish whether concentrations with a Community dimension are compatible or not with the common market from the point of view of the need to maintain and develop effective competition in the common market; Whereas, in so doing, the Commission must place its appraisal within the general framework of the achievement of the fundamental objectives referred to in Article 2 of the Treaty.*'

These considerations show that the attainment of the objectives of the Treaty, in particular those of ensuring undistorted competition and achieving a high degree of competitiveness, is an important element of the application of the merger regulation.

State aid secondary legislation

Enterprise policy considerations necessarily have an influence in the field of State aid. Article 87(3)/EC permits the Commission, when examining a State aid measure, to derogate from the general prohibition on State aid in Article 87(1). Article 87(3)(c) in particular gives the Commission discretion to strike a balance between a certain degree of distortion of competition and the possible beneficial effects resulting from the aid to the enterprises or the industry. In this context, regulations, guidelines, communications and frameworks have been adopted to define the conditions under which aid can be found compatible with the common market and authorised.

This secondary legislation and 'soft laws' deal with horizontal aid (aid for SMEs, employment and training, aid for environmental protection, aid for the promotion of risk capital and aid for restructuring of firms), regional aid (including aid to deprived urban areas and aid for large investment projects) or aid to particular industries (such as synthetic fibres, motor vehicles, shipbuilding, steel and coal). A further regulation defines *de minimis* measures, which are held not to affect trade between Member States and therefore not to constitute aid in the sense of Article 87(1). In defining which conditions should apply for an aid to be considered compatible, and in particular intensity ceilings for State aid, the Commission is necessarily making choices which have an impact on enterprises and on the decisions of economic operators. The nature of the sector concerned may have an impact. For instance, the existence of excess capacities in the market in which the beneficiary enterprises are operating is bound to be taken into account in assessing whether aid to create new capacity can be allowed or to restructure an enterprise which would otherwise go out of business.

IV.3 Economic aspects of the links between competition and enterprise policies

IV.3.1 Economic principles underlying the Commission's enterprise and competition policies

Economic rationale behind enterprise policy goals

The Commission's enterprise policy is primarily based on four closely linked principles: encouraging entrepreneurial activity, promoting small and medium enterprises (SMEs), fostering innovation and keeping markets open[97]. The entire business environment should be oriented towards enabling enterprises to strengthen their competitiveness and to grow and develop in a way that is compatible with the goal of sustainable development. This approach not only helps to define clear targets for enterprise policy. It also serves to identify areas where market failures exist and where further substantial progress is needed. These include the completion of the internal market, the improved availability of finance for small, new and innovative enterprises, an adequate regulatory and administrative framework and a climate more supportive to entrerpreneurship and innovation.

Specifically, this approach points towards the promotion of all enterprises (not only industry), towards keeping in mind the needs of all the different sizes and types of firms and towards stressing the dynamic features of the economy. A sound economy needs a spectrum of enterprises of various sizes, as each has its specific comparative advantages in the process of generating and diffusion organisational and technical change. In addition, the evolutionary argument holds true that the existence of a large set of different enterprises, all of which act independently and follow their individual objectives, implies that unexpected changes in the economic environment or radical novelties will less likely be able to destabilise the economy. In fact,

97 See also European Commission (2000a).

the opposite holds true: Diversity of enterprises increases the likelihood that some firms will benefit from new market opportunities that emerge when parameters in the economic system change. They will thus grow and challenge formerly big firms, a process which benefits competitiveness and competition.

This widened focus renders it indispensable to understand that enterprises can both be market incumbents and potential new entrants, i.e. firms that are currently active in a market and firms that might be so only in the future. This latter point is an essential ingredient of any dynamic perspective.

The competitiveness of enterprises is closely linked with these efforts at deepening the internal market. The causal relationship works both ways. On the one side, strengthening the Internal Market creates new business opportunities for European companies and therefore gives incentives to innovate and compete. On the other side, any improvement of firms' competitiveness fosters a market dynamic that increases the pressure to reduce trade barriers and to create a genuine level playing field. In other words, the strengthening of competitiveness and the completion of the Internal Market are mutually reinforcing goals.

New ways of organising production processes and new forms of distribution — often, but not necessarily, forming part of the knowledge-based economy — push towards enlarged markets, reduce obstacles to trade and take up market-based solutions, which are hard for regulators to foresee. Any enterprise policy that is to keep pace and go with the grain of these developments needs to build upon a dynamic, process-oriented approach.

Enterprise policy tries to attain a spectrum of objectives, and it does so with an elaborate toolbox. Most enterprise policy goals are closely entwined with competition policy objectives. The question arises to what extent the economic rationale behind competition policy is similar and where differences occur.

Economic rationale behind competition policy goals

Like enterprise policy, competition policy *is one of the pillars of the European Commission's action in the economic field*[98]. While competition is not the *single ultimate* goal of EU economic policy, this policy is built on the principle of '*a system of open and competitive markets'*[99]. Competition is thus considered as a fundamental principle, which enables the EU economy to achieve the optimum allocation of resources and the highest possible welfare. The principle of an open market economy does not, however, mean blind faith or indifference towards the operations of market mechanisms. It requires, on the contrary, constant vigilance aimed at preserving those mechanisms.

The economic rationale behind this competition policy approach is built around three basic assumptions.

First, competition stimulates economic activity. Already in 1972, the Commission explained in its first competition report:

'Competition is the best stimulant of economic activity since it guarantees the widest possible freedom of action to all. An active competition policy makes it easier for the supply and demand structures continually to adjust to technological development. Through the interplay of decentralised decision-making machinery, competition enables enterprises continuously to improve their efficiency … Such a policy encourages the best possible use of productive resources for the greatest possible benefit of the economy as a whole and for the benefit, in particular, of the consumer.'

Second, competition policy serves the purpose of achieving a genuine Internal Market, without competition distortions from companies and from Member States. For antitrust, the Commission only assesses agreements *which may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the common market* (Art. 81(1)/EC). As regards State aid, the Commission can challenge aid granted by Member States when such aid is likely to distort competition and trade within the EU.

Third, competition policy needs to adapt constantly to reflect the reality of new markets and business practices. It therefore must take a dynamic view which aims at assessing the transformation and restructuring of European industry on a forward looking basis in order to protect 'effective competition', as required by the Treaty.

98 European Commission (2000b).

99 Article 4/EC.

IV.3.2 The links between enterprise and competition policies from an economic perspective

From a general economic perspective, there exists no *a priori* reason for conflict between competition and enterprise policies. They are both cornerstones of the EU policy framework for achieving high and sustainable productivity growth, for that growth depends on a regulatory environment that enables enterprises to access new markets and to turn inventions into innovations. Thus the Lisbon goal calls for policies that establish an environment conducive to enterprise growth and innovation while ensuring that the market players are subject to uniform rules. Enterprise policy focuses on the first objective, while competition policy emphasises the second. But both policies contribute to high and sustainable productivity growth. Effective competition does so by inducing firms to search for efficiency-enhancing solutions that lead to product and process innovation. Enterprise policy does so by correcting market failures and enabling more firms to engage in market transactions, thus increasing the population of potentially innovative firms.

The nature and the practical application of each policy have their own emphasis that need to be balanced in the decision-making process of the Commission. The following examples underscore this point.

(1) Proper product and geographic market delineation, is crucial for competition decisions. This is so because it makes it possible to calculate market shares that convey meaningful information regarding market power. In most cases, it is obvious that the broader the market definition, the less likely it is that anti-competitive concerns will arise. While market definition is not required for enterprise policy, its instruments — such as internal market legislation, standardisation and benchmarking — may speed up changes in product and geographic market structures which should be reflected in finding the appropriate market delineation for competition purposes[100].

(2) Enterprise policy emphasises the need to foster innovation by creating widespread and closely entwined knowledge pools, which in particular help to raise the R & D potential of SMEs. From a competition perspective, certain cooperation agreements may imply anti-competitive behaviour such as market foreclosure or hampering rivals' innovation capability.

(3) Concentrations and cooperation agreements between enterprises have the potential to increase productive efficiencies and thus competitiveness. For instance, merging firms may be able to benefit from economies of scale and scope and from combining complementary technologies. Moreover, lower costs may modify market conditions so as to make collusion less likely. Most cooperation agreements are not problematic for competition and benefit from exemptions under Article 81(3)/EC relating to efficiency considerations. The large majority of mergers is also cleared under the merger regulation without revealing any competition problem.

(4) Technological development and innovation, the drivers of increased productivity, are by their nature uncertain. Assessing their effects for future market dynamics and for future competitive conditions is a permanent challenge. Competition decisions can take such developments into account to the extent that their consequences can be predicted with sufficient certainty. By doing so, the Commission raises to the challenge of going beyond static snapshots of market structures at a fixed point in time and beyond extrapolation of past behaviour.

(5) Overall reduction of State aid to a minimum is a generally agreed objective in light of their potential market distortion effects. Yet, market failures occur and justify targeted state interventions at a European, national or regional level. A balance between State aid control and overcoming market failures needs then to be struck.

Both policies are also faced with the same challenges, which are presented in the context of the knowledge-based economy and the emergence of new forms of production and distribution within the digital economy. The past years have witnessed the emergence of many new sectors which centre on technological breakthroughs (examples are information processing or biotechnology). In addition, new ways of distributing products have come into existence (e-commerce). The recent economic literature explains the mechanics behind these developments and gives useful insights[101]. Key aspects that are highlighted

100 Commissioner Mario Monti stressed this recently: 'The opening up to competition of markets as a result of European Union liberalisation efforts or harmonisation resulting from European Union harmonisation directives will normally result in the widening of the scope of markets at some point in time. The telecommunications sector offers a very god example of the above as regards both equipment and services'. Monti, M. (2001a).

101 For instance, see: Luis Cabral (ed.) (2000); Wolfstetter E. (1999).

include, for instance, the need to find a compromise between the openness of markets and the optimal flow of information within knowledge networks. In this context, the question of voluntary standards also plays a role. As regards network industries in general, the economic effects of first-mover advantages and path-dependent processes have to be carefully examined from a long-term perspective, which takes the different phases of the market evolution into account. Furthermore, it is important to ensure that companies do not leverage old monopoly rents into new markets — a concern to both enterprise and competition policies.

All these insights point towards the dynamic aspects of market evolution, knowledge creation and innovation. They call for sound economic reasoning as a basis for both enterprise and competition policy. This requirement is now being understood more and more. In competition policy, it provides the impetus for the ongoing regulative reforms which adopt a more economic and dynamic approach to competition.

IV.4 The US approach to links between competition and enterprise policies

IV.4.1 Key comparisons

A growing convergence between EU and US competition policies

There are a number of institutional and substantive differences between EU and US competition policies that are described below. However, it is worth emphasising that overall there has been an increasing convergence between the EU and US systems of competition law and practice[102]. The convergence is taking place both in the economic analysis of competition issues and in a growing number of substantive and policy issues, such as the enforcement priority given to tackling cartels. EU and US competition policies pursue very similar objectives, with the exception that EU competition policy is also an instrument to achieve a genuine European market without internal frontiers[103]. The differences described below, however, rarely lead to significantly different economic outcomes and potential conflicts.

102 See: Monti M. (2001b).
103 Jacquemin A. (2000), p. 19.

Different institutional settings and material differences

The links between competition and enterprise policies in the United States take place in an institutional framework different from the EU landscape. Competition policy is pursued by federal authorities of which the main are the Federal Trade Commission (FTC) and the Department of Justice (DOJ) as well as an extensive three-level system of federal courts. Competition policy is also pursued by State authorities (most often State Attorneys-General and State courts). Different federal authorities also play a significant role in pursuing industrial policy[104], either as part of the economic policy they pursue (Department of Commerce) or as a 'side policy' alongside their core policy (NASA, Department of Defence, Federal Communications Commission and Federal Energy Regulatory Commission). A switch of government permits the appointment of new chairpersons to these federal authorities and thus may lead to changes in the application of industrial and competition policies.

Because of this different institutional setting, mergers in several specific sectors (such as banking, airlines and offshore oil production) are subject to the review of more than one federal body or agency, some of which may have opposing policy objectives[105]. Moreover, US antitrust agencies are exempted from publishing reasoned decisions when they clear mergers without remedies. This may facilitate a consideration of arguments other than those based on pure competition policy.

In the EU, as regards competition policy, the Commission currently has exclusive jurisdiction to handle anti-competitive practices that affect trade between Member States. Concerning mergers, the Commission must adopt and publish reasoned decisions in all cases, even cases that are 'simple' from a competition point of view as they clearly do not pose any competition problems.

As regards mergers, from a procedural point of view, the US merger control system differs significantly from the EU system because there are no fixed deadlines within which difficult cases need to be approved. The second request phase is indeed not limited in time whereas an EU second-phase investigation is limited to four months, giving timing certainty to merging parties.

104 The term 'industrial policy' is used in this section instead of 'enterprise policy' because the latter concept is unknown in the United States.
105 Example: The acquisition of control in spring 2001 by the Dutch company ASM Lithography over the Silicon Valley Group was nearly blocked for US security defence reasons.

In competition matters, the decision-making process is also slightly different from the EU process. The two federal authorities have some administrative powers but, before contesting any merger, agreement or practice, must seek approval of their decisions by independent federal courts that review the evidence and arguments which they submit in an adversarial procedure where the companies concerned are involved on an equal footing. In the European Union, the European Commission has exclusive powers, as administrative authority, to decide on mergers reaching certain turnover thresholds and on agreements or concerted practices affecting trade between Member States. All the Commission's decisions, however, are subject to judicial review by the European Court of Justice.

It is notable that in merger control the US authorities rely on the concept of 'substantial lessening of competition' (SLC-test) for the appraisal of notified concentrations, as opposed to the dominance test used in the European Union. On the one hand this test allows to capture more anti-competitive effects when compared to the dominance test because no finding of single or collective dominance is required to show a significant lessening of competition. On the other hand, this test allows the competition authorities to consider the benefits of concentrations for customers. While in practice, differences seldom occur, it is not guaranteed that the US SLC-test and the EU dominance test always come to the same conclusions. In borderline cases, different outcomes might result. For this reason, the Commission has invited comments on the merits of the respective tests in its Green Paper on the review of the merger regulation.

Subsidies are outside the scope of US competition policy

In the US, subsidy control is not considered to form part of competition policy, whether granted by federal authorities or individual States. There are no rules in the United States to control subsidies other than the WTO rules and the general constitutional limitations, which are much less strict than those within the European Union, and there is no supervisory authority in charge of monitoring State aid. In addition, key types of subsidies to enterprises, such as for R & D, are mostly federal[106] in the United States whereas the bulk of State aid in the European Union is granted by Member States.

Under EU competition law, the Commission can challenge State aid granted by Member States when such aid is likely to distort competition and trade within the European Union. This reflects the scope of EU competition policy, which addresses competition distortions caused by the actions of Member States and not just economic operators. One of the specific features of the EU system is the transparency in the administrative review procedure when the Commission decides to open a full investigation. No equivalent system exists in the US.

IV.4.2 Beyond the conventional free market view: some key US Government supporting measures to businesses

At first sight, the US economy is run as a *free market*, and the federal and States governments do not support industrial and commercial sectors. In most cases, this is doubtless true, but it is not the case with strategic sectors. As mentioned above, subsidies are not dealt with at all under US competition laws.

Typically, US subsidy policy is oriented towards strategic industrial sectors. From an EU perspective, we can focus on two topics of particular interest: (1) SMEs and venture capital, and (2) R & D.

In addition, although this subject is outside the scope of this chapter, these subsidies are often combined with protectionist measures, such as the Buy America Act (1933) and similar State legislation, and the Small Business Act (1953), and with national security policies which contribute to the support given to these economic sectors[107].

SMEs and venture capital

For promoting innovative American SMEs, US SBIR[108]/STTR[109] is *the most important source* of high tech-based venture capital funding in the United States (especially for inventors, new start-ups and early-stage, small businesses). In addition, public support to US venture capital industry is widespread, mainly through the Small Business Investments Company Program (SBIC) of the public Small Business Administration (SBA) which, at relatively low cost and in contrast to more 'direct' financing mechanisms, provides guarantees to financial institutions

106 It should be noted that individual States and cities can grant very large incentives to individual businesses to attract new investment projects.

107 See European Commission: *United States Barriers to Trade and Investment*.

108 Small Business Innovation Research USD 1.2 billion program to provide grants (no pay back required) to small US business for R & D of commercialisable concepts.

109 Small Business Technology Transfer (same as SBIR except cooperation with a not-for-profit R & D institution).

which lend to venture capitalists and thereby enables a leverage of considerably higher levels of funds than such investors could themselves provide[110]. In 1999, around 70 % of all new companies in the United States which received venture capital funds were co-financed by SBIC (providing 10 % of the total volume of VC investments). They thus obtained publicly-leveraged funds, with a special focus on high-tech companies. The United States' early investment spurred by public funds in technological SMEs contributed to the US lead in early stage venture capital and to overall US lead in high-tech venture capital.

R & D

In the field of R & D, US policy is to subsidise industries that are considered strategic. This applies in particular to the aerospace and electronics industries, but has been used in other sectors as well, such as the car industry, when a technology gap with competitors existed.

— The *aerospace industry* is the most striking example of such a deviation from the non-intervention theory. It is now widely admitted[111] that America's historic dominance in commercial aerospace, and particularly the large commercial aircraft sector, arose on the back of defence technology paid for by the US Government. The analysis of federal policy for large aircraft industry shows that, in the past, US companies derived benefits from a vast amount of public expenditures in the field of R & D activities, both from the NASA[112] budget and the Department of Defence (DOD)[113] budget, from which they received more than 70 % of their R & D expenses.

— The *electronic industry* and especially the semiconductors industry is also considered a strategic industry that needs a large support to maintain and strengthen the position of US enterprises in the global market. A lot of funding sources could be identified, but it is possible to focus on two main issues, the Sematech[114] Program, and the funding provided by DARPA[115]. It is also common knowledge that the Internet started in 1970 as a communication network among research institutes, the development of which was entirely funded by the DOD. Even if it can be argued that there is also a public funding of research in the EU, within national schemes or the FPRD, the level of funding is not the same and the difficulties of coordination can lead to a dispersion of effects. Furthermore, FPRD is more oriented to fundamental research than DARPA funding or Sematech objectives, which seem to be clearly pre-competitive and competitive development-oriented.

IV.4.3 The importance of international cooperation

The brief overview of the nexus between competition and enterprise policies in the United States makes it clear that there are some differences when compared to the European Union. In addition, a growing number of other countries have adopted competition rules. As more and more commercial transactions are falling within the jurisdiction of more and more countries, there is an increased risk of inconsistent outcomes and conflicts. In order to avoid these, the Commission must continue to strengthen the ongoing bilateral and multilateral initiatives covering competition policy and related economic policies, such as between the European Union and the United States, on the one hand and under the auspices of the WTO or the International Competition Network on the other hand[116].

IV.5 Current competition issues of interest to enterprise policy

IV.5.1 Mergers

The Commission currently intends to review and clarify to the business community its merger policy

110 The SBIC program was launched in 1958, SBIR was created in 1982.
111 See for example the Senate Armed Service Committee 1997 report.
112 NASA funding for R&T is officially justified by the inability or unwillingness of private companies to provide sufficient funding to R&T. NASA aeronautics expenditure (1992/1997) was USD 7.3 billion of which some USD 3.5 billion subcontracted to US aerospace industry. USD 3.1 billion had clear civil or dual use applicability; Lawrence (2001).
113 There is also much dual use between military and civil aeroplanes in a lot of technological fields where military technologies have spin-off potential. For example, Mr Condit (CEO of Boeing) confirmed that design tools developed for the JSF program will be used on new civil programs (Sunday Times, 12/06/00).DOD subsidies to US large aircraft manufacturers through dual use technologies have been estimated at some USD 550 million per year in 1992–1997; Lawrence (2001).
114 Federal support to US high-tech through programs such as Sematech do not appear to be in line with the WTO Subsidies Code. Sematech, formed in 1987, by the government and major US semiconductors companies aimed at improving the technological capabilities of US suppliers of semiconductor manufacturing equipment and to strengthen vertical collaboration between manufacturers and suppliers. US government spent 100 million dollars a year for seven years in Sematech.
115 DARPA (Defence Advanced Research Program Agency) has planned to invest more than USD 641 million on the advanced electronics technology program and USD 860 million on the materials and electronic technologies program for fiscal years 2000–02. The sub-programs include clearly dual-use technologies as manufacturing technology applications, advanced lithography, MEMS and integrated Microsystems technology.
116 See, e.g., OECD (2001); Council of Economic Advisers (2002).

in the framework of the Green Paper on the review of the merger regulation. It also reflects on providing an explanatory notice on (collective and single) dominance.

Are mergers effective in achieving optimum size?

Merger proposals are invariably supported by claims of efficiency as a result of large-scale production or large-scale distribution and marketing, enhancing, in this way firm competitiveness. However, internal (organic) expansion is often a more certain way of benefiting from scale economies than acquisition and more likely to be solidly based on long-term efficiency gains and innovation. In contrast, mergers as compared with internal growth are often just an easy way of gaining positions of market power without necessarily any accompanying efficiency gains.

But mergers may bring certain advantages relative to internal growth. First, mergers offer an opportunity to adapt, in a short period of time to a changing competitive environment. In fact, although mergers have increased industrial concentration, they often do not lead to permanent increases in market power. In part this is due to a simultaneous increase in international competition. Second, mergers allow firms to avoid part of the uncertainty and risk associated with the large investments required to be competitive in a global scale.

Moreover, when firms have to grow in size to become competitive on a larger geographic market, they may find it more feasible and efficient to merge with a company originating from the same country. This is linked to considerations such as geographical proximity of production sites, common language, and common business culture. Such mergers generally do not create competition problems if the geographic market is wider than national. Market definition is linked to the integration of European markets. The faster the trade barriers fall and EU markets become integrated, the easier it will be for companies to consolidate, even domestically[117]. Domestic mergers can, in some cases, create pan-European companies that may have the potential to further foster the internal market development. Where domestic mergers raise competition concerns in markets that are not yet integrated, these concerns may be alleviated by adequate remedies that contribute to the successful development of the internal market.

More generally, mergers that allow a more efficient combination of assets will enhance the competitiveness of the merging firms leading to increased competition and ultimately consumer welfare gains. Competition policy has recognised this with the merger regulation, which offers a one-stop shop to facilitate industry restructuring. However, a debate is necessary as to whether verifiable efficiency gains resulting from a proposed merger can offset any price increases or other negative effects caused by the creation or strengthening of a dominant position. Raising to the challenge, the Commission has launched a debate on this issue, in the context of the Green Paper on the review of the merger regulation. This process will shed light on the treatment of efficiency gains.

Is merger policy SME friendly?

As regards SMEs, the objectives of enterprise and competition policy are almost perfectly aligned. Indeed, the beneficiaries of an efficient merger policy are frequently other enterprises, quite often SMEs, as customers of the merging firms. In this respect merger control provides a powerful tool to safeguard and protect the competitiveness of smaller firms by preventing price increases of intermediate inputs resulting from a dominant position acquired after an upstream concentration.

Moreover, both policies are equally concerned with the fact that mergers have sometimes been important historically in creating positions of market dominance. Also, there is much evidence to show that dominant firms have substantial advantages over new entrants and small competitors. These advantages are related to factors such as complex technologies, financial power, access to distribution channels and customer attachments. Theory does not give clear guidance on the extent to which these advantages should be condemned. But empirical evidence confirms that view that SMEs, which are unable to compete with a dominant firm are likely to be forced to exit the market. All efforts in promoting the creation and development of SMEs are likely to be ineffective in a competitive environment dominated by large incumbents.

Furthermore SMEs often provide a source of potential competition to a large dominant incumbent. In such circumstances, it must be acknowledged that the preventive takeover by a dominant firm of a much smaller competitor, even if it does not lead to a substantial change in market concentration, may reduce the future competitiveness of the industry by eliminating the possibility that the small

117 Monti (2001a).

acquired company would, in the future, be in a position to challenge the large dominant firm.

Does merger policy hinder the rationalisation of declining industries?

Occasionally the Commission has acknowledged the different competitive nature of declining industries in its merger decisions. As it is well known, declining industries engage in a sort of prisoners' dilemma exit game. The question of who goes out first is a difficult, and irreversible, strategic decision. Even when it is clear to all market participants that a market is in decline, each firm may decide not to exit or reduce capacity, expecting that a rival will be the first one to do so. In such circumstances, there may be persistently low returns and little innovation in the industry over long periods. The usual signs are chronic over-capacity and low profitability.

Outside intervention may be needed to implement a program of rationalisation to ensure orderly exit. Such a process may rely heavily on mergers to reduce the number of competitors and excess production capacity in the industry. Merger policy does not stand in the way of such a restructuring, provided that the process of concentration does not lead to the creation of a dominant company. Such an end-result should be avoided, both from a competition policy and enterprise policy point of view, as it is well known from economic theory that, even in declining industries, positions of excessive market power may persist over a long time to the detriment of customer, often enterprises from other industries, and final consumers alike.

However, there is a debate on whether the criteria used to exempt an anti-competitive takeover involving a failing firm should explicitly acknowledge the competitive conditions of declining markets and the benefits to consumers of rationalisation.

Do merger rules endanger innovation?

Few economists doubt that dynamic-efficiency gains from continuing innovation far outweigh the static gains from marginal-cost pricing. Thus, it has been argued that in markets where innovation is frequent, monopoly rents will be constantly eroded as new products and processes are introduced. In attempting to determine whether innovation will be harmed or promoted through a merger, it is necessary to first understand the likely sources of innovation in the relevant sector and subsequently to decide whether the merger changes the rate or type of innovation.

On the one side, there are instances where R & D investment is largely redundant and, after a merger, some of those resources could be put to better use in other fields. It is also possible that merger efficiencies could free up resources to be used for R & D. Combining innovators also may be beneficial when the different innovation strategies being pursued are complementary, so that a combination of the two would create a better final outcome. On the other hand, reducing the number of firms reduces the likelihood of achieving the most effective outcome. Several competing research programs increase the likelihood that at least one firm or group of firms will innovate successfully. In the uncertain realm of R & D, some redundancy may be optimal from a social welfare standpoint.

In conclusion, there is an ambiguous relationship between industrial concentration and the rate of effective innovation. Determining what the combined effect of mergers will be on both factors is a difficult and challenging task for both merger and enterprise policy. Therefore a fluent and continuous dialogue is required to assure policy consistency.

Are merger remedies a tool to influence industry structures?

Mergers that are deemed anti-competitive may be ultimately authorised if the merging parties enter into commitments vis-à-vis the Commission with a view to remedy the competition concerns raised by the proposed merger. The Commission typically informs third parties — customers and competitors — about the remedies offered by the merging parties and enquires their views on the competitive impact of these remedies before granting its approval. Despite the important role played by replies from third parties, it is the Commission's responsibility, as competition authority, to decide which remedies are appropriate to approve the relevant merger.

Such a decision goes far beyond the binary decision to approve or prohibit a merger. It must take into account the structural or behavioural nature of the proposed remedies and many other factors, which aim at restoring conditions for effective competition. Predicting with reasonable certainty which elements will restore competition after a structural reallocation of productive assets is quite a complex exercise. The coordination mechanisms of the Commission are there to ensure that competition policy makes full use of enterprise policy expertise in evaluating the short and long-term impact of proposed remedies in order to avoid demanding

disproportionate commitments or accepting inadequate and unworkable remedies to an otherwise anti-competitive merger.

The Commission has published a notice[118], which sets out the requirements for an effective remedy, and which assists companies in formulating adequate proposals to remedy competition concerns raised by a merger.

Merger control and defence-related industries

The application of competition policy to defence-related industries is a challenging matter. The EC Treaty allows Member States to take measures necessary for the protection of their essential security interests which are connected with the production of, or trade in, armament, provided that such measures do not adversely affect the conditions of competition in the common market regarding products which are not intended for specifically military purposes.

Challenges are linked to competition problems for industries active in upstream markets, for the whole supply chain, for Member States that do not have any significant defence industry and as regards spill-over effects on non-military products.

IV.5.2 Antitrust

General remarks

Striking the right balance between the competition and competitiveness goals is a particularly challenging task for antitrust analysis, as many practices may restrict competition to some degree but also create efficiencies. Moreover dominance of firms — and its resulting potential for abuse — may be, under certain market conditions, a transitory phenomenon. Moreover, firms that have a dominant position do not per se abuse that position.

To strike the right balance, the Commission is rebuilding the legal framework in a way that gives greater weight to economic reasoning. The new block exemption Regulations for horizontal and vertical restraints, the corresponding guidelines, and the new 'de minimis' notice are all based on an economic approach which focuses on the impact of an agreement on the market and not on its form. They are also open to dynamic arguments, in which the competitiveness goal of enterprise policy and the competition policy goal meet.

118 European Commission (2001).

Enterprise policy is not only about economic contents, but also about formal aspects, such as legal certainty for firms. Indeed, legal certainty becomes an economic issue itself if the lack of it induces companies to curb their investments, because they can foresee less clearly how their activities might be regulated. Thus, the rebalancing of legal versus economic issues needs to be limited where legal certainty falls below a critical threshold. Therefore measures — such as explanatory guidelines and dissemination of information — are taken by the Commission to make sure that problems do not emerge in this regard.

Current antitrust issues affecting the link between enterprise and competition policies

Some of the concrete issues currently debated within antitrust will have a particularly strong effect on the link between enterprise and competition policies.

(1) The modernisation of Regulation No 17 will replace the current notification system by a system of legal exception. Under the new framework, greater freedom to act, but also greater responsibility will be allocated to enterprises. They need not notify certain agreements any more in advance but have to check themselves if their actions violate competition law. This will help to avoid time-consuming administrative procedures, but will also increase the necessity for rules guaranteeing sufficient legal certainty. In this context, emphasis must be also on the coherent application of Community law.

(2) The review of the Transfer of Technology Block Exemption Regulation (TTBER), which has recently started, will redefine the balance between intellectual property rights (IPRs) and competition policy. The central aim is to find an appropriate and endurable equilibrium between both. Cooperation among firms and the creation of knowledge networks take more and more complex forms, many of which are unproblematic from a competition perspective or cannot be regulated (such as information flow via observation effects in clusters or via exchange of personnel). Nevertheless, other issues, such as pre-emptive patenting or the creation of closed knowledge pools, can facilitate foreclosure of markets or prevent innovation by competitors.

(3) Many systems of distribution, particularly in e-commerce, currently undergo rapid change, and new forms of advertising and merchan-

dising products lead to new solutions, which are hard to predict *ex ante*. In many circumstances, new entrants are the drivers of such changes, as their activities increase market efficiencies and foster innovation and competition. Provided that such welfare-enhancing effects exist, the interests of new distributors have to be taken equally into account within legislative reforms as those of more traditional operators.

(4) The special situation of SMEs has already in the past been a cornerstone of enterprise policy. This will also hold true for the future. For instance, the envisaged modification of the definition of SMEs takes into account the sustained need to give special protection to these enterprises, which often are particularly innovative and which generate new employment to a significant degree. This has also been realised in the reform of the de minimis rules, which clearly reflect the fact that SMEs will normally be unable to perceptible affect trade or diminish competition. In addition, SMEs have a special interest in participating in information-sharing agreements, so that they can accumulate knowledge that is internally available in larger enterprises. To sum up, therefore, SMEs have been and should also in the future be assessed differently from larger enterprises, not the least in competition policy.

IV.5.3 State aid

General remarks

The Commission has identified certain objectives for which State aid can be authorised. These include horizontal objectives, notably those where aid addresses market failures. Identifying and addressing such market failures is also an objective of enterprise policy. It is widely recognised that general market failures exist in areas like R & D, SMEs financing and investment in environmental protection beyond legal standards. But for large amounts of aid granted to single companies or for aid granted in sensitive sectors, the case for the existence of market failure is much weaker and aid is normally granted for other reasons, including for social or equity reasons. In these circumstances, striking the right balance between competition, competitiveness and other goals is a particularly challenging task, as the economic and industrial analysis can always be challenged. This is generally the situation in sectors facing over-capacity or declining markets, where the distortions caused by State aid are likely to be more severe and for which stricter rules of control therefore have to be applied.

The Stockholm European Council underlined the relatively high level of aid in the European Union and called for its reduction. But, from an economic point of view, not all aid is the same. Some categories of aid cause more distortion than others. This fact is already recognised in the State aid rules, for example through the more generous aid levels allowed for training, R & D and environmental protection. The same type of aid may be justifiable in some sectors and create adverse effects in others. For instance, investment aid may be justifiable in rapidly growing sectors but not in sectors in absolute decline.

Current State aid issues affecting the link between enterprise and competition policies

From the enterprise policy point of view are of particular interest:

(1) While subscribing fully the overall objective of reducing State aid, there is equally a necessity to render State aid instruments more effective in overcoming the associated and accepted market failures. This can be achieved by examining the efficiency of aid measures from a macro- and a micro-economic perspective and by convincing Member States to initiate benchmarking exercises of their various State aid regimes. The experience and methodologies of benchmarking enterprise policies is very relevant in this context. While the justification for State aid rules must always be essentially the control of distortion of competition, the Commission could when reviewing State aid rules have a more favourable attitude towards aid regimes which can be shown to be likely to be more effective.

(2) There is a growing gap between R & D expenditure in Europe and its main competitors. From the enterprise policy point of view, R & D is not an area where reduction of aid should be endeavoured. Moreover, in the future the use of the linear approach of innovation could be questioned, as the innovation process in enterprises is becoming more and more a continuous one, involving interactions between all fields of research.

(3) Another key question refers to the market failure in the area of SME financing particularly as regards the availability of equity capital. The level of financing of start-up and the early

stages of innovating SMEs in the European Union (both in new high-tech sectors and in traditional sectors) is far behind the United States[119]. One of the main market failures which enterprise policy wants to address is to create the conditions to bridge this gap, and the Commission has made it clear that the philosophy underlying the strategy for developing the EU risk capital market attributes primary importance to the creation of an environment favourable to creating and sustaining new and innovative businesses, through structural and horizontal measures. In addition, however, the Commission has recognised 'a role for public funding of risk capital measures limited to addressing identifiable market failures'. The Commission has recently established new criteria enabling State aid measures for the promotion of venture capital to finance the start-up and early stages of SMEs, in its communication on State aid and risk capital. The next step will be to evaluate to what extent this and other instruments have permitted an acceleration of entrepreneurial activity.

(4) One of the recurring issues in competition and enterprise policies is the existence of so-called 'sensitive' sectors, i.e. sectors suffering from structural over-capacities or declining markets. The traditional State aid approach is to consider these sectors as specific and to address their problems by specific State aid codes which are stricter than the general rules. The new State aid approach is to merge all such sectoral codes and to treat these sensitive sectors in a coherent way, recently decided upon at the occasion of the new so-called 'multisectoral' framework[120]. Whenever a Member State wants to give large amounts of regional aid to very big investment projects, the Commission will examine under this framework the impact of such projects on the market concerned. However, the Commission still needs to resolve the selection of sectors to be regarded as sensitive, and the size of the investment projects from which a reduction of aid should apply by reference to the normal regional aid ceilings. Good knowledge and data concerning particular industries is of key importance both in determining and in defending this list.

(5) Finally, the EC Treaty explicitly provides for the possibility to approve State aid to projects that present 'common European interest' (Article 87(3)(b)). Case-law has been developed on how to apply this Treaty provision to R & D projects. Projects of common European interest can by their nature have a positive impact on innovation and competitiveness at EU level.

IV.6 Concluding comments

The overview of the interactions between the competition and enterprise policies of the European Union shows their synergy and the potential to further increase it. EU competition policy must contribute to the attainment of enterprise policy objective while enterprise policy must not distort competition. Both policies need to adjust continuously to the new challenges that emerge at an accelerating rate: new markets, new ways of doing business, new drivers of growth and of dynamic competition.

The reformulation of enterprise policy in the light of the strategy adopted at the Lisbon European Council, as well as the current revision of major parts of the competition legislation are occasions to achieve an even better synergy between both EU policies.

References

Cabral, L. (ed.) (2000): 'Readings in Industrial Organisation', Blackwell.

Council of Economic Advisers (2002): Economic Report of the President, United States Government Printing Office, Washington, 2002.

Council Regulation (EEC) No 4064/89, of 21 December 1989 on the control of concentrations between undertakings, as complemented by Council Regulation (EEC) No 1310/97.

European Commission (1990): 'Industrial Policy in an Open and Competitive Environment: Guidelines for a Community Approach', Communication, COM 90 (556) final, 16 November 1990.

European Commission (2000a): Commission Staff Working Paper SEC(2000)771, 8 May 2000, 'Towards Enterprise Europe. Work programme for enterprise policy 2000–2005'.

119 For example, although the volume invested in early stage investment reached EUR 2.99 billion in 1999, the US equivalent was for the same year EUR 0.232 billion. As a result, US venture capital funds invested EUR 7.12 billion more in early stage investments than their counterparts in European Union. This represents a dramatic increase of 7.4 times compared with EUR 945 million in 1994.

120 Cf. IP/02/242 of 13 February 2002.

European Commission (2000b): 'XXXth Report on Competition Policy', p.8 (published in conjunction with the General Report on the Activities of the European Union — 2000).

European Commission (2001): Notice on remedies acceptable under Council Regulation (EEC) No 4064/89 and under Commission Regulation (EC) No 447/1998.

European Commission: 'United States Barriers to Trade and Investment', (various years) available at: europa.eu.int/comm/trade/bilateral/usa/pr_usrbti.htm.

European Commission Regulations. The text of the various regulations quoted in this chapter can be found at http://europa.eu.int/comm/competition/index_en.html.

Jacquemin, A. (2000): 'Theories of Industrial Organisation and Competition Policy: What are the Links?', European Commission, Forward Studies Units, Working Paper, p. 19.

Lawrence P. (2001), *US Aircraft Subsidies*, Aerospace Research Center.

Monti, M. (2001a): 'Market Definition as a Cornerstone of European Union Competition Policy', Speech given in Helsinki, 5 October, available at: europa.eu.int/rapid/start/,speech01/439.

Monti, M., (2001b): 'Antitrust in the United States and Europe: a History of Convergence', Speech before the American Bar Association on 14 November 2001, available at: europa.eu.int/rapid/start/, speech01/540.

OECD (2001): OECD Global Forum on Competition, Merger Enforcement and International Co-operation — Submission by the EC, pp. 55–63.

United States National Defence Authorisation Act for Fiscal Year 2002, Section 317.

Wolfstetter, E. (1999): 'Topics in Microeconomics — Industrial Organisation, Auctions and Incentives', Cambridge University Press.

CHAPTER V
Sustainable development in the EU manufacturing industry

V.1 Introduction

The Brundtland Commission (1987) defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. The idea that the management of natural resources and the environment should be consistent with the preservation of its reproductive capacity has become — along with the promotion of economic and social progress — one of the fundamental objectives of the European Union as expressed in the Treaty on European Union.

At the June 2001 Gothenburg summit, European Union leaders endorsed a strategy for sustainable development containing three pillars relating to economic, social, and environmental development. The integration of the three pillars into a single strategy was designed to ensure that in the longer-term economic growth, social protection, and environmental quality all developed in a harmonious balance. In this context the European Council stressed the importance of decoupling economic growth from resource use.

The issue of the relationship between output growth and resource use, widely interpreted also to include emission of pollutants, is therefore essential to sustainable development. Is it inevitable that as the economy grows over time, resource use and emissions of pollutants will have to increase indefinitely? If so, such economic growth would be ultimately unsustainable. The earth has limited stocks of non-renewable resources and a limited carrying capacity for the absorption of pollutants. Increased growth of emissions of pollutants would lead to intensifying environmental damage with potentially irreversible impacts on human health and biodiversity.

In fact, however, the evidence is that as economic development expands beyond a certain threshold, environmental pressures may slacken and even begin to decrease. As society becomes richer, its demand for environmental quality increases. Moreover, increased economic growth at high levels of income provides the additional resources that are needed to better tackle environmental pressures. Many observers of the main industrialised economies have therefore identified the phenomenon of a so-called environmental Kuznets curve[121]. As a country's real income increases, its emissions of pollutants and use of raw materials at first increases. However, emissions and raw material use subsequently peak or even begin to decline at higher income levels.

This chapter examines the relationship between economic growth and the natural resource use and emissions of pollutants with regard to EU manufacturing enterprises over the last 20 years. Manufacturing industry, directly involved in the transformation of materials into products, has in the past been considered one of the major contributors to environmental degradation. However the environmental performance of manufacturing industry over the last 20 years has very substantially improved in response to increased regulation, stronger market competition, and through investment and better management of resources by industry itself[122].

The chapter is structured as follows: Section V.2 reviews some general considerations concerning the concept and determinants of eco-efficiency. Section V.3 examines in detail the actual environmental performance of EU manufacturing industry over the last 20 years with respect to two measures of natural resource inputs — energy and raw materials — and four measures of the emission of pollutants

121 See, for example, Grossman and Krueger (1995) and Hettige et al. (1997).

122 This improved performance has been recognised in recent editions of the European Environment Agency's *Environmental Signals Report*. See the chapter on manufacturing in the 2000 Report (EEA, 2000) and the especially the summary table (Figure 1.4) in the 2001 Report (EEA, 2001a).

— greenhouse gases, acidifying gases, ozone-precursor gases and ozone-depleting gases; moreover, comparisons are made where possible with US industry. Section V.4 then reviews evidence on the costs to manufacturing industry of improving its eco-efficiency and Section V.5 provides some conclusions.

V.2 Eco-efficiency and its determinants

Eco-efficiency measures the productivity of resource use or pollutant emission in an industry. It is defined as the ratio of economic output to environmental pressure[123]. It can be calculated as the quantity of value-added output divided by the physical quantity of resource input or quantity of emissions of pollutants respectively:

Eco-efficiency = Output/Environmental pressure

Eco-efficiency is a key concept since it provides a measure of the wedge between economic growth and environmental impact. For instance, in the case of emissions of pollutants, the definition of eco-efficiency can be rearranged as:

Emissions = Output/Eco-efficiency

Therefore, for small percentage changes[124]:

% growth in emissions = % growth in output — % growth in eco-efficiency.

Over the longer term of course the percentage growth in output for most industries will be positive. Therefore, the impact on emissions crucially depends on developments in eco-efficiency. If the percentage growth in eco-efficiency is positive but less than the rate of output growth, emissions will rise but by less than output growth and *relative de-coupling* is said to have occurred. In contrast, if the percentage growth in eco-efficiency is greater than the rate of output growth, emissions over time will actually fall and *absolute de-coupling* is said to have occurred. Similar definitions can be derived for resource use.

It is therefore of great importance to examine the underlying determinants of eco-efficiency. In general these will depend on the rate of technological progress, the degree of environmental regulation, the extent of competition in product markets, and upon the investment and quality of management of resources by industry itself.

Concerning energy and natural resource use, the economics of production[125] suggests that the use of inputs of resources by industry will depend on a number of factors including the following:

— Rate of technological progress. Technological progress will tend over time to reduce the requirement for material inputs by improving processes. Whilst some technological progress might be applicable using existing equipment, full benefits from technological progress usually require investment in new equipment.

— Relative price of material inputs. A rise in the relative price of one input will tend to reduce its usage and increase incentives for its substitution by other inputs, including labour and capital. Such substitution may require additional or replacement capital equipment.

— Efficiency in management of resources. Improved management of resources by firms may occur either as a result of external competitive pressures or as a result of internal management improvements.

— Rate of capacity utilisation. In the short-run, measured eco-efficiency particularly of energy use tends to decline in periods of low capacity utilisation. This is perhaps because it is technically necessary to keep machines running anyway, independent of the quantity of production.

Public policy can influence resource use in a number of ways. One is by directly changing the relative price of resources through indirect taxes such as an energy tax. However, public policy also influences the management of resources by increasing the external competitive pressures on firms through markets integration, preserving competition and free entry, and by encouraging market-based economic reforms. Finally the public sector can also influence resource use by providing incentives for the adoption of resource-conserving production techniques and by promoting efficiency-enhancing managerial standards such as EMAS or ISO 14001.

Turning to the emission of pollutants by firms, once again technological factors will tend to improve the eco-efficiency of production over time. Moreover,

123 See OECD (1997), Anite (1999).

124 Because of the non-linear relationship between variables, this relationship will not exactly hold for large percentage changes.

125 See Fuss and McFadden (1978) and Färe et al. (1994).

the investment decisions and managerial efficiency of firms will again be important determinants of eco-efficiency of emissions. However over and beyond these factors, a major determinant of emissions eco-efficiency in practice will be the legally- binding environmental emissions standards required by public authorities. Conformity with these standards in general requires additional expenditure both in terms of investment and running costs.

A variety of means are available to firms in order to reduce their emissions in conformity with environment standards. These include the following[126]:

— Improved technical efficiency of the production process. This might occur through technological progress or investment in more efficient techniques, and may also result in savings in energy and natural resource use. Such efficiency savings may require further investment.

— Substitution of inputs. Examples would be the substitution of coal and oil fuel inputs by non-combustion fuels such as renewable energy or low-emissions fuels such as gas or low-sulphur fuel oil. The substitution of alternative inputs may be costly and may or may not require further investment to upgrade or replace existing capital equipment.

— Use of additional inputs or processes. Examples would be the pre-cleaning of materials before use, requiring additional inputs from capital, labour, and water and resulting in additional waste by-products.

— Investment in end-of-pipe emission controls. Examples would be flue gas de-sulphurisation and de-noxing technologies. Such technologies might have the side effect of reducing production efficiency.

— Improved management of resources. Improved management could improve the handling, timing, and use of resources, including the optimal utilisation of capacity.

With regard to the control of emissions of carbon dioxide there is a big technological difference from the control of standard air pollutants in that end-of-pipe techniques are currently not available for reducing carbon dioxide emissions. Control measures for carbon dioxide therefore have to take a different form, relying on input substitution or increased efficiency.

The means available for and costs of the additional reduction of emissions of pollutants differs greatly between industries and firms[127]. In particular there are important differences between controlling emissions from combustion processes and from direct production processes. Generally emissions from combustion processes are easier to control than those from direct production processes, since combustion is by nature a concentrated and specific process compared to more diffuse other production processes. These differences in the costs of emissions control make a strong case for the use of market-based environmental instruments such as emissions trading. Such instruments ensure the achievement of emissions reductions by the lowest cost means, through giving incentives to firms with lower emission-reduction costs to make the largest contribution to the overall reduction in emissions.

126 See, for example, the technical annex to the 1994 Sulphur Protocol (UNECE, 1994) which describes the various means which may be used to control emissions of sulphur dioxide.

127 For some discussion of the differences in costs of abatement see Hartman et al. (1997).

Box V.1: The key relationships between environmental expenditures, economic growth, and the growth of eco-efficiency and environmental pressures

This box examines the key steady-state macroeconomic relationships between environmental expenditures, economic growth, and the growth of eco-efficiency and environmental pressures. These relationships are illustrated more formally in a small macroeconomic growth model contained in the Annex V.1.

The first relationship is that between environmental expenditures and eco-efficiency. A certain amount of trend improvement in eco-efficiency might be expected over time as a result of technological progress even in the absence of any environmental expenditure. To obtain further improvements in eco-efficiency growth beyond this trend growth rate would require additional expenditure on environmental protection (or equivalently the progressive adoption of some higher cost substitute materials or processes). It is likely that progressively increasing environmental expenditures will ultimately begin to experience diminishing returns to scale. For instance, whilst some initial relatively cheap improvements in eco-efficiency may be obtained using end-of-pipe techniques, further improvements may entail considerably higher expenditures involving changes to production techniques. Hence, the relationship between environmental expenditures and increasing eco-efficiency is likely initially to be relatively steep, whilst tending to level off at higher levels of expenditures. Indeed ultimately there may also be physical or chemical limits to the extent to which eco-efficiency can be improved given an existing technology.

Looking next at the relationship between the scale of environmental expenditures and the resources available for investment and economic growth, the currently available evidence would suggest a clear negative relationship to be expected. Evidence from a number of US studies demonstrates that there is a clear negative relationship in aggregate between environmental expenditures and conventionally-measured productivity growth[128]. That this is almost inevitable can be seen from the basic consideration that environmental expenditures — whatever their value to society in general — represent to the firm which incurs them a cost which does not directly provide an output or input with a market valuation. In general, increased environmental expenditures can be expected to reduce profits and hence the overall resources available to firms for productive investment. As a partial offset to this overall effect, there is also some evidence that increased environmental regulation increases the rate of induced technological innovation of firms[129].

The implications of the two above relationships taken together is that there is likely to be a clear trade-off between the rate of economic growth and the rate of reduction in environmental pressures[130]. Moreover, because of the diminishing returns assumed for environmental expenditures, this trade-off is likely to become more pronounced as environmental expenditures increase. Governments may thus make choices about the extent to which they wish to combine economic growth with the rate of change in environmental pressures[131].

An interesting aspect to the trade-off between economic growth and environmental pressures is the extent to which it is affected by improved economic performance or by improved environmental technology. Improved economic performance might occur through market integration such as the single market process or through other means of increasing efficiency such as structural reforms. The result would be to allow a better trade-off between economic growth and environmental pressures. In particular the fruits of economic reform would be to allow both a higher rate of economic growth and a faster reduction in environmental pressures to occur simultaneaously.

Likewise, an improvement in the performance of environmental technology — perhaps through greater investment in this sector — might allow for an increase in the trend rate of improvement in eco-efficiency. Such a development would also improve the trade-off between economic growth and environmental pressures, potentially allowing more favourable developments in each.

128 See Pearce and Palmer (2001) and Jaffe et al. (1995) for recent surveys of the available evidence on the relationship between environmental expenditures and conventionally-measured economic growth. Of course, conventional measures of economic growth do not take account of the non-marketed social value of environmental improvements (see e.g. Färe et al. (2001), for the demonstration of such an alternative measure).

129 The so-called Porter hypothesis (Porter and van der Linde, 1995). For a recent survey of the evidence on this effect see Jaffe et al. (2000). They conclude that there is only limited evidence for the existence of induced innovation, but that in principle this should be stronger with the use of market-based regulatory instruments.

130 Raising environmental expenditures will reduce both economic growth and environmental pressures. The latter through both reducing the economic growth rate and increasing the rate of growth of eco-efficiency.

131 Schematically the public sector will in practice making choices about exactly what trade-off they wish to make by designing environmental regulations which determine environmental expenditures and hence economic growth.

V.3 The environmental performance of EU manufacturing industry

This section looks at the environmental performance of EU manufacturing industry over the last 20 years with respect to natural resource inputs and emission of pollutants. Two measures of natural resource inputs are considered, energy and raw materials, together with four measures of the emission of pollutants, greenhouse gases, ozone-depleting gases, acidifying gases, and ozone-precursor gases. These are the only environmental indicators for EU manufacturing which are both available for a sufficiently long time period and cover in a consistent manner all of the Member States. The analysis is based upon aggregate data covering the 15 current Member States[132]. The analysis uses the longest reliable series of data available, generally consisting of data from 1980 onwards; 1985 in the case of energy use and carbon dioxide emissions. Each of the sub-sections which follow covers a single issue. A brief explanation of the environmental factors involved is followed by a description and analysis of the environmental performance of EU manufacturing industry. Some comparisons are also made between the environmental performance over the last 20 years of EU manufacturing industry and that of US industry.

132 The data excludes the former German Democratic Republic prior to 1991. Adjustments have been made to the analytical data where possible to correct for the direct impact of German reunification (see data appendix).

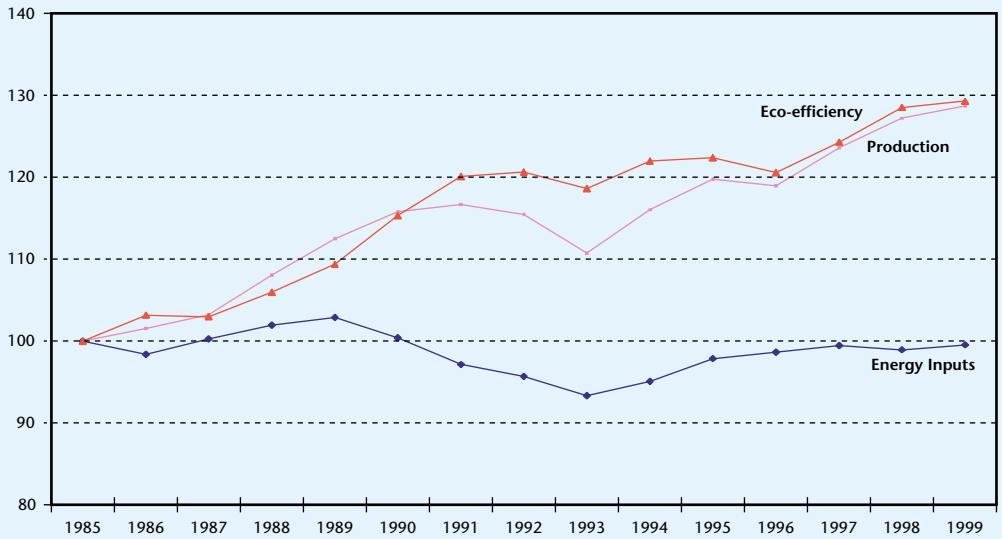
Energy use

Industrial energy use is a key environmental issue because of the major role of energy in producing emissions of pollutants, because of the environmental impact of the extraction of energy, and to a limited extent also because of resource scarcity. Energy production, predominantly from fossil fuel sources, is a major contributor to the generation of the greenhouse gas, carbon dioxide, and a host of air pollutants. The extraction of energy takes up extensive land and is responsible for multiple impacts on human health and nature. Finally, for existing stocks of some fuels, notably petroleum, there are relatively extensive but still finite reserves in existence.

Energy use by manufacturing industry in 1990 made up 31 % of total final energy consumption. The main contributing sectors were iron and steel (accounting for 21 % of total manufacturing energy use), chemicals (19 %), and the non-metallic mineral industries (13.8 %).

Graph V.1 shows the development of manufacturing output, energy consumption, and energy eco-efficiency since 1985. Despite a rise in manufacturing output of some 29 % over the period,

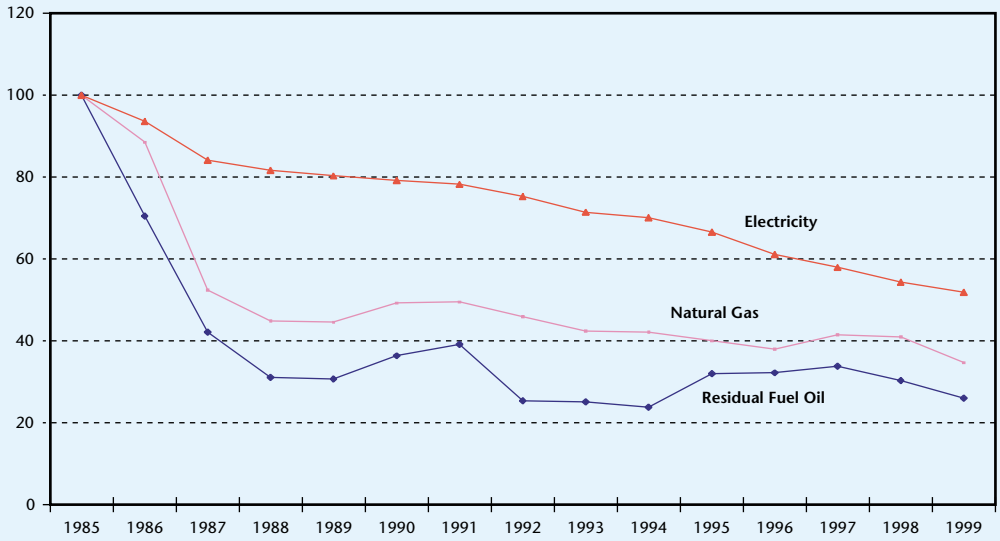
Graph V.1: Eco-efficiency of EU manufacturing industry: Energy inputs Index 1985 = 100[133]



Source: Commission services.

133 Definitions of variables used for the graphs of the chapter V are available in the end of the chapter.

Graph V.2: EU industrial energy prices
(without VAT, 1995 prices) Index 1985 = 100



Source: Commission services.

energy consumption by industry has remained broadly unchanged. The increase in energy eco-efficiency is therefore broadly of the same magnitude as the growth in manufacturing output.

The improvement in eco-efficiency has occurred despite a substantial reduction in real energy prices (Graph V.2), which slowed the improvement in eco-efficiency through substitution effects. Energy prices would have fallen further however without the offsetting rise in energy taxes (see Graph V.14).

One of the main reasons for the substantial improvement in energy eco-efficiency is technological progress. In particular, individual energy-intensive sectors have made major contributions to improving their eco-efficiency including all three of the largest users, the iron and steel, chemicals, and the non-metallic mineral industries (the glass, ceramics, lime, cement industries)[134]. The rise in energy taxes and shifts in the sectoral structure of industrial production are also partly responsible for the improvement in eco-efficiency.

Compared with the performance of US manufacturing industry (see Graph V.3), the energy eco-efficiency of EU industry has been consistently more than twice as efficient over the entire period 1985–99. The improvement in eco-efficiency in each economy has been broadly similar.

134 See the Integration Indicators for Energy (1985–98 data), Eurostat (2001a). Updating indicators for most recent 1999 data shows the continuation of these trends.

Raw materials usage

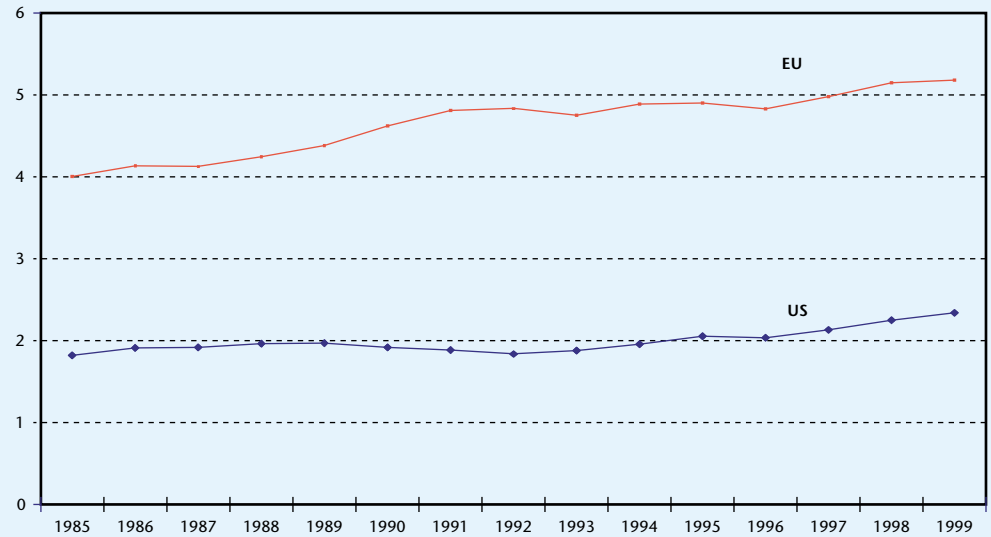
The environmental impact of industry depends crucially on the quantity of materials taken from the environment, which subsequently must be returned to it after use in the form of wastes or emissions. Measures of these physical materials inputs into industry have recently been developed in the context of the derivation of material flow accounts for the European Union (see European Environment Agency 2001b, Eurostat 2001c). These measures differ from the conventional national accounting of measures of natural resource inputs into industry in which not all material inputs may be properly accounted for. In particular, within the national accounts, the direct extraction of products by manufacturing industry, such as, for example, clay for brick making, would be accounted for as a component of industrial value-added output rather than as input into the production process.

To derive as accurately as possible a measure of the non-energy material inputs into manufacturing industry, the economy-wide estimates of material flows have been refined to an aggregate including only industrial minerals and ores. The flows represent domestic consumption of industrial minerals and ores measured aggregated by weight in metric tons.

The data show a close relationship between material inputs and manufacturing output until the early 1990s (see Graph V.4). Eco-efficiency over this

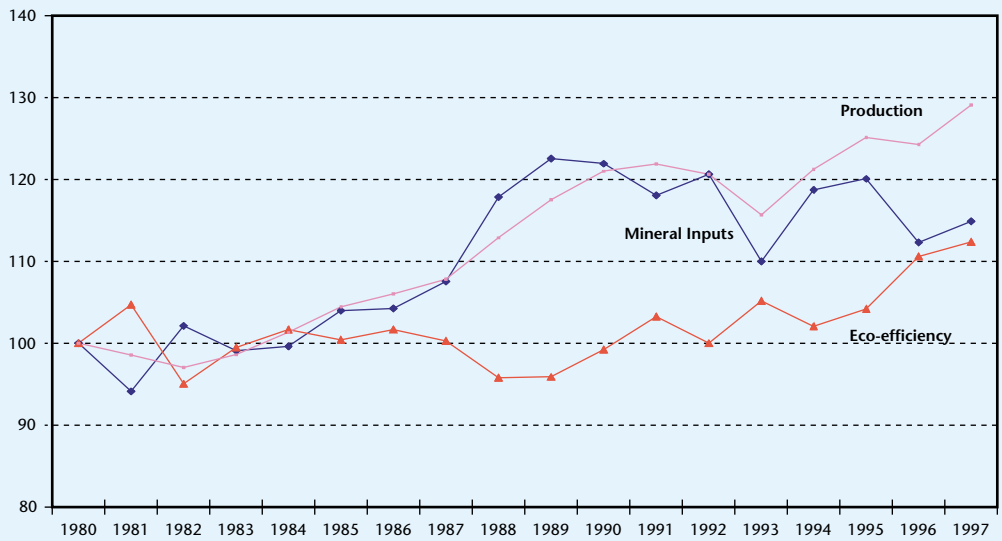
period was broadly stable. From 1993 onwards there seems to be some evidence of some improvements in eco-efficiency, as materials usage has stabilised. Over the whole period, eco-efficiency in mineral usage has improved by some 12 %, entirely accounted for by the period 1992–97.

Graph V.3: Comparison of Eco-efficiency of manufacturing: EU versus US energy inputs
(million EUR per 1 000 TOE)



Source: Commission services.

Graph V.4: Eco-efficiency of EU manufacturing industry: Minerals consumption
Index 1980 = 100



Source: Commission services.

Box V.2: Microeconomic efficiency considerations concerning policies towards natural resources use and emission of pollutants

The Hotelling theory of the optimal use and depletion of natural resource use provides a baseline for the analysis of the sustainable development of energy and raw material use[135]. According to the theory in the absence of externalities, the price of a non-renewable resource should optimally rise at a rate equal to the interest rate, until it reaches a final price (at the exhaustion of the stock) equal to that of a higher-cost substitute renewable resource. The interest rate gives the time preference of society for consumption tomorrow versus today. Theoretically a competitive market would deliver exactly the required optimal set of prices and rate of depletion. For instance, were the expected rate of price growth higher than the interest rate, then producers would have an incentive to leave the resource in the ground rather than market it today. Likewise, were the expected future price lower than the interest rate, then producers would have the incentive to produce more today[136]. Users of the material resource would equate its current price with the value of its marginal product in the production process. The resulting profile of resource prices would be exactly that which is socially optimal.

Of course, in practice, natural resource markets do not behave anything like this idealised model. Amongst the key distortions in practice are the following:

— Non-renewable natural resource prices are often distorted through oligopolistic suppliers or through price regulation and subsidies.

— Renewable resources are often over-exploited and may become totally exhausted owing to lack of entry restrictions.

— The full costs to society of the extraction and use of natural resources are often not monetised and are therefore not taken into account in consumption. An important example of the latter phenomenon is the effects of the use of fossil fuels in producing carbon dioxide, which contributes to global warming.

In the presence of such distortions, public sector action is necessary to influence resource use and restore optimality. The theory of optimality suggests that the best public policies are those which directly address the source of the market failure or distortion, for instance, by correcting prices through taxes which take account of the non-monetised social costs of their use. Whilst such a rule is useful in principle, in practice, of course, it is difficult to properly calibrate and evaluate such non-monetised social costs and to make the appropriate adjustments over time in order to respond to socioeconomic developments.

In contrast, there is a very clear public sector role in ensuring the control of emissions of pollutants. This is for two reasons. First, emissions of pollutants are essentially the unintended by-products of the production process: hence controlling them has only a relatively secondary value to producers themselves. Second, there is no easy way to establish an unregulated market for pollutants, which would require the establishing of private property rights over media such as clean air and water.

The key policy issues with relation to emissions of pollutants are which threshold to set for the emissions and how to achieve this threshold in the most cost-effective manner. In setting an acceptable threshold for emissions, the costs and benefits to society from reducing emissions need to be balanced. In the absence of any emissions controls, the benefits to society from starting to make emissions reductions would be very considerable and likely outweigh the additional costs involved. However as further reductions in emissions are required, the costs of these reductions are likely to rise, whilst the additional benefits to society are likely to fall. The optimal emissions reduction policy would therefore balance the marginal cost to firms of making additional emissions reductions with the additional benefits to society of such reductions. Using similar reasoning, the most cost-effective means of achieving such an emission threshold would be to equalise the marginal costs of emissions between different firms. The most efficient means of achieving this would be through market-based instruments such as emissions trading.

135 See, for example, Tietenberg (2000).

136 To illustrate how the model works, for instance, consider the announcement of new discoveries of the natural resource: this would reduce today's price since it would postpone the date of exhaustibility. However it would not alter the final price at exhaustion (equal to the price of the renewable resource) nor would it change the rate of change of the natural resource's price over time (equal to the interest rate).

Emissions of greenhouse gases

Climate is strongly influenced by changes in the atmospheric concentrations of the greenhouse gases, which help to trap infrared radiation in the lower atmosphere. There is now considerable evidence that the increased accumulation of these gases is causing a global warming of the earth.

The main greenhouse gases are water vapour, carbon dioxide (CO_2), ozone methane (CH_4), nitrous oxide (N_2O), and industrial gases such as halocarbons and others. Non-industrial gases occur naturally and are essential to life, keeping the planet some 30° warmer that it would otherwise be. Water vapour is the largest contributor to the natural greenhouse effect. However, human activities are affecting greenhouse gas levels, thereby changing the earth's energy balance and enhancing the natural greenhouse effect to cause global warming.

Emissions of carbon dioxide (mainly due to the combustion of fossil fuels) are responsible for over 60 % of the EU's contribution to the 'enhanced' greenhouse effect; methane emissions (due to agriculture and changes in land use) contribute another 20 %; and nitrous oxide, ozone (generated mainly by automobile exhaust fumes) and industrial gases such as sulphur hexafluoride (SF_6) and halocarbons (CFC_s, HFC_s and PFC_s) contribute the remaining 20 %.

In 1990 emissions from EU manufacturing industry made up some 23 % of total carbon dioxide emissions. The major part comes from industrial combustion of fossil fuels particularly by the iron and steel, non-ferrous metals, and paper and pulp industries. A significant contribution to emissions also comes from industrial processes, particularly from the production of cement and other mineral products and from the chemicals industry.

Overall emissions of carbon dioxide by EU manufacturing industry have fallen by over 11° % over the period 1985–2000[137] (see Graph V.5). This compares with an actual increase in total EU carbon dioxide emissions over the period, largely the result of the expansion of emissions from the transport sector, which offset the substantial reductions from both the energy and manufacturing industries.

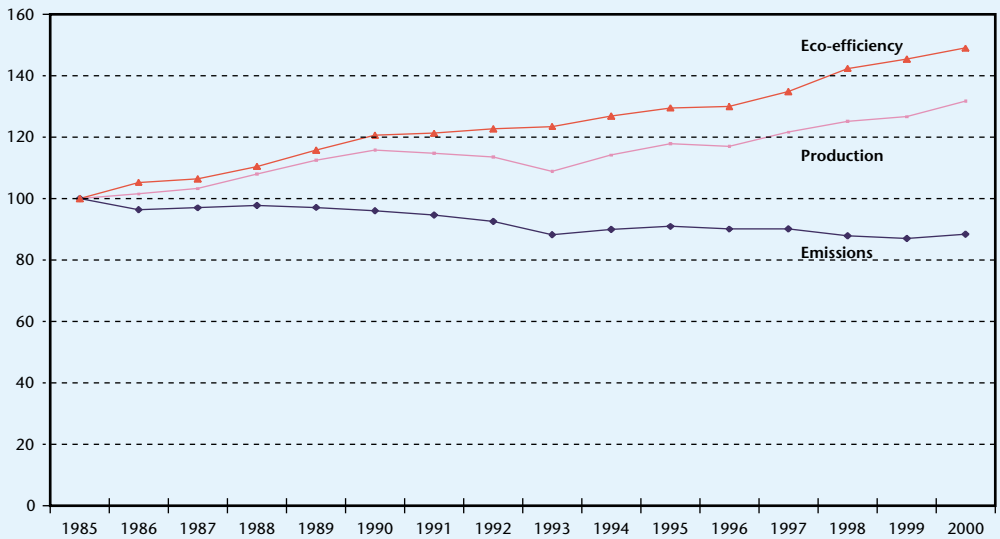
The reductions in carbon dioxide emissions in industry are mainly attributable to improvements in industrial fuel consumption, and reduced emissions from industrial processes.

The majority of the reduction in industrial CO_2 emissions appears to have come from reduced emissions from industrial combustion. This was

137 The data for emissions, production, and eco-efficiency presented here and in graph V.5 have been adjusted for the direct impact of German reunification. German reunification led to a major restructuring and reduction in size of the industrial sector in the former East Germany. Including data for the former DDR in the European Union numbers prior to 1991 would add an additional 5.2 percentage points to the reduction in total European Union carbon dioxide emissions over the period 1985–99 (see Ziesmer, 1996 and Eichhammer et al., 2001). (see Ziesmer, 1996 and Eichhammer et al., 2001).

Graph V.5: Eco-efficiency of EU manufacturing industry: CO2 emissions

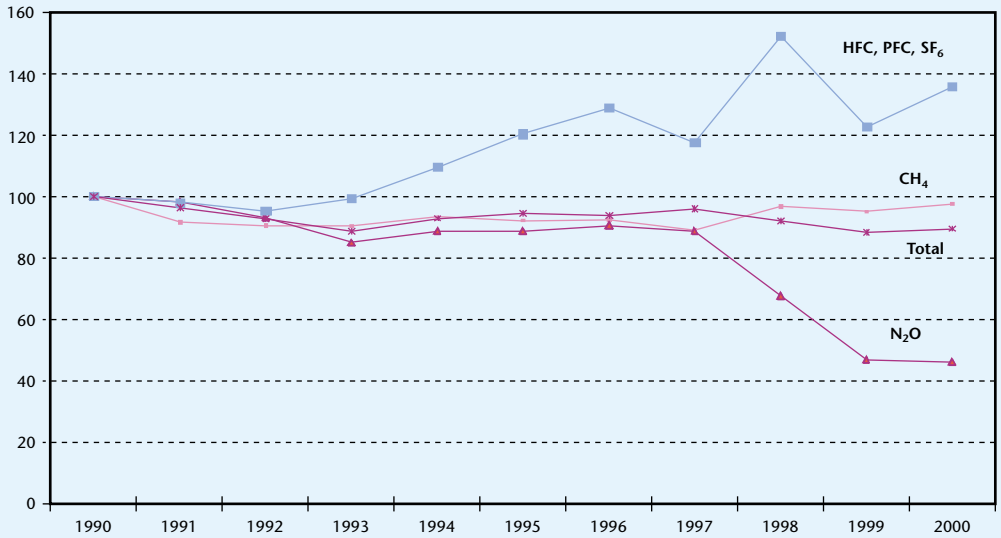
Index 1985 = 100



Source: Commission services.

Graph V.6: EU Industrial emissions of individual greenhouse gases

Index 1990 = 100



Source: Commission services.

largely a result of improved fuel efficiency, the switching to less carbon-intensive fuels such as gas, and some structural change in EU industry. Some modest progress was also made in reducing emissions from industrial processes.

The eco-efficiency of EU manufacturing industry with respect to carbon dioxide rose over the last 15 years. Overall manufacturing production rose 31 % over the period 1985–2000, resulting in a rise of eco-efficiency by some 49 % over the same period.

Reliable data on emissions of greenhouse gases other than carbon dioxide emissions is only available from 1990 onwards. Emissions of nitrous oxide fell by 53 % over 1990–2000, mainly owing to emissions reduction measures in the chemicals industry. In contrast, emissions of the less quantitatively significant fluorinated gases increased by 36 %, largely as a result of the substitution of ozone-depleting chloroflurocarbons by HFCs. Over the same period, carbon dioxide emissions fell by 7.2 %. Overall industrial emissions of greenhouse gases (measured in CO_2-equivalents) fell by 10.5 % between 1990 and 2000 (see Graph V.6).

Compared with the performance of US manufacturing industry (see Graph V.7), the eco-efficiency of EU industry with respect to greenhouse gas emissions has been consistently more than three times higher over the period 1990–99. The improvement in eco-efficiency has been slightly greater in the EU.

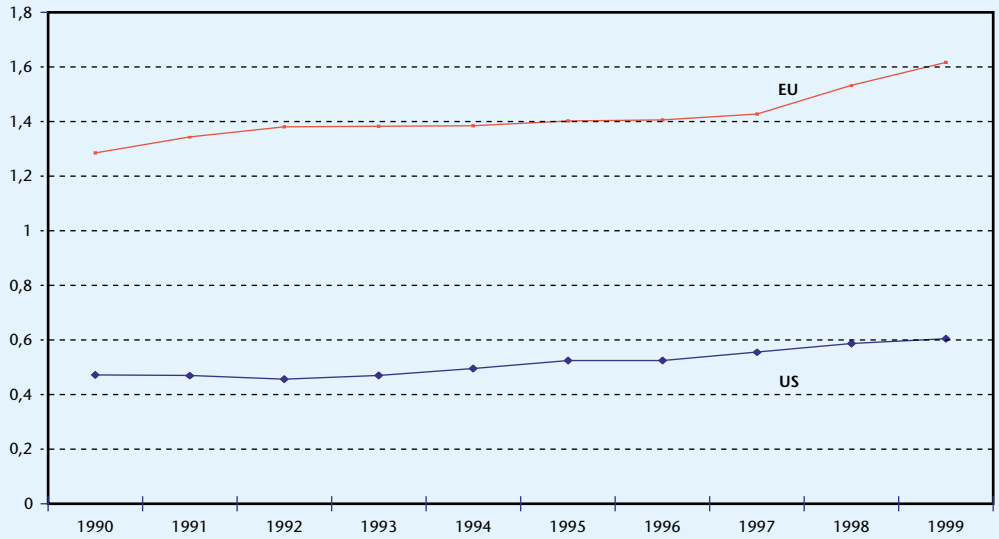
Emissions of acidifying gases

The acidifying gases responsible for acid rain consist in sulphur dioxide (SO_2), the nitrogen oxides (NO_x), and ammonia (NH_3). Industrial emissions of these gases can be carried by winds for hundreds of kilometres before being deposited in the environment. The acids ultimately get deposited either through dry deposition or along with rain and snow. The deposition of acid in this manner has been shown to cause extensive damage to forests and soils. It also has effects on ground and surface waters and can result through eutrophication in the impoverishment of biodiversity in lakes and rivers. Acid rain also causes damage to buildings and has been shown to have deleterious effects on human health.

Industrial emissions made up nearly 16 % of total EU emissions of acidifying gases in 1990. Roughly three quarters of emissions came from industrial fuel combustion, whilst the rest came from other industrial processes. Industrial emissions of sulphur dioxide largely come from industrial combustion plants burning fossil fuels, with substantial contributions also from metal smelters, pulp production, and oil refineries. Nitrogen oxides are emitted largely by industrial combustion plants and through acid production and processing of fossil fuels. Ammonia was primarily emitted by the organic chemicals industry, particularly from the production of fertilisers.

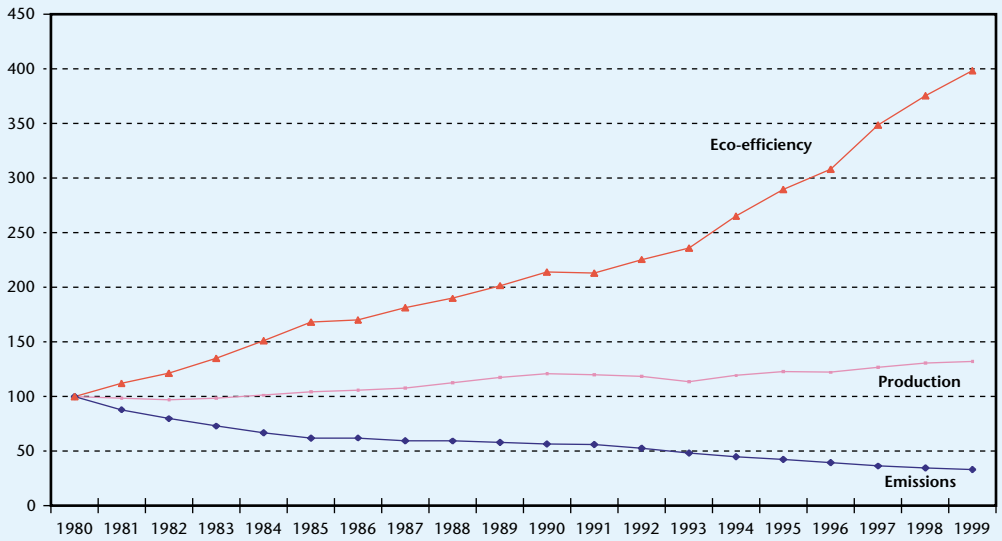
Over the last 20 years, there has been a striking reduction in the emissions of acidifying gases by EU

Graph V.7: Comparison of Eco-efficiency of manufacturing: EU vs. US: Greenhouse gases
(million EUR per ktonne CO_2 equivalent)



Source: Commission services.

Graph V.8: Eco-efficiency of EU manufacturing industry: Acidifying gases
Index 1980 = 100



Source: Commission services.

manufacturing[138]. Overall acidifying gas emissions fell by some 67 % between 1980–99 (see Graph V.8). This was principally due to a very substantial decline by three-quarters in sulphur dioxide emissions. Emissions of nitrous oxides fell by over 30 %, whilst ammonia emissions fell by nearly 40 %.

Manufacturing industry contributed some quarter of the total reduction in EU emissions of acidifying gases over 1980–99. Manufacturing industry's emissions fell by a comparable percentage to that of energy production, but considerably faster than other sectors such as transport and agriculture. The overall share of manufacturing in total EU emissions fell from some 19 % in 1980 to 12 % in 1999.

138 The data for emissions, production, and eco-efficiency presented here and in graph V.8 have been adjusted for the direct impact of German reunification. The extent of the impact of reunification on measured eco-efficiency can be seen in Graph V.9.

The eco-efficiency of manufacturing industry with respect to acidifying emissions increased very substantially over the last 20 years. Overall manufacturing production[139] rose by 32 % over the period 1980–99, resulting in an increase in eco-efficiency by some 300 % over the period.

The pattern of emission reductions is closely related to the introduction of emission controls on acidifying gases, in particular the Large Combustion Plants directive of 1988. This legislation strictly controlled the emissions standards of new industrial combustion plants and required Member States to draw up emissions reductions programmes for existing plants. The nature of Member State reduction programmes differed considerably[140]. Some countries, notably Germany and the Netherlands had already introduced earlier national legislation. These countries chose to upgrade their limits on existing plants using further legislation backed by voluntary agreements with industry. In other countries, such as France and the United Kingdom, the targets for emissions reductions by existing plants were primarily met by substitution of other fuels together with end-of-pipe measures in a limited number of plants.

Scientific model-based analysis indicates that the substantial reduction in emissions of acidifying gases was largely due to shifts to pollution control measures and the changes in the structure of input fuels. Wüster (2000) using the RAINS model calculates that total sulphur dioxide and nitrogen oxide emissions in Europe were each reduced owing to pollution control measures by some 20–25 percentage points respectively over the period 1980–2000. Changes in the structure of specific fuel inputs reduced sulphur dioxide emissions by some additional 10 percentage points over the same period. Other reasons for changes in the ratio of industrial emissions were changes in the structure of industry and shifts between self-generation of power and electrical power.

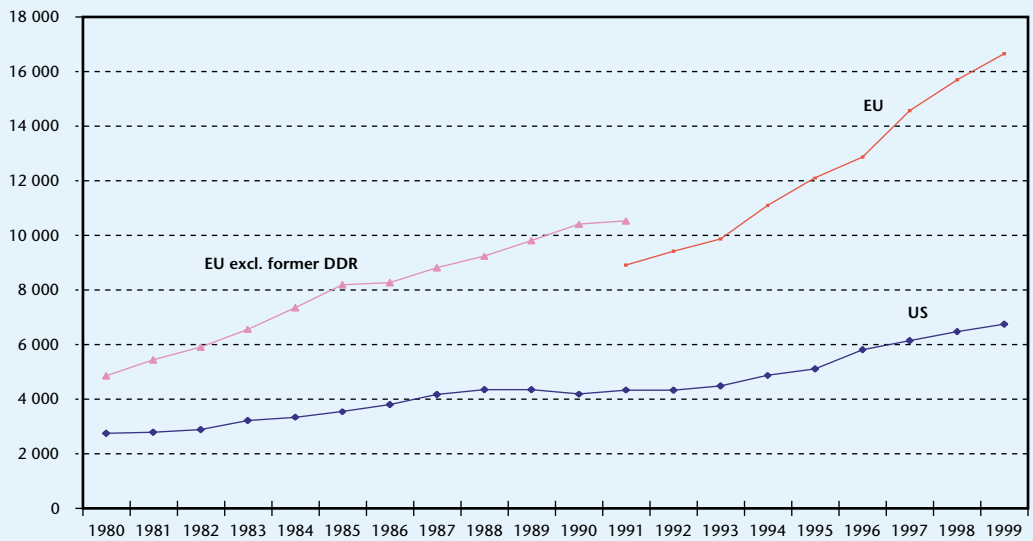
The performance of EU manufacturing industry in reducing acidifying gases compared favourably with that of manufacturing industry in the United States (see Graph V.9). Even taking account of the reduction in measured eco-efficiency caused by German reunification, the eco-efficiency of manufacturing in the European Union is higher and has improved considerably more quickly than in the United States. This is despite the impact in the United States of the sulphur dioxide emissions trading scheme set up under Title IV of the 1990 Clean Air Act. The scheme however commenced only in 1995.

Emissions of ozone precursors

Whilst at the stratospheric-level ozone provides an essential shield against the sun's ultraviolet radiation, at tropospheric-level (ground-level) ozone is a secondary pollutant harmful to both human health and ecosystems. Ozone forms by the oxidation of

139 Adjusted for reunification of Germany.
140 See Eames (2001), together with Bültmann and Wätzold (2000) for Germany, Lulofs (2000) for the Netherlands, and Schucht (2000) for France.

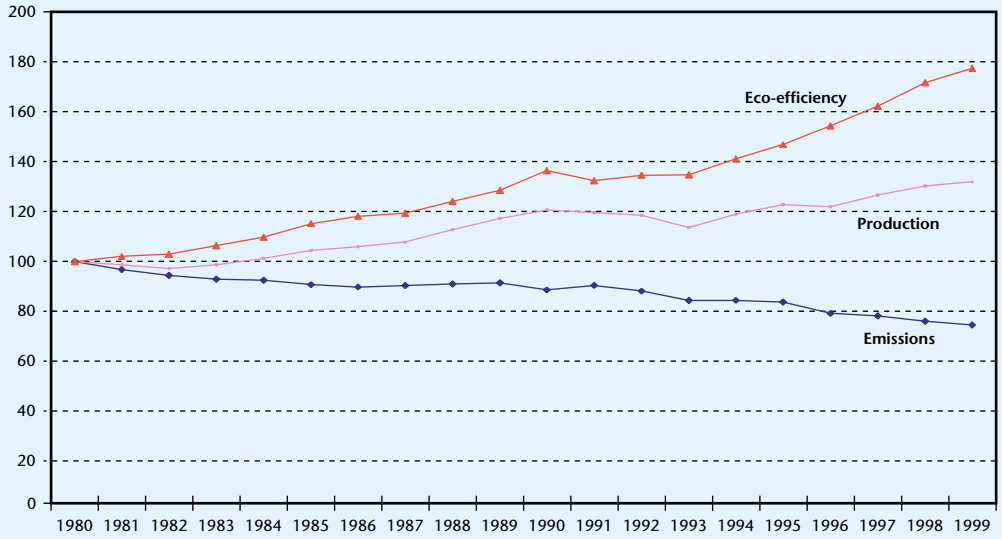
Graph V.9: Comparison of eco-efficiency of manufacturing: EU vs. US: Acidifying gases
(million EUR per ktonne acid equivalent)



Source: Commission services.

Graph V.10: Eco-efficiency of EU manufacturing industry: Ozone precursors

Index 1980 =100



Source: Commission services.

volatile organic compounds and carbon monoxide in the presence of nitrogen oxides and sunlight. Harmful ozone concentrations are a problem throughout Europe, but particularly in cities and in the southern European countries. The ozone-precursor gases consist in the non-methane volatile organic compounds (VOCs), the nitrogen oxides (NO_x), carbon monoxide (CO), and methane (CH_4).

Industrial emissions made up 11 % of total EU ozone-precursor emissions in 1990, roughly equally divided between industrial combustion and other processes. The industrial emissions of VOCs come largely from the use of solvents in industrial processes, the petroleum industry, industrial combustion, with smaller amounts from the food and iron and steel industries. Carbon monoxide is produced both from industrial combustion and through industrial processes such as iron and steel production. Manufacturing industry is responsible for only relatively small amounts of methane emissions.

Despite a rise in EU manufacturing production of 32 % between 1980 and 1999[141], its emissions of ozone precursors fell some 25 % over the period[142] (see Graph V.10). Whilst this is not such a substantial fall as that experienced with acidifying gases, the eco-efficiency of ozone precursors rose by some 80 %. As with acidifying gases, there is a very substantial difference between the performance of industry up to 1989, and from 1989 onwards. Ozone precursor emissions fell by only 9 % in the first period, with a full 20 % reduction in emissions taking place in the second.

VOC emissions from solvent use and manufacturing processes have been reduced through introduction of best-practice techniques, substitution by water-based products, and use of pollution abatement technology. The implementation of the 1999 solvents directive will reinforce these tendencies. Small reductions in carbon monoxide emissions have also occurred.

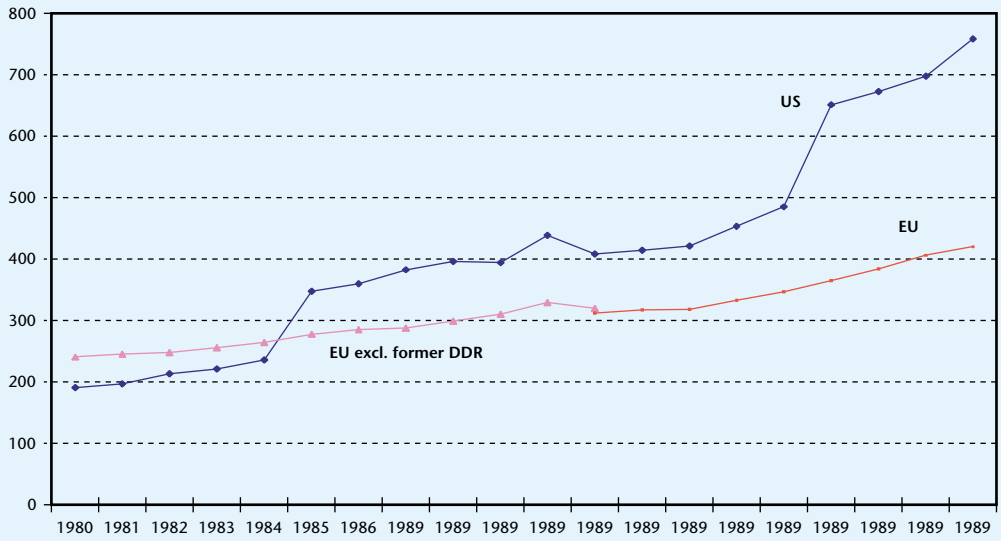
Despite the significant improvements in air quality, particulate matter and ozone remain a problem and adopting strategies to combat their impact on the environment will be a major priority of the next phase of the EU's air quality policy. Under the sixth environment action programme, the Clean Air for Europe (CAFE) programme aims to develop a long-term, strategic and integrated policy leading to the adoption of an European Union Thematic Strategy on Air by 2004/5.

The improvement in the European Union of eco-efficiency with regard to emissions of ozone precursors has been less pronounced than that which has occurred in the United States (see Graph V.11). Partly owing to differences in continental climates, the combat of ozone and smog has been a major

141 Adjusted for reunification of Germany.

142 The data for emissions, production and eco-efficiency presented here and in Graph V.10 have again been adjusted for the direct impact of German reunification. The limited extent of the impact of reunification on measured eco-efficiency can be seen in Graph V.11.

Graph V.11: Comparison of eco-efficiency of manufacturing: EU vs. US: Ozone precursors
(million EUR per ktonne total ozone forming potentials)



Source: Commission services.

policy issue in the United States. The implementation of the re-authorised United States Clean Air Act of 1977 and the Clean Air Amendment Act of 1990 can be seen to have had very significant impacts on the eco-efficiency of US industry.

Emissions of ozone-depleting gases

The ozone-depleting substances concerned are the chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, nitrogen oxides and methyl bromide. Since the 1960s CFCs and halons were being used in refrigerators, air conditioners, spray cans, solvents, foams, fire extinguishers etc. HCFCs have been developed as the first major replacement for CFCs.

Located between 10 and 50 km above the Earth's surface, containing 90 % of all stratospheric ozone, the ozone layer is essential to life on Earth. It protects living things from harmful ultraviolet-B radiation from the sun. The destruction of the ozone layer was one of the first global environmental problems to be understood by the general population. Evidence gathered in the late 1970s and early 1980s, revealed that the ozone layer was thinning due to human-made chemicals.

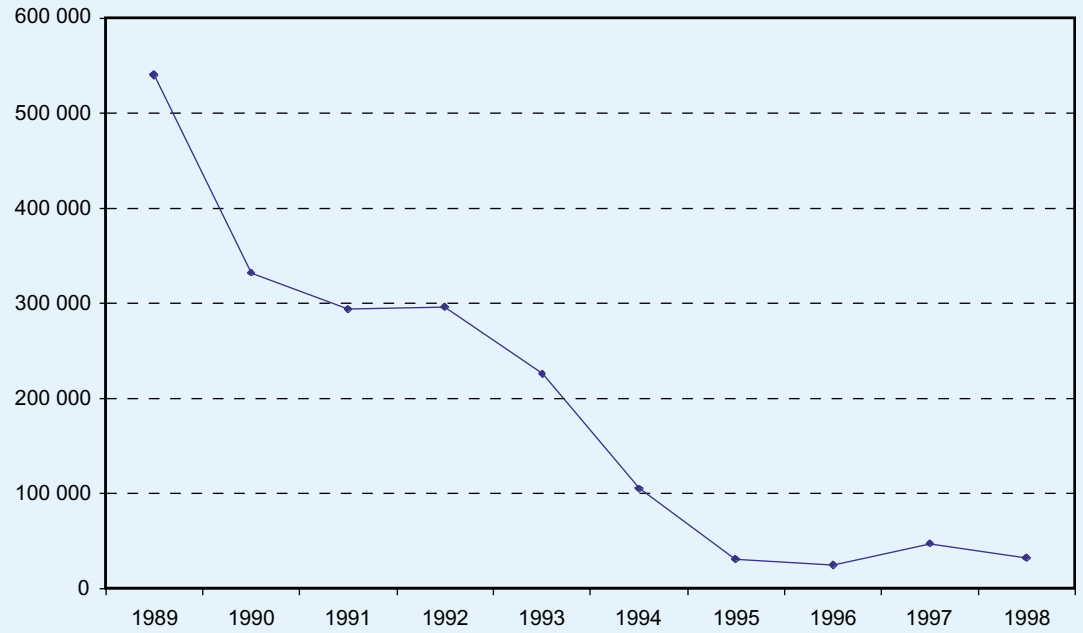
The international response resulted in the signature in 1985 of the framework Vienna Convention for the Protection of the Ozone Layer, followed by the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, which introduced international control measures for the production and consumption of ozone depleting substances. In 1990, the Montreal Protocol was revised to provide for the phase-out by 2000 of the consumption and production of CFCs and halons, with certain exemptions for essential use of halons.

The implementation of the commitments under the Montreal Protocol is mainly carried out at Community level. In 1988 a regulation set down specific rules for restricting the production, sale and import of CFCs and halons: a freeze on the production at 1986 levels and then a reduction ultimately to 80 % of 1986 levels from 1 July 1993. This was strengthened in 2000 by Council Regulation (EC) No 2037/2000 to include controls on the production, importation, exportation, supply, use leakage and recovery of controlled substances, including a ban on the production and use of most CFCs, with exceptions for essential uses.

Due to the adoption of EU legislation following the international agreement, the production of ozone-depleting substances by EU industry had declined by 80–90 % from their peak values in the late 1980s (see Graph V.12). The bulk of this production was of chemicals covered by Annex A of the Montreal Protocol (CFCs and halons), 82 % in 1990. As these have been phased-out, the importance of the other chemicals such as HCFCs has increased.

The success of the control of ozone-depleting substances has been possible because science and

Graph V.12: EU production of ozone depleting chemicals



Source: Commission services.

industry have been able to develop and commercialise alternatives to ozone-depleting chemicals. EU industry has in fact ended the use of CFCs faster and with considerably less cost than had been originally anticipated.

V.4 The costs of environmental policies

Whilst the last section has documented the substantial progress that has been made in improving the environmental performance of EU industry, the cost of this achievement has largely been funded by manufacturing industry itself. This section therefore looks at three aspects of costs of environmental protection: the scale of environmental protection expenditure; and the other potential costs of environmental protection on industry; and the scale of taxes on industrial energy inputs.

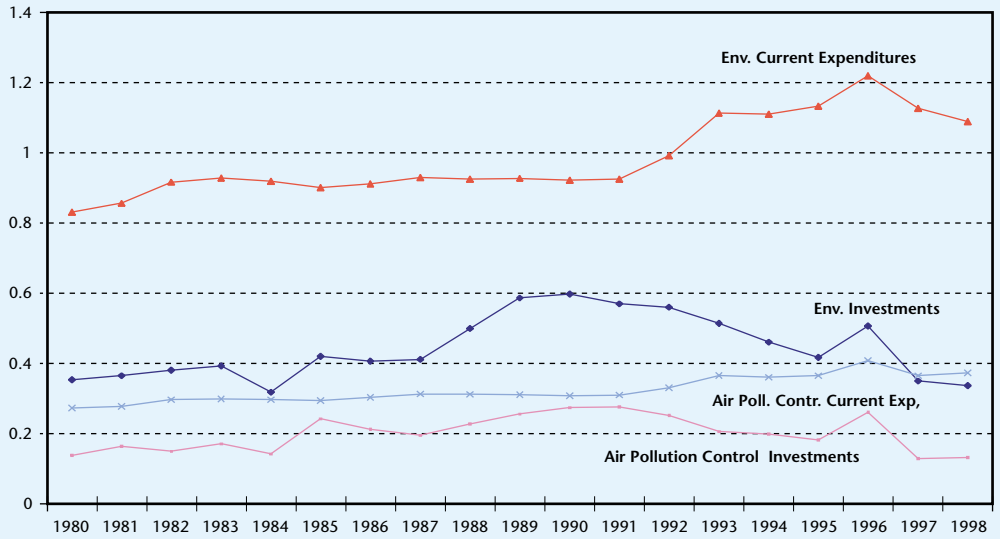
The extensive range of EU and national environmental legislation has increasingly led to a drift upwards in spending by manufacturing on environmental protection. Consistent and comparable time series information on environmental expenditure in the European Union is unfortunately fairly scarce[143]. Graph V.13 shows the development in environmental protection expenditures in Germany since 1980. Investment expenditures have averaged at 0.4–0.5 percentage points of manufacturing value-added, temporarily rising in the late 1980s and early 1990s partly owing to expenditure on air pollution control. Current expenditures on environmental protection have consistently risen over time from some 0.8 percentage points of manufacturing value-added in 1980 to 1.1 percentage point by the late 1990s. This is likely to reflect higher operation and maintenance costs of capital equipment and increased expenditures on environmental management schemes. Total expenditure on environmental protection has thus risen from some 1.2 % of value-added in 1980 to 1.5 % of value-added in 1999. Broadly similar patterns of environmental expenditure are seen in other EU countries for which data is available, such as the Netherlands and France.

Table V.1 shows the latest (1998) estimates of EU environmental protection expenditures for manufacturing industry and the energy sector[144]. Overall environment protection expenditures are equal to 2 percentage points of total industrial value added; expenditures on preventing aerial emissions alone make up some 0.6 percentage points of industrial

143 See Eurostat (1998, 2001b) and Pearce and Palmer (2001).

144 The estimates for the European Union total cover the manufacturing, mining, and electricity, gas, and water industries. No separate disaggregation is available. On average, the manufacturing component makes up some 90 % of the total expenditure in those countries for which a breakdown is available. Eurostat (2001) describes the estimate as a 'low end estimate'.

Graph V.13: Environmental expenditures of German manufacturing industry
(% of value added)



Source: Statistisches Bundesamt.

Table V.1: Environmental protection expenditure in the EU in 1998
Total industry (including mining and electricity, gas and water)

(EUR 1 000 million)	TOTAL	INVESTMENT	CURRENT
Waste	4.9	1.2	3.7
Wastewater	8.7	2.7	6.0
Air	9.6	4.3	5.3
Noise	0.7	0.4	0.4
Nature	2.2	1.7	0.5
Other	5.9	1.8	4.1
Total	**32.1**	**12.1**	**20.0**
In % of industry value added	2.0	0.8	1.2

Source: Eurostat (2001b).

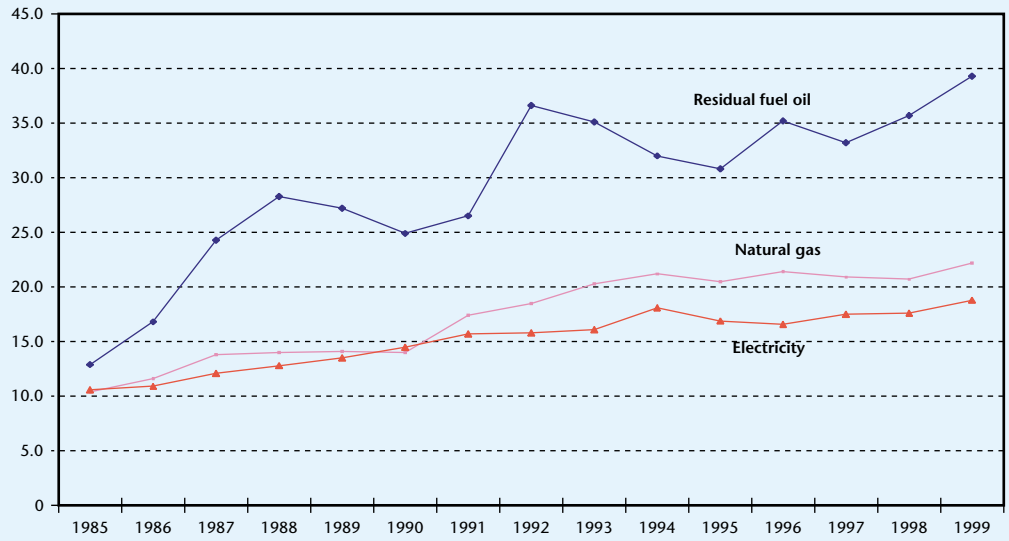
value-added. Within the overall total, some industries spend considerably more than this, with particularly high expenditures in the refineries, chemicals, and paper and pulp industries.

Not all measures that reduce environmental pressures are of course included in environmental protection expenditure. There is probably some underestimation due to measurement problems. Moreover many environmental improvements are also made as part of the normal expenditures of companies. This includes investments in new production equipment, which often are more efficient than the old in terms of environmental performance. Estimates of such additional expenditures do not exist for the EU, although these have been found to be substantial in US industry[145].

Taxes on industrial energy consumption are determined at Member State level. Whilst value-added tax is refunded to industry, specific duties on fuels have to be paid. In part for environmental reasons, the majority of Member States have consistently raised these specific taxes on industrial fuel consumption since 1985 (see Graph V.14). This rise has partly offset the fall in world energy prices over the period. Between 1985–1999, the tax component of industrial fuel prices has risen for fuel oil, natural gas, and electricity to stand at 39 %, 22 % and 19 % respectively in 1999. The current tax component of fuel prices makes up a significant proportion of manufacturing value-added.

145 See Gray and Shadbegian (1995), who suggest environmental protection expenditures may underestimate actual impacts on industrial costs by a minimum of 35 %.

Graph V.14: EU tax component of industrial energy prices
(%)



Source: Commission services (2001a).

V.5 Conclusions

This chapter has analysed the environmental performance of EU industry over the last 20 years with respect to two measures of natural resource inputs, energy and raw materials, and four measures of the emission of pollutants, greenhouse gases, ozone-depleting gases, acidifying gases, and ozone-precursor gases.

While recognising the limitations of the data currently available, the result of this study has been to reveal a significant de-coupling of economic growth in manufacturing from intensified environmental impact[146]. There is therefore significant evidence for the environmental Kuznets curve hypothesis that environmental pressures stabilise or even improves at higher levels of income. The most striking example of this is the progress made by EU manufacturing over the last 20 years in substantially reducing its emissions of acidifying gases, such as sulphur dioxide and nitrogen dioxide. Graph V.8 shows that, despite the 32 % rise in manufacturing production over the period 1980–99, emissions of acidifying gases declined by 67 %. Similarly, over the same period, industrial emissions of ozone-precursors have been reduced in absolute terms by some 25 %. Production of ozone-depleting gases in the European Union has now almost ceased. Meanwhile energy consumption has remained broadly constant since the mid–1980s despite the increase in manufacturing output. This has contributed to the reduction that has occurred in industrial emissions of greenhouse gases since the Kyoto baseline date of 1990. Recent years have also seen some stabilisation in industrial consumption of minerals and ores. Overall, the performance of EU industry compares favourably with that of US industry. In the extreme case of acidifying emissions, the eco-efficiency of EU industry has increased almost twice as quickly as in the United States.

Environmental policies have had a clear role in these developments. For example, the most significant decoupling of acidifying gases from economic growth followed the large combustion plants directive of 1988. Environmental policy played a key role also in the phasing out of CFC ozone-depleters. Policy progress has also been made on local air pollution, albeit at a slower pace. Manufacturing industry has responded by developing new technologies, improving its management practices, and greater investment in pollution prevention technologies.

The completion of the single market and the increasing deregulation of markets through the Lisbon strategy have improved the economic performance of the EU economy and provided the resources needed to improve the environment. These structural reforms have had some direct influ-

146 The partial evidence that is available on the other environmental impacts of manufacturing suggests important progress has been made in reducing water abstraction, but that less progress has been made in reducing industrial wastes (see EEA, 2001 and OECD, 2001). Action is currently taking place to reduce impacts from chemicals.

ence in improving energy-intensity and hence indirectly on greenhouse gas emissions. Increasing competition from the single market programme has increased the pressures on firms to improve their efficiency resulting in pressures to improve their energy efficiency. Moreover, where it has been carried out, energy market deregulation has tended to increase the usage of natural gas with a low carbon dioxide content.

The environmental improvement has come at an important financial cost to manufacturing industry and its customers. Environmental expenditures by EU industry stood in 1998 at some EUR 32 000 million, some 0.4 % of GDP or 2.0 % of industrial value-added. A drift upwards in environmental protection expenditure have occurred since the early 1980s.

References

Anite Systems (1999): 'A first set of eco-efficiency indicators for industry: pilot study', Report for Eurostat and DG Enterprise (Final report, 13 December 1999).

Baldwin, R. (1989): 'The growth effects of 1992', *Economic Policy*, No 9.

Bültmann, A. and Wätzold, F. (2000): 'The implementation of national and European legislation concerning air emissions from large combustion plants in Germany', UFZ-Centre for Economic Research, Liepzig.

Eames, M. (2001) 'The Large Combustion Plant directive (88/609/EEC): an effective instrument for SO2 pollution abatement' in M. Glachant (ed.) *Implementing European Environmental Policy*, Edward Elgar, Cheltenham.

Eichhammer, W. et al., (2001): 'Greenhouse Gas Reductions in Germany and the United Kingdom — Coincidence or policy?', Umweltbundesamt, *Research Report* 01/01, Berlin

EEA (2000): Environmental Signals 2000, EEA, Copenhagen.

EEA (2001a): Environmental Signals 2001, EEA, Copenhagen.

EEA (2001b): 'Total material requirement of the European Union', *Technical Report* No 55, EEA, Copenhagen.

EEA (2001c): 'European Community and Member States greenhouse gas emission trends 1990–1999', *Topic report* 10, EEA, Copenhagen.

EEA (2002): 'Annual European Community Greenhouse Gas Inventory 1999–2000 and Inventory Report 2002', *Technical report* No 75, EEA, Copenhagen.

Eurostat (1998): Environmental Protection Expenditure in Member States (1988–96 data), Luxembourg.

Eurostat (2001a): Integration Indicators for Energy (1985–98 data), Luxembourg.

Eurostat (2001b): Environmental Protection Expenditure in Europe (1990–99 data), Luxembourg.

Eurostat (2001c): 'Material use indicators for the European Union', Working Document 2/2001/B/2, Luxembourg.

Eurostat (2001d): 'Measuring progress towards a more sustainable Europe (1980–99 data)', Luxembourg.

Färe et al., (1994): *Production Frontiers*, Cambridge University Press, Cambridge, United Kingdom.

Färe et al., (2001): 'Accounting for air pollution emissions in measures of state manufacturing productivity growth' *Journal of Regional Science*, Vol. 41(3), pp..381–409.

Fuss, M. and McFadden, D. eds, (1978): *Production Economics: A Dual Approach* (2 vols), North Holland, Amsterdam.

Gray, W.G. and Shadbegian, R. J. (1995): 'Pollution abatement costs, regulation, and plant-level productivity', Working Paper 4994, National Bureau of Economic Research, Cambridge, Mass.

Grossman, G. M. and Kreuger, A. (1995): 'Economic growth and the environment' *Quarterly Journal of Economics*, Vol. CX(2), pp. 353–377, May 1995.

Hartman, R.S., Wheeler, D. and Singh. M. (1997): 'The cost of air pollution abatement' Applied Economics, vol. 29, pp. 759-774.

Hettige et al. (1997): 'Industrial pollution in economic development: Kuznets revisited', Development Research Group, World Bank, Washington D.C.

Jaffe, A. B., Peterson, S. R., Portney, P. R. and Stavins, R. N. (1995): 'Environmental regulation and the competitiveness of United States manufacturing: what does the evidence tell us?' *Journal of Economic Literature*, 33, pp. 132–163 (March 1995).

Jaffe, A. B., Newell, R. G. and Stavins, R. N. (2000): 'Technological change and the environment' Discussion paper 00-47, *Resources for the Future*, Washington D.C.

Lulofs, K. (2001): 'Adjustments in the Dutch electricity producing sector in the context of the European directive (88/609/EEC)' *CERNA Research Paper* 2000-B-4, ENS des Mines, Paris.

OECD (1997): 'Eco-efficiency', OECD, Paris (March 1997)

OECD (2001): 'Indicators to measure decoupling of environmental pressures from economic growth' *OECD* mimeo, OECD, Paris.

Pearce, D. W. and Palmer, C. (2001): 'Public and private spending for environmental protection: a cross-country policy analysis', *Fiscal Studies*, Vol. 22, No 4, pp. 403–456.

Porter and van der Linde, (1995): 'Towards a new conception of the environment-competition relationship' *Journal of Economic Perspectives*, Vol. 9(4), pp. 97–118 (Autumn 1995).

Schucht, S. (2001): 'Implementing the Large Combustion Plant directive (88/609/EEC) in France' *CERNA Research Paper* 2000-B-3, ENS des Mines, Paris.

Tietenberg, T. (2000): *Environmental and Natural Resource Economics*, Addison Welsey Longman, Reading, Mass.

UNECE (1994): The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions, United Nations Economic Commission for Europe, Geneva.

Wan, H.Y. (1971): *Economic Growth*, Harcourt Brace Jovanovich, New York.

Wünster (2001): 'Factors responsible for emission changes 1960–2020', mimeo, IIASA-RAINS, Laxenburg, Austria.

Ziesmer, T. (1996): 'Energieverbrauch und CO_2-Emissionen in Deutschland in der ersten Hälfte der neunziger Jahre' *DIW Wochenbericht* 4/96, DIW, Berlin.

ANNEX V.1
A simple growth model including environmental expenditures

This appendix outlines a simple growth model outlining the relationships between environmental expenditures, economic growth, and the growth of eco-efficiency and environmental pressures.

The growth model is a version of the standard Harrod-Domar growth model[147]. Let the growth of output (*Y*) be a simple function of aggregate investment (*I*):

$$\Delta Y = a*I$$

where *a* is the incremental output-capital ratio.

Aggregate investment is given by aggregate savings:

$$I = s*(1-e)*Y$$

where *s* is the saving ratio from real income taking account of environmental expenditures, assumed to be a fraction *e* of total real income.

Bringing these two equations together, we obtain a modified Harrod-Domar model for growth in real output[148]:

$$\Delta Y/Y = a*s*(1-e)$$

Let the growth in eco-efficiency (*P*) be given by the function:

$$\Delta P/P = \pi + F(e)$$

Where π is the long-run or trend rate of improvement in eco-efficiency and *F(e)* is a concave function in *e*[149]. The theory behind the equation is that to increase the rate of eco-efficiency growth beyond the trend rate, π, requires steadily increasing fractions of output to be spent on environmental expenditures.

The workings of the model can be shown in Graph V.A1. The *output growth curve* represents the equation for the rate of growth of output: it is a line declining in *e*, the fraction of output spent on environmental expenditures. The *eco-efficiency curve* represents the equation for the growth in eco-efficiency: it has the intercept π and is increasing, but at a diminishing rate, in *e*, the fraction of output spent on environmental expenditures.

From the definition of eco-efficiency (see Section two), we have the identity:

$$\Delta E/E = \Delta Y/Y - \Delta P/P$$

the percentage growth in environmental pressures equals the percentage growth in output minus eco-efficiency.

Hence the rate of growth of environmental pressures is given by the gap between the two lines on the graph. To the left of the intersection of the two lines, the growth of environmental pressures is positive but less than the rate of growth in output (relative de-coupling). To the right of the point of intersection, the environmental pressures are contracting (absolute de-coupling). Environmental pressures are of course stable at the point of intersection.

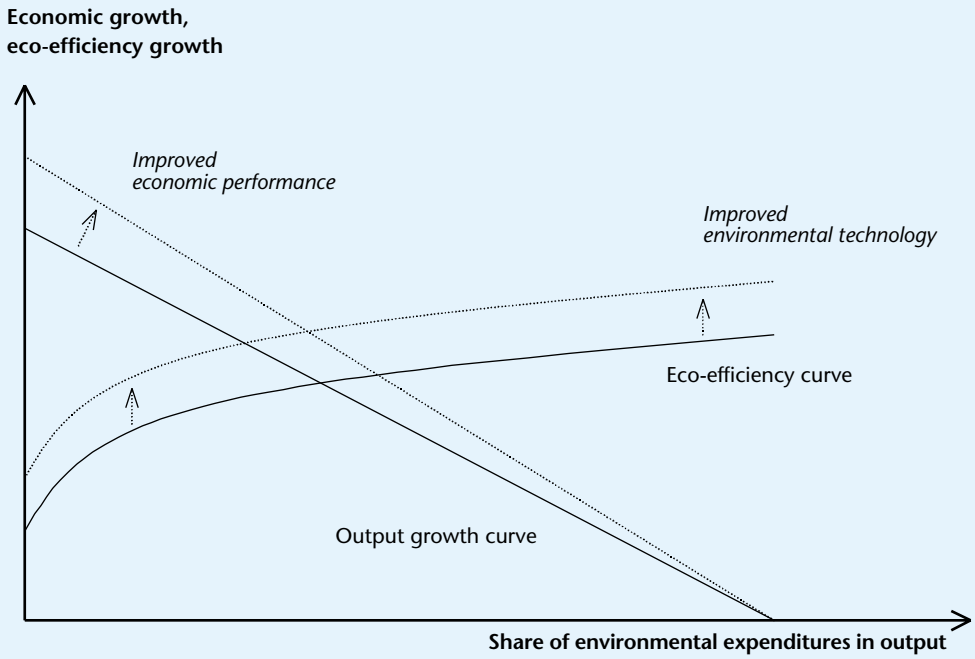
To complete the model, it is assumed that the government can choose the rate of environmental expenditures to determine both the rate of growth of output and environmental pressures. The *trade-*

147 See e.g. Wan (1971). The use of alternative technology assumptions would affect slightly the qualitative results. The Harrod-Domar assumption is consistent with the hypothesis of increasing returns to scale. With a Solow-type model with constant returns to scale, higher environmental expenditures would result in a temporary reduction in the growth rate and a lower long-run level value of both output and capital-output ratio. For alternative models see Baldwin (1989).

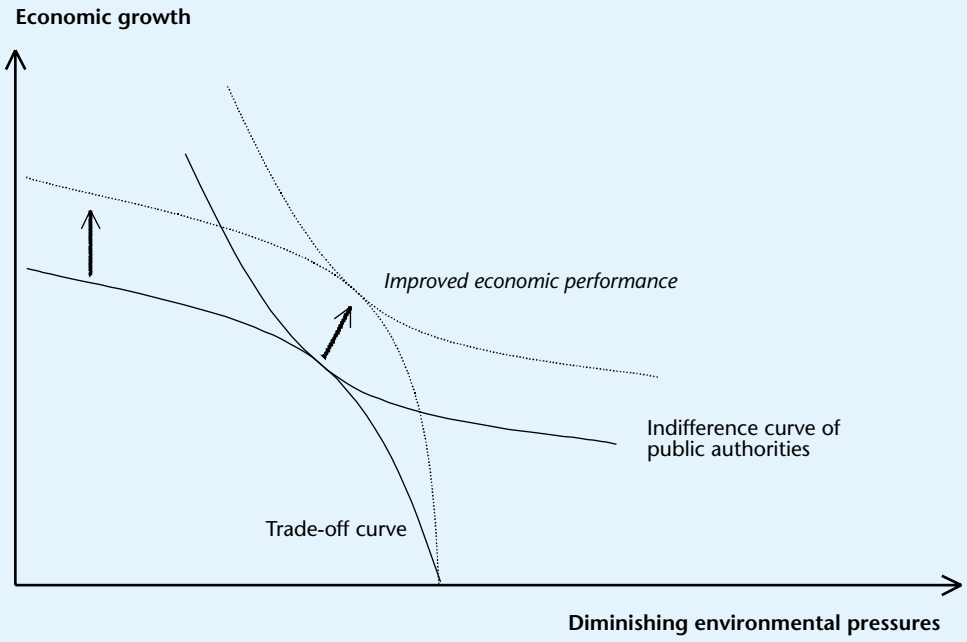
148 In principle, the incremental output-capital ratio, *a*, may also be an increasing function of environmental expenditures as suggested by Porter's win-win hypothesis. However the impact of this effect on the properties of the model is likely to be of second-order importance.

149 *F(e)* has the properties: *F(0) = 0, F(1) < ∞, F'(e) > 0, F''(e) < 0*. An example of such a function is $\sqrt{e}$.

Graph V.A1: A growth model with environmental expenditures

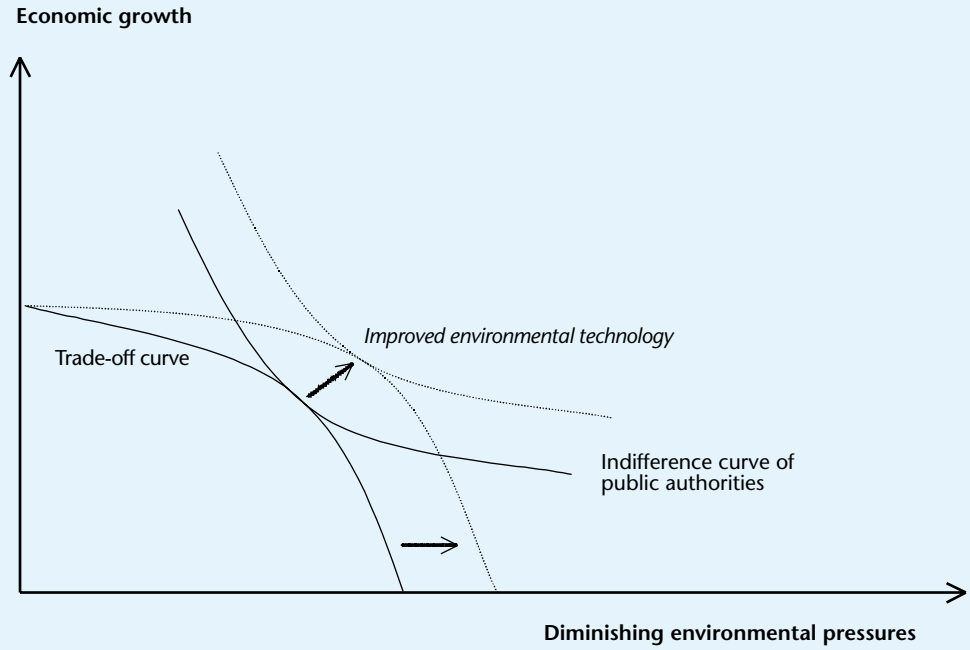


Graph V.A2: Effect of improved economic performance



off curve in Graph V.A2 (and 3) shows the feasible combinations achievable by the government: as environmental protection expenditures increase, the growth in environmental pressures is reduced, but the economic growth rate declines. The government is assumed to have preferences for lesser environmental pressures and higher economic growth given by a series of *indifference curves*. The government optimises by choosing the level of environmental expenditures allowing it to reach the highest possible indifference curve. Note that the position of these indifference curves will in general depend on the *absolute level* of real income: as society becomes richer preferences may well

Graph V.A3: Effect of improved environmental performance



change away from economic growth towards lowering environmental pressures. This would be represented by the locus of the indifference curves moving downwards.

The implications of an improvement in economic efficiency — perhaps through improved economic integration or greater market flexibility — can be shown in terms of the model. Improved economic efficiency would be shown as an increase in the incremental output-capital ratio or the saving ratio. This will improve the trade off between both output growth and the rate of growth in environmental pressures. In Graph V.A1, the output growth curve would pivot upwards (see dotted line) allowing the possibility of both an increase in the growth rate and a fall in the rate of environmental pressures. From Graph V.A2, the trade-off curve would also pivot upwards allowing the achievement of a higher indifference curve (again showed through dotted lines). Given normal preferences, the result will be both reduced growth in environmental pressures and higher economic growth.

A similar analysis may be done for the implications of an improvement in the performance of environmental technology which leads to an increase in the trend rate of improvement in eco-efficiency (π). This would result in a parallel movement upwards in the eco-efficiency curve in Graph V.A1, reducing the rate of growth of environmental pressures for each level of environmental expenditure. The trade off curve shown in Graph V.A3 would pivot outwards in the direction of improving environmental performance, improving the trade-off between economic growth and environmental pressures, and most likely resulting in more favourable developments in each.

Definition of variables

EU-15 DATA:

Production: Value added in manufacturing output ESA 95 (National accounts definition NACE rev.1, section D) in EUR millions at 95 constant prices. 1980–1990: European Union excluding former DDR; 1991–1999: EU-15 including former DDR. (Source: Eurostat and Commission services).

Acidifying gases: Industrial emissions of SO_2, NO_x and NH_3 in ktonnes acid equivalent. EU-15 (including former DDR prior to 1991). (Source: European Environment Agency: Indicator Fact Sheet Signals 2001: Emissions of Acidifying Substances, 2001 (updated by EEA, 2002)).

Ozone precursor emissions: Industrial emissions of NO_x, non-methane volatile organic compounds, CO and CH_4 in ktonnes total ozone forming potentials. EU15 (including former DDR prior to 1991). (Source: European Environment Agency: Indicator Fact Sheet Signals 2001: Emissions of Ozone Precursors, 2001 (updated by EEA, 2002)).

Greenhouse gas emissions (1990–1999): Industrial emissions of total greenhouse gases, CH_4, N_2O and aggregation three halocarbons: HFCs, PFCs and SF_6 in ktonnes CO_2 equivalent. EU15. (Source: EEA, 2002).

Carbon dioxide emissions (1985–1999): ktonnes CO_2. EU15 (including former DDR prior to 1991). (Source: New Chronos database, Eurostat, updated).

Energy Inputs: Final energy consumption (all products) by industry in ktonnes of oil equivalent. 1980–90: European Union excluding former DDR; 1991–99: EU-15 including former DDR. (Source: Eurostat, 2001a, Table 3.4, p. 45 (updated by Eurostat).

Energy Prices: EU-15. (Source: Eurostat, 2001a, Table 7.6, p. 135).

Mineral inputs: Domestic consumption of industrial minerals and ores in ktonnes. 1980–90: European Union excluding former DDR; 1991–99: EU-15 including former DDR. (Source: Eurostat — personal communication).

Ozone depleting chemicals: Industrial production in tonnes of ozone depleting potentials. EU-15 (Source: Eurostat, 2001d, table on page 68).

US DATA:

Production: Value added in manufacturing output (National accounts definition) at constant prices of 1995 converted to EUR millions at 1995 purchasing power parity exchange rates. (Source: 1987–99, United States Bureau of Economic Analysis; 1980–87, Federal Reserve Board, http://w3.access.gpo.gov/usbudget/fy2003/erp.html#erp3).

Acidifying gases: Industrial emissions of SO_2, NO_x and NH_3 in ktonnes acid equivalent. (Source: EMEP: http://www.emep.int/index_data.html).

Ozone precursors: Industrial emissions of NO_x, non-methane volatile organic compounds, CO and CH_4 in ktonnes total ozone forming potentials. (Source: EMEP: http://www.emep.int/index_data.html).

Greenhouse gases: Industrial emissions of CO_2, CH_4, N_2O and three halocarbons: HFCs, PFCs and SF_6 in ktonnes CO_2 equivalent. (Source: United Nations Framework Convention on Climate Change: http://unfccc.int/resource/ghg/tempemis2.html).

Energy inputs: Primary energy consumption by industry in ktonnes of oil equivalent. (Source: United States Energy Information Administration: http://www.eia.doe.gov/emeu/international/total.html#IntlConsumption).

Other data

Data on environmental protection expenditures in Germany, Statistiches Bundesamt (personal communication).

Data on emissions of acidifying gases, ozone-precursors, and greenhouse gases from former DDR (1980–94), unofficial estimates of Deutsche Umweltbundesamt (personal communication).

Details of adjustment of data for German reunification

The official data on aerial emissions of carbon dioxide, acidifying gases, and ozone-precursors for Germany includes emissions from the former DDR prior to 1991. These official data on emissions therefore are contaminated by the effects of the collapse of East German industry between 1989 and 1991. This resulted in a very substantial overall reduction in emissions of pollutants from the previously heavily-polluting East German industry. To exclude these effects and to make the emissions data fully compatible with manufacturing production data, the official German emissions data have been adjusted using unofficial Umweltbundesamt estimates of emissions from the former DDR. The extent of these adjustments can be seen in the following table:

	Effect of inclusion of former-DDR on total EU15 emissions in 1991 (%)	Effect of inclusion of former-DDR on total EU15 eco-efficiency in 1991 (%)	Impact of inclusion of former-DDR on growth of EU15 emissions 1980- or 1985- 1991 (%)[150]
Acidifying gases	+ 18.2	- 16.8	- 2.8
Ozone-precursors	+ 3.7	- 2.3	- 7.8
Carbon-dioxide	+ 6.4	- 5.0	- 6.0

150 The number denotes the percentage difference between the growth of emissions of the EU-15 (excluding the former DDR) and the growth of emissions of the EU-15 (including the former DDR). The periods taken are 1980–91 in the case of acidifying gases and ozone-precursors and 1985–91 for carbon dioxide.

ANNEX
Background studies to the European competitiveness report 2002

The following background studies were commissioned and used in the preparation of the present Report:

Baker, P., G. Koop and A. Meijer (2002): 'Productivity performance of European market services'.

Van Riel, A., V. Davies, D. Patoir and I. Vogelaar (2002): 'Human capital, labour allocation and productivity performance'.

More information on the Enterprise DG

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:
http://europa.eu.int/comm/commissioners/liikanen/index_en.htm

Enterprise DG on the web:
http://europa.eu.int/comm/dgs/enterprise/index_en.htm

Cordis (Community Research and Development Information Service):
http://www.cordis.lu

Enterprise DG work programme:
http://europa.eu.int/comm/dgs/enterprise/work_programme_2001.htm

Enterprise DG's printed publications:
http://europa.eu.int/comm/enterprise/library/index.htm

Newsletters

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.

http://europa.eu.int/comm/enterprise/library/enterprise-europe/index.htm

Cordis focus is published twice a month in English, French, German, Italian and Spanish. It provides a review of the main developments in all aspects of EU research and innovation activities, covering general policy developments, programme implementation, calls for tenders and results, events, legislative activities, and much more.

http://www.cordis.lu/focus/en/src/focus.htm

Innovation & technology transfer is published six times a year in English, French, German, Italian and Spanish by the European Commission's Innovation Programme, which aims to promote innovation at Community level and encourages SME participation under the fifth research framework programme. The emphasis is on timely news relevant to these objectives and in-depth 'case studies' of successful projects.

http://www.cordis.lu/itt/itt-en/home.html

Euroabstracts is published six times a year in English by the 'Innovation and SMEs' programme, part of the European Commission's fifth research framework programme. The Innovation and SMEs programme promotes innovation and encourages the participation of small and medium-sized enterprises in the framework programme.

http://www.cordis.lu/euroabstracts/en/home.html

European trend chart on innovation newsletter. The trend chart project develops practical tools for innovation policymakers in Europe. It pursues the collection, regular updating and analysis of information on innovation policies at national and Community level. The newsletter is published quarterly in English, French and German. Further reports and studies are available on the web site http://trendchart.cordis.lu/Reports/

Enterprise Papers

Global competitiveness in pharmaceuticals — A European perspective. Enterprise Papers No 1, 2001.
A. Gambardella, L. Orsenigo, F. Pammolli. Luxembourg (Eur-Op), 2001. 108 pp. (EN). Cat. No NB-37-01–162-EN-C

The textile and clothing industry in the EU — A survey. Enterprise Papers No 2, 2001.
W. Stengg. Luxembourg (Eur-Op), 2001. 68 pp. (EN). Cat. No NB-38-01-770-EN-C

External services, structural change and industrial performance. Enterprise Papers No 3, 2001.
M. Peneder, S. Kaniovski, B. Dachs. Luxembourg (Eur-Op), 2001. 36 pp. (EN). Cat. No NB-38-01-956-EN-C

Europe's position in quality competition. Enterprise Papers No 4, 2001.
K. Aiginger. Luxembourg (Eur-Op), 2001. 66 pp. (EN). Cat. No NB-38-01-964-EN-C

Innovation, technology and risk capital. Enterprise Papers No 5, 2001.
D. Steinbock. Luxembourg (Eur-Op), 2001. 48 pp. (EN). Cat. No NB-40-01-339-EN-C

Assessment criteria for distinguishing between competitive and dominant oligolopies in merger control. Enterprise Papers No 6, 2001.
Europe Economics. Luxembourg (Eur-Op), 2001. 164 pp. (EN). Cat. No NB-40-01-608-EN-C

Innovation and competitiveness in European biotechnology. Enterprise Papers No 7, 2002.
A. Allansdottir, A. Bonaccorsi, A. Gambardella et al. Luxembourg (Eur-Op), 2002. 112 pp. (EN). Cat. No NB-40-01-690-EN-C

Technology policy in the telecommunication sector — Market responses and economic impacts. Enterprise Papers No 8, 2002.
Heli Koski. Luxembourg (Eur-Op), 2002. 46 pp. (EN). Cat. No NB-AE-02-001-EN-C

Business impact assessment pilot project. Final report — Lessons learned and the way forward. Enterprise Papers No 9, 2002.
European Commission. Luxembourg (Eur-Op), 2002. 40pp. (EN). Cat. No NB-AE-02-002-EN-C

Innovation Papers

21 University spin-outs in Europe — Overview and good practice
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20 Assessment of the Community regional innovation and technology strategies
Luxembourg (Eur-Op), 2002. Cat. No NB-NA–17-028-EN-C.

19 Corporation tax and Innovation
Luxembourg (Eur-Op), 2002. Cat. No NB-NA–17-035-EN-C.

18 Innovation and enterprise creation: statistics and indicators
Luxembourg (Eur-Op), 2001. 300 pp. EN. Cat. No NB-NA–17-038-EN-C.

17 Innovation policy in Europe: European trend chart on innovation
Luxembourg (Eur-Op), 2001. 52 pp. (DE, EN, FR). Cat. No NB-NA–17-044-EN-C.

16 Innovation policy issues in six candidate countries: the challenges
Luxembourg (Eur-Op), 2001. 190 pp. EN. Cat. No NB-NA–17-036-EN-C.

15 Guarantee mechanisms for financing innovative technology
Luxembourg (Eur-Op), 2001. EN. _ 20 Cat. No NB-NA–17-041-EN-C.

14 Interim assessment of the I-TEC pilot project.
Luxembourg (Eur-Op), 2001. EN. Cat. No NB-NA–17-033-EN-C.

13 Training needs of investment analysts.
Luxembourg (Eur-Op), 2001. 48 pp. (EN). Cat. No NB-NA–17031-EN-C.

12 Informal investors and high-tech entrepreneurship.
Luxembourg (Eur-Op), 2001. 91 pp. (EN) Cat. No NB-NA–17030-EN-C.

11 Building an innovative economy in Europe.
Luxembourg (Eur-Op), 2001. 67 pp. (EN). € 11.50. Cat. No NB-NA–17-043-EN-C

10 Enforcing small firms' patent rights.
Luxembourg (Eur-Op), 2001. 89 pp. (EN). Cat. No NB-NA–17-032-EN-C.

Observatory of European SMEs

Highlights from the 2001 Survey. No 1, 2002.
Luxembourg (Eur-Op), 2002. 32 pp. (DE, EN, FR). Cat. No NB–14-01-001-**-C.

SMEs in Europe, including a first glance at EU candidate countries. No 2, 2002.
Luxembourg (Eur-Op), 2002. 52 pp. (DE, EN, FR). Cat. No NB–14-01-002-**-C.

Regional clusters in Europe. No 3, 2002.
Luxembourg (Eur-Op), 2001. 64 pp. (DE, EN, FR). Cat. No NB–14-01-003-**-C.

Reports, studies etc.

A pocket book of enterprise policy indicators. 2001 edition.
Luxembourg, 2002. 29 pp. (EN). Cat. No NB-41-01-649-EN-C

European competitiveness report 2001.
Luxembourg (Eur-Op), 2001. 139 pp. (EN). € 10. Cat. No NB-39-01–110-EN-C

Competitiveness, innovation and enterprise performance.
A selection of graphs and tables from the competitiveness report, the innovation scoreboard and the enterprise scoreboard. Brussels: Enterprise DG, 2001. 104 p. (EN).

The e-economy in Europe: Its potential impact on EU enterprises and policies, Brussels, 1–2 March 2001.
Luxembourg (Eur-Op), 2001. 47 pp. (EN). Cat. No NB-35-01-053-EN-C

Creating an entrepreneurial Europe. The activities of the European Union for small and medium-sized enterprises (SMEs) — 2000 edition.
Luxembourg (Eur-Op), 2001. 150 pp. (all Community languages). Cat. No NB–27-00-992-**-C

The intangible economy: impact and policy issues.
Luxembourg (Eur-Op), 2001. 59 pp. (EN). € 20. Cat. No NB-31-00-772-EN-C

Implementation report on the action plan to promote entrepreneurship and competitiveness.
Luxembourg (Eur-Op), 2001. 28 pp. (all Community languages). Cat. No NB-34-00-390-**-C

Industrial aspects of the information society: business networks and the knowledge-driven economy: an empirical study carried out in Europe and Canada.
Luxembourg (Eur-Op), 2000. 81 pp. (EN). € 43. Cat. No CO–25-99–253-EN-C

Methodologies for benchmarking framework conditions.
Luxembourg (Eur-Op), 2000. 17 pp. (EN). Cat. No NB-31-00-780-EN-C

The role of information and communications technologies in growth and competitiveness.
Luxembourg (Eur-Op), 2000. 17 pp. (EN). Cat. No CO–26-99-449-EN-C

Enterprise guides

Recreational craft directive and comments to the directive combined. A guide to the application of Directive 94/25/EC of 16 June 1994 on the approximation of the laws, regulations and administrative provisions of the Member States relating to recreational craft.
Luxembourg (Eur-Op), 2001. 104 pp. (EN). Cat. No NB–19-98-334-EN-C

ATEX guidelines. Guidelines on the application of Directive 94/9/EC of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
Luxembourg (Eur-Op), 2001. 118 pp. (EN). Cat. No CO–22-99-014-**-C

Helping businesses start up: A 'good practice guide' for business support organisations.
Luxembourg (Eur-Op), 2000. 36 pp. Cat. No CT–25-99-980-**-C

Guide to the implementation of directives based on the new approach and the global approach.
Luxembourg (Eur-Op), 2000. 112 pp. (DE, FR, EN). Cat. No CO–22-99-014-**-C

Electrical and mechanical engineering directory, 2000 edition.
Luxembourg (Eur-Op), 2000. 133 pp. (EN). Cat. No CO–24-99–275-EN-C

Useful facts in relation to the personal protective equipment (PPE) Directive 89/686/EEC.
Luxembourg (Eur-Op), 2000. 145 pp. (EN). Cat. No CO–21-99-020-EN-C

Machinery: useful facts in relation to Directive 98/37/EC.
Luxembourg (Eur-Op), 1999. 266 pp. (EN). Cat. No CO–20-99-866-EN-C

Pharmaceuticals in the European Union
Luxembourg (Eur-Op), 2000. 36 pp. (EN). Cat. No NB-30-00-059-EN-C

Cosmetlex: The rules governing cosmetic products in the European Union.
Luxembourg (Eur-Op), 2000, 3 vol. (EN). Vol. 1: Cosmetics legislation, 74 pp., EUR 14.50; Vol. 2: Methods of analysis, 187 pp. EUR 31; Vol. 3: Guidelines, 84 pp., EUR 16. Vol. 1 Cat. No NB–26-99-958-EN-C Vol. 2 NB–26-99-966-EN-C Vol. 3 NB–26-99-974-EN-C

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Medicinal products for human and veterinary use, Vol 4

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