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Raising productivity growth: key messages from the European Competitiveness Report 2007

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EXECUTIVE SUMMARY

This is the tenth edition of the European Competitiveness Report since the 1994 Industry Council Resolution established its basis by inviting the Commission to report annually on the competitiveness of European industry. In this Report, competitiveness is understood as a sustained rise in the standards of living of a nation or region and as low a level of involuntary unemployment as possible. At the level of industrial sectors, maintaining and improving the position in the global market is the main criterion for competitiveness.

This concept of competitiveness does not necessarily entail a comparative perspective. However, the use of cross-country comparisons when assessing competitiveness and the frequent use of the US as the reference point can be useful to the extent that the US can be considered to epitomise in many fields the "technology frontier".

The Report approaches competitiveness issues from the viewpoint of economic theory and empirical research. Its ambition is to contribute to policy making by highlighting relevant trends and developments, and by assessing in an analytical manner the expected outcomes of the various policy options. The Report's main subject of interest is productivity growth and the factors affecting it.

After a review of recent developments concerning growth, productivity and employment, both at the level of the EU and of the main economic sectors, the Report reviews the state of microeconomic reforms under the Lisbon agenda from the point of view of their potential of raising productivity. It focuses, more particularly, on skills, as a factor for competitiveness. In addition, the Report assesses the relative strengths and weaknesses of European industries with respect to the various dimensions of competitive performance and concludes with presenting a long term vision of European manufacturing so as to put the emerging trends and challenges in perspective and check whether existing policies are consistent with them.

Growth, employment and productivity

Recent developments of the European economy in comparison with the US, confirm that the trend of ever increasing economic growth and productivity gap which could be observed over the last decade has come at a halt. While the reasons underpinning this trend were structural, it is still too early, at this moment, to say whether this change is the product of purely cyclical developments or the first manifestation of a new pattern.

The real growth rates of the EU-27 Gross Domestic Product (GDP) were both in the last quarter of 2006 3.5% year-on-year) and in the whole year (3.0%) the highest since the year 2000.This improvement has been supported by both a higher productivity growth and a stronger employment growth. In this context, it has also to be noted that the enhanced productivity growth is mainly caused by an accelerating growth of total factor productivity, i.e. the part of productivity growth that cannot be assigned to an easily measurable factor such as capital deepening or improved labour quality, but must be attributed to less tangible factors such as technical and organisational progress. In fact, this productivity component grew last year much faster than in previous periods.

These developments and the fact that the EU-27 productivity growth was last year for the first time since 2001 higher than in the US[1], thus closing the EU-US productivity gap, are encouraging. On the face of existing evidence, while the upturn is essentially cyclical in nature, it seems likely that there is also a structural component linked with past structural reforms enacted by the EU Member States, especially in the labour market. Sectoral productivity gains, such as in network industries, and the increase in the skill levels of the work force also support such a view. Such a structural improvement in productivity can be expected to become visible in the future as the effects of recent reforms – particularly those generated through the renewed Lisbon strategy – start feeding through more strongly.

The fact remains, however, that in terms of productivity levels, productivity in the US remains much higher. The main source of the gap is total factor productivity, and secondarily, the quality of human capital, while capital deepening contributes towards closing this gap.

These macroeconomic developments are reflected at sector level. All manufacturing sectors in the EU, with the exception of tobacco, exhibit substantially higher growth rates in 2006, thus contributing to the up-turn in EU growth in the last year. Even textiles and clothing, two sectors with negative growth over the last decade, have improved their performance, although they still show negative growth rates in 2006. However, GDP growth in the EU is *concentrated* in a few sectors, which account for a large share of total growth. Particularly, the contribution of services sectors to EU growth is substantial. Among manufacturing, only two sectors (electrical and optical equipment and chemicals) can be mentioned, even if their contribution to GDP growth is much lower than the one of the top sectors.

As for the whole of the economy, labour productivity decelerated in nearly all sectors of the economy in the period 2000-2005. However, a change took place in 2006, when growth rates increased significantly in comparison to the period 2000-2005 and even to the period 1995-2000.

Sector level data give some additional insights in the comparison of productivity developments between the EU and US. For instance, they confirm that the lower labour productivity growth in the EU economy in the last decade was due mainly to the poorer aggregated performance in labour productivity growth of EU sectors and not to the sectoral composition of the economy (industry mix), which exerted a slightly positive influence in the results. Here too, the most recent data (available for manufacturing only) confirm that the productivity growth differential in favour of the US becomes negligible at the end of 2006 and has turned positive since then.

Too often, globalisation is associated with job losses - or with some undefined and hypothetical opportunities. The resulting social costs and anxiety are real and call for appropriate policy response to accompany and anticipate transition. However, they should not lead to losing from sight the positive effects that opening up and integration into world markets have in a country's economic performance, i.e. productivity gains from the resulting specialisation, from scale effects, from the greater competitive pressures that forces less efficient firms out of the market, and from the greater ability to absorb technological advances and new ideas developed in the rest of the world. Taken together, these factors suggest that openness to trade can play an important role in raising the rate of productivity growth of an

[1] However, the deceleration of US productivity growth in 2006 contributed more in this result than the corresponding acceleration in the EU.

economy; with the full benefits of openness accruing to economies that can easily redeploy factors of production between firms as well as from declining to growing industries.

The Report illustrates the positive relationship between aggregate productivity and globalisation, using trade openness as a proxy for the later, and summarises empirical findings on the causal relationship between productivity and globalisation. While the direction of causality can go both ways, of course, it is clear that with increases in the tradability of services and with a growing fragmentation of production processes, companies can reconfigure their production networks to boost overall productivity and hence competitiveness.

Microeconomic reforms and productivity

Raising the long-term economic growth potential by increasing productivity growth is one of the fundamental objectives of the renewed Lisbon strategy and an important response to the challenges of globalisation, ageing, the rapid pace of technological progress, the global increase in the demand for high-skilled labour and the need to combat climate change. If the European Union wants to sustain its social model in the future, strong productivity growth is one important precondition for being able to do so. Reforms in pursuit of this objective are being undertaken mainly in the microeconomic policy pillar of the integrated strategy. Among the policies most relevant to TFP growth are those designed to foster increased investment in R&D and innovation, the use of ICT, competition and product markets reform but, also, the quality of human capital and better regulation.

Thus the rationale for structural reforms rests in the role specific policies can play in raising productivity growth and potential output. How the respective roles look like and how effective they are remains the subject of an ongoing debate, although some conclusions can already be drawn:

– Investment in R&D and innovation is conducive to boosting productivity, the more so if the elements of the knowledge triangle, R&D, innovation and education and training, are well integrated.

– ICT investment has high returns in terms of productivity growth when accompanied by appropriate organisational changes, which ensure that ICTs are used efficiently.

– Increased competition on better regulated markets tends to have positive effects on productivity and employment by improving allocative efficiency (static), productive efficiency (work organisation), and dynamic efficiency (innovative products and processes) even though the effect on innovation is more ambiguous depending on market structures and on the distance of market participants to the technological frontier. Competition is of particular importance for the countries and industries close to the technological frontier for maintaining their edge.

– Significant increases of output and consumption can also be achieved by reducing the administrative burden and thereby freeing resources for more productive uses. In addition, well-designed tax policies may provide the correct incentives to better achieve the objectives of growth-enhancing policies.

An assessment of recent reforms by Member States in product and services markets as well as on the field of better regulation reveals that, in general, reforms in these areas have made

notable progress, even if this progress is not yet fully reflected in the data measuring performance.

For instance, Member States have been strengthening their Better Regulation policies in recent years thus improving the quality of regulation and cutting back on red tape. The promotion of excellence in education and research is also pursued vigorously by many Member States together with sustained efforts to increase spending on R&D. Finally, Member States have made considerable progress in reducing start-up costs for SMEs by facilitating procedures and setting up one-stop-shops.

The coordination of national reform policies in the EU is an important aspect of the Growth and Jobs Strategy. There are several reasons why the coordination of Member States' economic reforms may bring additional benefits. While countries can learn from each other, joint efforts are stimulating to carry on reforms and coordination can also help to overcome national resistance against reforms. Most importantly, coordinated implementation may create benefits which would be absent, had reforms been pursued unilaterally.

The empirical analysis of spillovers from reforms confirms that coordinated action in the areas mentioned above produces, in many cases, benefits substantially superior to those of acting alone. For instance, roughly half of the potential increase of GDP generated by Member States' achievement of their R&D intensity targets would result from cross-border knowledge spillovers. Additional benefits are accruing from policy complementarities. As an example, increasing skills and R&D raises real wages, which in turn should increase participation rates. Also, the reduction of administrative burdens, through lower mark-ups, has strong synergies with the employment target as it works through a reduction in equilibrium unemployment.

Skill problems in European Industrial Sectors

Educational attainment shows an upward trend in the EU countries, as well as in most other countries across the world. A better educated work force is conducive for a country's economic performance. Human capital not only augments the efficiency of labour, it can also help to create absorptive capacity so that firms can more easily adopt technologies developed elsewhere. Both mechanisms would foster productivity and international competitiveness. For example, empirical research indicates that raising the average duration of schooling by one year would increase productivity by 8 to 10% in the long run.

The rising educational attainment and its contribution to competitiveness is also reflected at sectoral level. Skills upgrading is under way in all economic sectors, even in low-skill ones. Also, empirical analyses reveal that sectors employing a larger share of high skilled or medium skilled workers exhibit higher productivity growth while the share of low skilled workers in a sector is associated with a negative impact on productivity growth. Furthermore, skills matter for the speed of convergence towards the technology frontier. As might be expected, convergence is faster in high skill intensive industries.

The importance of skills can also be identified within a growth accounting framework. In most countries, changes in the skill composition of labour input are responsible for more than half of the gross changes in the composition of labour input measured in terms of the difference between the indices of hours worked and of labour services supplied, where the latter takes into account age, gender and skills. This shows that skill upgrading made a

relevant contribution to labour demand shifts and implies that there is a substitution process towards higher quality types of labour.

The same can generally be said for individual industries. Here the analysis demonstrates that the upgrading process within industries contributes more to the increasing demand for highly skilled workers than shifts of overall employment between sectors or industries. Nonetheless, there is also a general shift of employment away from low-skill intensive industries towards medium- and high-skill intensive industries, and this shift occurs across all groups of EU countries.

Against this background, skill gaps can be seen, firstly, as an adjustment problem, arising after an increase in demand for (or fall of supply of) a certain skill. In such a situation the government's role could be to smooth the transition process. Secondly, skill gaps can also be due to a non-optimal mix of skills in the economy. In this case government intervention might be needed to correct market failures or to improve institutions which prevent the economy from reaching an optimal mix of skills.

Case studies for six selected EU Member States on skill shortages in two of their industries, textiles and clothing, and mechanical engineering, show that skill shortages vary considerably across Member States, both in terms of their scale as well as in terms of rates of change, but greater problems are evident in the mechanical engineering industry. Skill shortages are usually most pronounced for technically skilled staff, and more acute for operatives than for ancillary staff. The causes of skill shortages in the mechanical engineering industry seem to be of a structural nature, often related to qualitative discrepancies on labour markets. The textiles industry, by contrast, is confronted with a low level of education among many of its employees, which limits the sector's adaptability and the capability of workers to learn new skills.

The performance of European industries

In order to obtain a full picture of European competitiveness, an in-depth analysis of sectoral competitiveness for 52 sectors is undertaken. This analysis covers the relative strengths and weaknesses of European industries with respect to various dimensions of performance such as the growth of value added, employment, labour and Total Factor Productivity, international trade, and foreign direct investments.

All in all, the competitive performance of European industries is highly variable, both across countries and between sectors. More specifically, competitiveness differs greatly depending on which dimension of performance is investigated. For the period since 1995, the EU exhibits relatively low performance in terms of value added growth, labour and Total Factor Productivity growth, while appearing quite healthy in terms of sectoral profitability and trade performance. Incidentally, the latter stands in sharp contrast with the US which lost market shares in almost all of its manufacturing industries.

Assessing the relative strengths and weaknesses by sector, the mining sector and the production of leather and footwear, clothing, textiles, nuclear fuel and tobacco show a persistent decline in terms of value added and employment. Conversely, almost all industries with the highest rates of value added growth in the European Union are associated with the new information and communication technologies, i.e. communication equipment, office machinery and computers, as well as telecommunications and computer related services.

Compared to the US, the biggest gap in sectoral performance can be found in the manufacturing of office machinery and computers, wholesale and retail trade, air transport, and the financial services. The latter three services sectors all appear to be rather sensitive to economies of scale and are likely to benefit from larger integrated markets in the US. Conversely, the EU shows pockets of higher growth in selected areas of high-tech manufacturing, particularly pharmaceuticals, and the network industries, such as electricity, gas and water supply, water transport, and telecommunications, which are apparently undergoing substantial restructuring processes.

Addressing the dynamics of labour productivity growth, the data confirm a tendency of general catching-up, including many service sectors. This implies that countries with lower initial levels of labour productivity have on average achieved higher growth, whereas countries initially ranking at the top of productivity performance found it more difficult to maintain high growth rates. However, pharmaceuticals and the computer industry are exceptions to this rule. They are characterised by dynamic specialisation, where given competitive strength not only persists but tends to be reinforced. Consequently, certain countries with an initially high level of productivity in these industries also enjoy higher rates of labour productivity growth at a later stage.

An analysis of structural relationships among different performance indicators highlights the trade-off between the growth of employment and labour productivity in the short to medium term. This trade-off touches upon the choice between policies which are primarily directed at raising the labour intensity of growth, and policies aiming at raising productivity growth. Overall, among the variables investigated, Total Factor Productivity growth appears to be the central driver of sectoral performance. It exerts a positive impact on the growth of value added and labour productivity, inward FDI, and gains in international comparative advantage.

Decomposing the entire variation in average sectoral performance between countries and industries shows that a relatively small portion of about 12% is accounted for by fixed country effects, i.e. differences in purely macro-economic conditions and the general business environment with equal impact on all industries. Conversely, fixed industry effects explain almost one third of the total variation in performance. These effects refer to intrinsic differences between industries and are as such not likely to respond to different policies. However, fixed industry effects do point toward the importance of structural change and the policies that enable it by raising the ability of labour and capital markets to reallocate resources efficiently.

The majority of variation, then, is explained by country-industry interaction effects, i.e. by the particular performance of a country and an industry. This fact is testimony to the heterogeneity in performance and the variety of causative factors. It calls for an integrative policy approach, where horizontal and vertical perspectives are combined in order to adjust the business environment to the particular characteristics and needs of the respective industries. And it confirms the validity of the integrated approach to industrial policy put forward by the European Commission in recent years, comprising as it does a wide-ranging work programme of both horizontal and sectoral initiatives. The Lead Market Initiative that the Commission is currently developing serves as an example of such an integrated approach.

The Future of Manufacturing in Europe

While structural adjustment and relocation have been linked to manufacturing for decades, the character and speed of adjustment and its potential longer-term consequences appear to have

taken on new dimensions in the current wave of globalisation. This fact has invigorated the discussion on how the manufacturing landscape will manifest itself in the near and longer-term future and which challenges may result for policy makers in Europe.

Although opinions vary, a considerable degree of consensus appears to exist on which drivers can be expected to shape the future of manufacturing. These drivers encompass increasing international competition, the rapid pace of technological change, major socio-demographic trends such as the 'greying' of most of the industrialized world, salient environmental developments such as climate change and, last but not least, the regulatory environment and the values of the public. It is worth noting in this context that long term projections generally confirm the role of Total Factor Productivity as the most important source of growth.

In terms of international competition, global markets will further integrate for both goods and services, and new competitors are likely to enter, thereby intensifying competition and posing new challenges for incumbents. However, the emergence of developing countries such as China or India also offers new opportunities due to larger markets and even more scope for specialisation for individual companies. And while the per capita income gap between Europe and these countries will remain substantial, steep rises in income in some developing countries will clearly have implications for the types of the goods and services which consumers demand.

As a consequence, relocations of production are likely to continue as companies endeavour to harvest the benefits of increasingly global production networks. But also new opportunities emerge for European manufacturers once the quality of the product as well as the quality of the supplier is of greater importance for customers. Against this background, close user-producer relationships, the available pool of high-skill labour and low political risks become major reasons for staying in, or even coming to, Europe.

Financial markets too are becoming more integrated and the influence of financial markets and shareholders on corporate governance and corporate behaviour will increase, possibly favouring as some have argued short-term financial goals at the detriment of strategic objectives and long-term competitiveness. But the jury is still out on whether these developments are on balance positive or negative, given that the necessary restructuring of underperforming firms may sometimes be facilitated by new people at the helm.

In terms of technological change, its rapid pace and the need of staying competitive in a globalising and increasingly knowledge-based world requires firms to focus even more on science, technology and innovation in order to master the transition from resource based to knowledge-based manufacturing. Enabling technologies such as information and communication technologies, micro-systems, advanced materials, and bio-technologies and nano-technologies, will play a crucial role in maintaining technological leadership for Europe. Key is in particular the pervasive diffusing capacity of these technologies, which potentially affects future competitiveness across a wide array of sectors.

The transition from resource-based to knowledge-based manufacturing will also make knowledge and skills absolutely crucial to future growth and competitiveness. Among these, particularly soft-skills become more and more important as organisations are progressively globally networked while non-technological innovation, predominantly organisational innovation, bears added significance on maintaining and improving competitiveness, both as an enabler and facilitator of technological innovation and in its own right.

In response to these challenges, new manufacturing paradigms are emerging, not only in Europe but also in Japan, on how manufacturing can transform and reinvent itself so as to face the future in a sustainable way. These paradigms often call for fundamentally different ways of production in view of an increasing scarcity of non-renewable energy and natural resources as well as climate change. In addition, these paradigms champion the adoption of mass customisation, more and better quality services, more networking and collaboration and embracing globalisation.

On the shop floor, the new manufacturing paradigms will call for, and be transposed into, new or modified business models, for which four major trends can be identified. Firstly, large businesses become less vertically integrated as they increasingly manage global production networks (e.g. car manufacturers). Secondly, together with mass-customisation a transition from products to services is observed, with manufacturing firms increasingly providing add-on services to their traditional products (e.g. photocopier manufacturers). Thirdly, firms increasingly diffuse intellectual property (IP) beyond company and even country boundaries, as innovation becomes more open (e.g. ICT companies and open innovation leaders). Lastly, in particular small businesses have to compete in manufacturing networks and collaborate openly to address market challenges.

Future societal developments and consumer behaviour will also significantly shape the setting for industries and firms. Thus an aging society is likely to induce demand shifts for both public and private goods and services. Furthermore, the decline of the labour force may induce skill shortages at a time when there is a growing need for skills. Environmental concerns are likewise important for the future of manufacturing in that the regulatory framework will have to respond to these concerns by becoming more stringent.

Much will depend on the ability of European manufacturing firms to capitalise on the opportunities that global challenges, such as ageing and climate change, represent. Since Europe needs to address them early on, there is a real opportunity for establishing lead market positions in products linked to health care, convenience, leisure and entertainment. While the global response to climate change remains uncertain, energy efficiency and recycling potential will be important value attributes. More generally, technologies that permit to operate within much stringer environmental constraints than today will offer lead market opportunities.

It is possible to push the analysis further by feeding the trends and drivers identified in the review of the foresight literature into more quantitative, model based scenarios. The value of the latter is purely indicative as the number of possible scenarios is infinite, however, considering alternative futures permits to be better prepared for unforeseen circumstances. By using a general equilibrium model to build the scenarios, those are made internally consistent. More importantly, this approach permits to evaluate the impact of policies that aim at improving the general framework conditions for competitiveness and their relative importance.

The two scenarios discussed differ across all the drivers of change discussed above; to summarise them, scenario I is characterised by slower globalisation and technological progress processes and a slower growth of manufacturing production than in scenario II. It results in a relatively larger European share in global production while in scenario II the geographical centre of global manufacturing production shifts to Asia.

The policies considered are:

– upgrading skills

– better regulation and less administrative burdens for firms

– R&D and innovation policies

– A strong competitive Single Market, including competition

– environmental policies

Their individual impact on GDP by 2025 is in the range of 0.5-0.6% (skills[2]) to3.0-3.5% (R&D), with the other structural policies in-between. Their cumulative impact amounts to around 8% (scenario I) to 9% (scenario II).

If the differences between the two scenarios in the macro effects of the individual structural policies are minor, the same cannot be said for their at sector level impact. As globalisation is an important driver that affects particular industries in different ways. The sectors which are already most open for international trade are also the ones mostly affected. These include textiles and wearing apparel, wood and other manufacturing, chemicals, rubber and plastics, electronic equipment, transport equipment and other machinery and equipment. Overall, the sectors food products and pulp, paper and publishing are less influenced. These are sectors which are more domestically oriented, less R&D intensive and face less technological progress. Europe has no comparative advantages in textiles and wearing apparel, electronic equipment and basic metals. Chemicals, rubber and plastics, transport equipment and other transport and equipment will be the important manufacturing sectors in Europe.

Of the structural policies fed into the model, improving skills, reducing the administrative burden and increasing energy efficiency, have the least impact on manufacturing. R&D and innovation policies and strengthening the internal market on the other hand have the strongest and most positive impact on manufacturing. In the coming decades Europe's share in global manufacturing production and trade will decrease more slowy. The structural policies decelerate further the relative decline trend of manufacturing in Europe, such that in some manufacturing sectors such as chemicals, rubber and plastics, and combined machinery and equipment sectors the trend is almost cancelled out. In terms of the EU share in world production, in the absence of structural policies, under both scenarios, there is no sector where EU maintains its relative importance by 2025. In the presence of policies (i.e. achievement of targets) sectors such as transport equipment, wood and other manufacturing, energy carriers, Research and development services, chemicals, rubber and plastics; transport services and other business services maintain or almost maintain, their global share.

All in all, the analysis suggests that the European manufacturing industry will still play a major global role in a context where the crucial assets will be knowledge and the skills to manage it. Indeed, many sectors will be able to maintain their global share in this, much bigger than today, market. While the negative trends concerning manufacturing employment and the share of manufacturing in the total economy will certainly continue, these trends must not be confounded with stagnation or decline as new opportunities emerge and are exploited.

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[2] The policy modelled is the achievement of the targets adopted in 2004 for 2010 (10% maximum of early school leavers, at least 85% of 2 years olds with upper secondary education, 20% reduction of 15 years olds with low reading literacy achieving , at least 12.5% participation in Lifelong Learning and 15% increase of S&T graduates). Their economic effect will increase very gradually only, as successive, better educated cohorts enter the work force.

INTRODUCTION

This is the tenth edition of the Commission's European Competitiveness Report since the 1994 Industry Council Resolution that established its basis. Competitiveness in this Report is understood to mean a sustained rise in the standards of living of a nation or region and as low a level of involuntary unemployment as possible. Maintaining and improving its position in the global market is the main competitiveness criterion at the level of an industrial sector.

As in previous years, the Report approaches the issues from the point of view of economic theory and empirical research and its ambition is to contribute to policy making by bringing to attention relevant trends and developments and by discussing analytically the likely outcomes of the various policy options. Its main subjects continue to be topics related to productivity, as the most reliable indicator for competitiveness over the longer term, developments regarding manufacturing industry and other microeconomic issues of the Strategy for Jobs and Growth.

Recent developments bring some good news, such as the end of the trend of an ever widening productivity gap with the US, taken as a benchmark of frontier productivity performance (Chapter 1). In addition, although hardly a new development, convergence among Member States in the form of productivity catching up continues. Reviewing trade performance brings in more good news: in spite of sometimes gloomy perceptions. Europe has, in general held its own in global markets. In addition, there is a positive relation between market openness and productivity growth, a message that merits to be underlined.

However, when levels of productivity are considered, Europe has still a long way to go. Taking into account the sectoral dimension confirms that this is not so much a question of economic structure but of lower productivity in some important sectors such as air transport and retailing. The sectoral analysis also underscores the central role of Total Factor Productivity (TFP) in explaining this gap, i.e. the part of productivity growth which must be assigned to factors such as technical and organisational progress, and cannot be attributed to improved labour quality or increase capital intensity.

The policies most directly relevant to TFP growth are those covered by the microeconomic pillar of the Lisbon strategy (Chapter 2): those fostering technological progress, the use of ICT, competition and product markets reform and infrastructures but, also, the quality of human capital. Coordinated action in these areas produces, in most cases, superior benefits to acting alone as an empirical analysis of spillovers from reforms confirms. In general, Member States have made notable progress in engaging reforms in the microeconomic pillar, which adds to the good news, even if these reforms are not yet fully translated in the data that measure performance.

Against this background, it is worth noting that skills contribute directly to international competitiveness and productivity (Chapter 3) while skills upgrading is under way in all economic sectors, even in low-skill ones. Incidentally, the latter is good news too, because it points to higher competitiveness and higher real incomes. However, imbalances such as skill shortages may occur in the short term, indicating that policies also have a role to play to smooth transition.

Competitiveness is a multifaceted target for which no single and fully comprehensive measure exists. To form a comprehensive picture, the Competitiveness Report assesses the relative strengths and weaknesses of European industries with respect to the various dimensions of

performance, such as the growth of value added, employment, labour and multifactor productivity, international trade, and foreign direct investments (Chapter 4).

Taking the long view (Chapter 5) indicates that Europe, whilst still among the richest regions on a GDP per capita basis, will most probably be passed by some of the emerging economies in terms of size. By 2050 Asia will most likely have become the most important market and pole of growth. It is worth noting that long term projections, as speculative as they may be, likewise confirm the role of TFP as the most important source of growth. Moreover, the future holds the promise that the European manufacturing industry will still play a major global role in a context where the crucial assets will be knowledge and the skills to manage it. Indeed, many sectors seem to be able to maintain their global share in this, much bigger than today, market. However, the negative trends concerning manufacturing employment and the share of manufacturing in the total economy will continue. These trends must not be confounded with stagnation or decline. To a certain extent, they result from normal developments and reflect the effect of different productivity growth rates and income elasticities of demand for goods and services.

Of real concern, over the longer term, would be a growing differential in productivity growth with our main competitors. While such a gap persists today compared to the US, it is not a fatality. In fact, policies count and haven proven to do so. For instance, achieving the Lisbon targets in R&D, skills, administrative costs or making the Internal Market more effective, under alternative scenarios about the future, consistently brings in more favourable outcomes in terms of wealth generation and international competitiveness. At the same time, these results are in line with the improved performance of the European economy that we can currently observe and that, most probably, can in part be attributed to recent reform efforts.

A. GENERAL DEVELOPMENTS

1. KEY FACTS ABOUT COMPETITIVENESS DEVELOPMENTS: GROWTH, EMPLOYMENT AND PRODUCTIVITY

1.1. Introduction

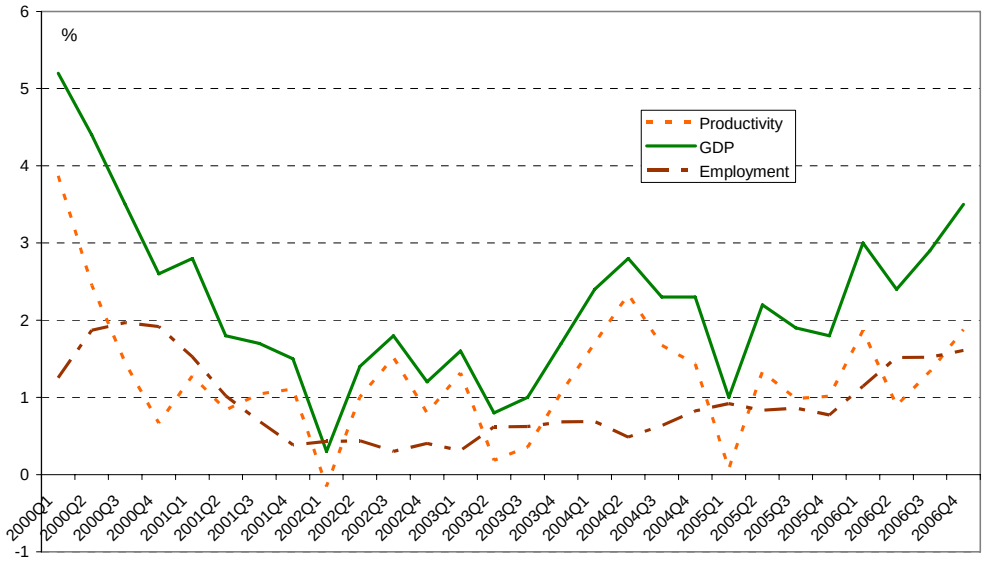
This chapter reviews recent developments of the European economy. The main point is the confirmation of the encouraging signs already seen in last year's report. The following section (Section 2) gives the big picture, the evolution of the main economic variables at country level that describe the current momentum of the European economies, i.e. growth, standards of living, employment and productivity. Section 3 focuses on the sources of the productivity gap between the EU and the US. Section 4 examines the sectoral dimension of these variables at EU level, presenting the contribution of the different sectors of the economy to the main macroeconomic developments. Finally, Section 5 explores some aspects of the relationship between globalisation and productivity.

1.2. Recent macroeconomic developments: the big picture

1.2.1. Economic growth and standards of living

The EU remains since mid 2005 on a brisk growth path, after having overcome a severe slow-down in 2002 (see Graph 1.1). The real growth rates of the EU-27 Gross Domestic Product (GDP) were both in the last quarter of 2006 3.5% year-on-year) and in the whole year (3.0%) the highest since the year 2000.

Graph 1.1: GDP, employment and productivity growth in the EU-27



Note: Growth compared to the same quarter of the previous year.

Source : Eurostat 25/05/2007

GDP per capita is a common indicator of the standards of living. In 2006, the growth rate of GDP per capita was higher in the EU-27 (2.6%) than in the United States (2.3%, see Table 1.1). In 2006 growth accelerated in 22 of the 27 Member States, compared to the period 2000-2005, bringing the EU's per capita growth at a rate which was nearly as high as in the period 1995-2000 (2.7%).

Within the EU, GDP per capita corrected for differences in price levels, through using purchasing power standards, vary from less than 40% of the EU-average in Romania and Bulgaria to 270% in Luxembourg. Average GDP per capita in the EU is about two thirds of that in the US. Most of the economies which have a GDP per capita level below the EU average continued in 2006 their catching up process in terms of higher-than-average GDP per capita growth.

Table 1.1: GDP per capita growth & per capita GDP level

EU-27	Average annual growth rate of GDP per capita *			2006 GDP per capita (in pps; EU-27=100)**
	1995-2000	2000 - 2005	2006	
Austria	2.8	0.9	2.7	127.8
Belgium	2.5	1.0	2.6	122.7
Bulgaria	-0.2	6.7	6.6	36.4
Cyprus	2.5	1.4	2.1	91.9
Czech Republic	1.6	3.7	5.9	78.9

Denmark	2.4	1.0	2.9	126.9
Estonia	6.7	8.6	11.6	67.6
Finland	4.5	2.3	5.0	117.5
France	2.4	0.8	1.4	111.0
Germany	1.9	0.6	2.8	114.5
Greece	2.9	4.1	4.0	88.5
Hungary	4.3	4.6	4.1	65.8
Ireland	9.2	3.4	3.4	145.3
Italy	1.9	0.1	1.4	103.4
Latvia	6.4	8.9	12.5	55.4
Lithuania	5.4	8.3	8.1	57.0
Luxembourg	4.7	2.2	5.2	267.3
Malta	3.9	-0.3	2.3	74.3
Netherlands	3.4	0.7	2.7	130.5
Poland	5.6	3.1	5.9	53.3
Portugal	3.7	0.1	0.9	73.2
Romania	-1.0	6.5	7.9	37.4
Slovakia	3.3	4.6	8.2	62.6
Slovenia	4.4	3.3	4.8	86.9
Spain	3.6	1.7	2.3	101.4
Sweden	3.1	2.0	3.8	120.7
United Kingdom	2.9	2.0	2.2	121.7
EU-27	2.7	1.4	2.6	100.0
US	2.9	1.4	2.3	153.4

Note: * The GDP per capita measured is in prices of 2000. The figures represent the average annual growth rates between the GDP levels of the first and the last years. **pps = purchasing power standards.

Source: Ameco, May 2007.

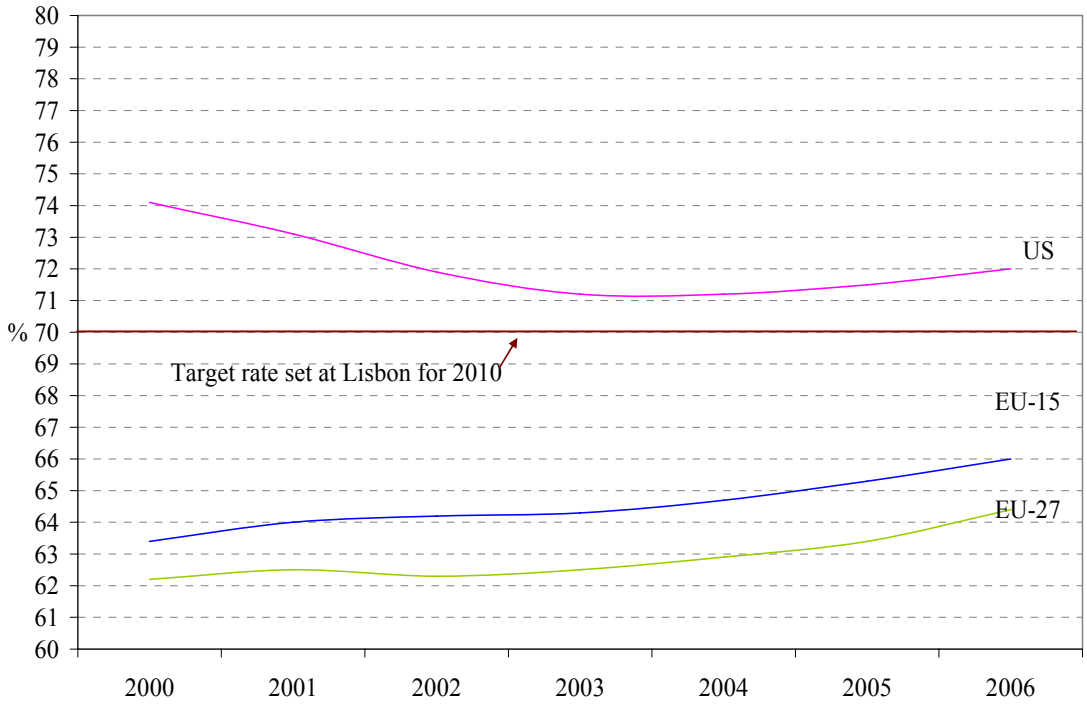
1.2.2. Employment

GDP per capita growth is determined by total population growth, employment growth and labour productivity growth, with the last two components playing the major part. As regards employment growth in the EU, the developments since 2000 confirm the usual time lag of several quarters between overall economic growth and employment growth: while a strong recovery has taken place since the beginning of 2006, a slight upward trend had already been visible since early 2003 (see Graph 1.1). Employment growth in 2006 (1.6%, see Annex Table 1.1) was significantly stronger than the average during the previous years (0.7% between 2000 and 2005 and 1.0% in the period 1995-2000).

Countries which are catching up in terms of GDP or GDP per capita are not generally performing better than average in terms of employment. In 2006, five out of the twelve new Member States recorded employment growth at rates below the EU-average. Half of last year's real GDP growth rate of 3.0% in EU-27 was generated by the increase in employment and the other half by productivity growth. This contrasts with the previous periods 1995-2000 and 2000-2005 where the contributions from employment were clearly lower than those from productivity. This development seems to reflect a change in terms of the employment content of growth. Under unchanged policies it will however not be sustainable, given the growth dampening impacts of the long-term demographic developments.

The largely positive developments in employment are also reflected in an improving employment rate, which reached in last year 64.4% in EU-27 (in EU-15 it amounted to 66%, see Graph 1.2 and Annex Table 1.1). It is particularly the increase by one percentage point between 2005 and 2006 which is promising, while the improvement between 2000 and 2006 by only 2 percentage points is rather moderate and indicates that reaching the EU's 70% target by 2010 is unlikely. Due to the simultaneous decrease by around 2 percentage points of the US employment rate since the year 2000, the gap between the EU and the US could be significantly reduced from about twelve to seven and a half percentage points.

Graph 1.2: Employment rates in the EU



Note: Employment rates are defined as the number of persons in employment aged 15-64 as a percentage of the population of the same age. EU-15 and EU-27 data for 2005 and 2006 are provisional.

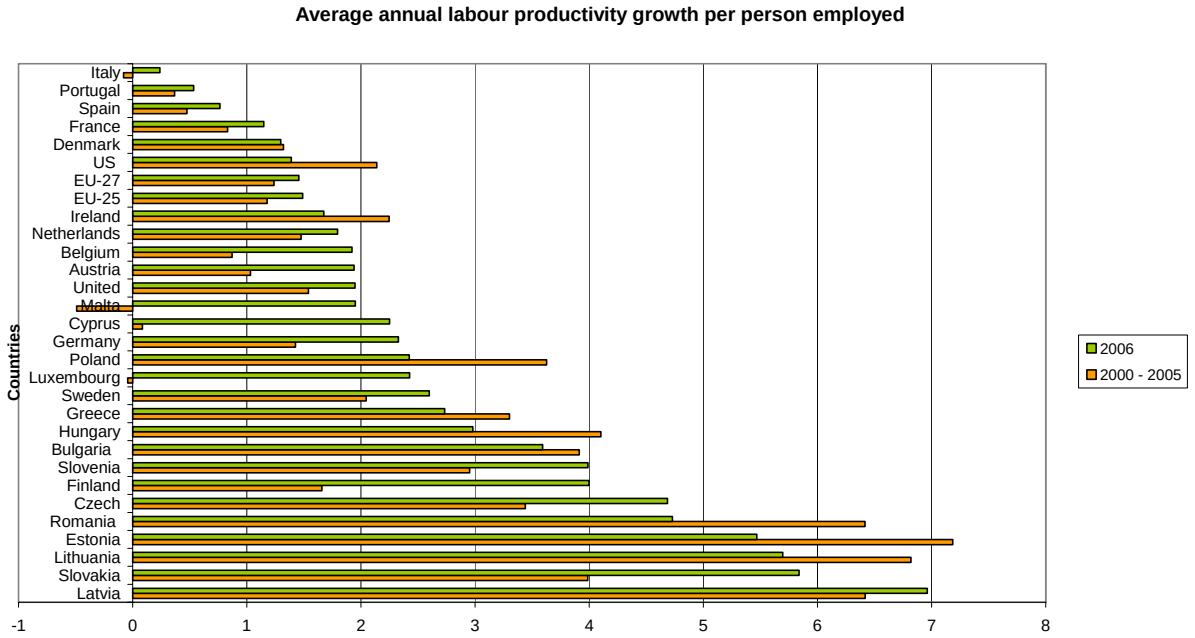
Source: Eurostat Labour Force Survey, 2007.

1.2.3. Productivity

The growth of labour productivity i.e. output per person employed – the other main component of GDP per-capita growth - picked up in the EU and in the majority of the Member States in 2006 compared to the first half of this decade (1.5% vs. 1.2%, see Table 1.2 and Graph 1.3). Productivity and employment growth accelerated simultaneously in 2006 for the first time since 1997. On a quarterly basis, a distinct upswing of productivity growth can be noticed since mid 2005, and a slight upward trend since mid 2002 (as shown by Graph 1.1). The recent increase is taking place in a context of positive investment growth and continued structural reforms in the Member States. It has to be noted also that the enhanced productivity growth is underpinned by an accelerating growth of total factor productivity, i.e. the part of productivity growth that cannot be assigned to an easily measurable factor such as capital deepening or improved labour quality, but must be attributed to less tangible factors such as technical and organisational progress. In fact, the total factor productivity component

grew last year by 1.1%, which represents an increase compared to previous five-year averages 2000-2005 (0.6%) and 1995-2005 (0.9%).

Graph 1.3: Average annual labour productivity growth per person employed



Note: For the period 2000-2005 the average annual growth rate is presented.

Source: AMECO, May 2007.

These developments and the fact that EU-27 productivity growth was last year for the first time since 2001 higher than in the US[3] are encouraging. In terms of productivity levels, productivity in the US remains much higher. Expressed as GDP per employed person, US productivity is 38.6% higher than in the EU. The productivity gap is lower when expressed in terms of GDP per hour worked (26% in 2005). Importantly, nearly all Member States with relatively low GDP per capita and productivity levels and all new Member States are catching up in terms of productivity growth, which indicates an improvement in their competitiveness. While productivity growth accelerated much more in Germany than in the other five large EU economies, growth rates of more than 3% were recorded only in the new Member States and Finland. However, the level of productivity per hour worked (the data for Romania are not available) is still particularly low in Bulgaria (30% of EU-25 average), the Baltic States (between 40 and 45%) and Poland (45%).

Table 1.2: Growth of real labour productivity per person employed & 2006 levels of GDP per person employed (ppe) and GDP per hour worked (phw)

EU-27	Average annual labour productivity growth per person employed	GDP ppe 2006	GDP phw 2006

[3] However, the deceleration of US productivity growth in 2006 contributed more in this result than the corresponding acceleration in the EU.

	1995-2000	2000 - 2005	2006	(EU-27=100) *	(EU-25=100) **
Austria	2.2	1.0	1.9	120.3	97.8
Belgium	1.6	0.9	1.9	134.0	127.5
Bulgaria	-0.6	3.9	3.6	34.5	30.3
Cyprus	2.6	0.1	2.3	84.3	68.0
Czech Republic	2.3	3.4	4.7	70.4	52.5
Denmark	1.8	1.3	1.3	108.2	100.3
Estonia	8.2	7.2	5.5	63.1	45.0
Finland	4.3	4.0	5.8	112.6	95.5
France	1.5	0.8	1.1	122.7	115.9
Germany	2.2	1.4	2.3	106.6	108.5
Greece	2.8	3.3	2.7	103.3	74.6
Hungary	2.9	4.1	3.0	75.1	55.1
Ireland	4.4	2.2	1.7	134.1	119.7
Italy	1.1	-0.1	0.2	108.7	88.2
Latvia	5.9	6.4	7.0	52.2	40.3
Lithuania	5.9	6.8	5.7	57.6	45.3
Luxembourg	1.9	0.0	2.4	171.3	162.0
Malta	3.8	-0.5	2.0	86.4	72.9
Netherlands	1.5	1.5	1.8	113.6	120.0
Poland	5.8	3.6	2.4	61.6	45.1
Portugal	2.2	0.4	0.5	66.4	58.8
Romania	0.6	6.4	4.7	41.5	#N/A
Slovakia	4.8	3.0	4.0	70.0	58.4
Slovenia	0.6	6.4	4.7	83.3	69.6
Spain	0.3	0.5	0.8	99.6	87.1
Sweden	2.4	1.7	4.0	110.0	101.5
United Kingdom	2.4	2.0	2.6	112.5	98.8
EU-25	1.9	1.2	1.5	103.6	100.0
EU-27	2.1	1.2	1.5	100.0	#N/A
US	2.1	2.1	1.4	138.6	#N/A

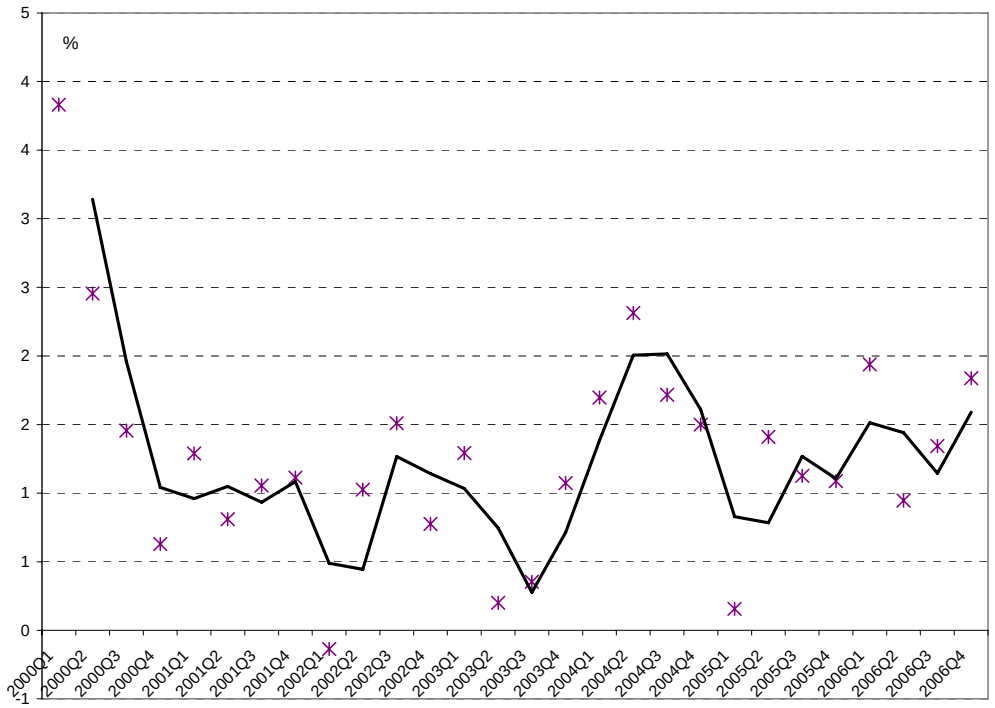
Note: * The relative levels of GDP per person employed and per hour worked have been calculated on the base of purchasing power standards. ** Dta for Romania, the US and EU-27 are not available.

Source: AMECO. May 2007.

Graph 1.4 shows that the trend decline in productivity growth which could be observed since the second half of the 1990s stopped in the second half of the year 2003. While the reasons underpinning the widening of the EU-US productivity gap over the last decade were structural, it is still too early to say whether this recent change is the product of purely cyclical developments or the first manifestation of a new pattern.

Analysis by the Commission services[4] indicates that, while the upturn is essentially cyclical in nature, it is likely that there is also a structural component linked with past structural reforms enacted by EU Member States, especially in the labour market. Sectoral productivity gains, such as in network industries, and the increase of skill levels in the work force would also support such a view.

Graph 1.4: Productivity growth in the EU-27



Note: GDP per person employed. Growth compared to the same quarter of the previous year. The line represents a moving average of 2 periods.

Source : Eurostat 25/05/2007.

1.3. Sources of the productivity gap between the EU and the US

As seen above, the productivity per person employed is about 39% higher in the US than in the EU. Regarding productivity per hour worked, the latest available comparable figures for the US (2005) indicate a gap of 26%. The gap per person employed is higher than the one per hour worked, because the number of hours worked per person employed is on average higher in the US than in the EU. This now raises the question of the sources regarding the gap in terms of productivity per hour worked.

[4] See *EU Economy Review 2007* and related Communication "Moving Europe's productivity frontier", forthcoming.

A productivity gap per hour worked can be broken down[5] into differences with respect to capital intensity, labour quality and total factor productivity: while capital intensity measures the capital stock per hour worked, the quality of labour is captured by the educational attainment of those employed and total factor productivity (which indicates progress in terms of technological progress, knowledge and organisational changes) is a residual between total hourly labour productivity and the first two components. The computation of such a breakdown reveals that the EU has a negative gap compared to the US with regard to labour quality and total factor productivity, with the latter much more important than the former, whereas capital intensity contributes towards closing the gap. The relatively high contribution of capital accumulation in Europe is reflecting to a certain extent its underutilisation of labour.

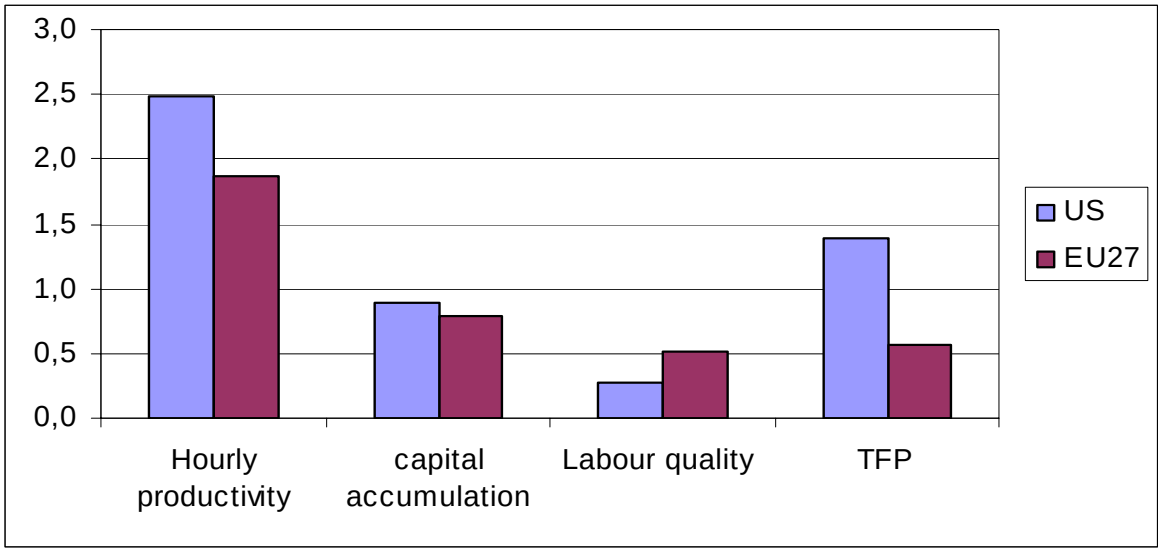
It is of high relevance for the EU economic policies to know that most of the labour productivity gap is caused by total factor productivity, while the quality of labour play a significant but secondary part. Although there is no need to catch up *quantitatively* in terms of capital stock, more developed analysis is required to analyse the "quality" of capital stock and the possible existence of quality gap with the US.

In order to complete the picture on the sources of the EU productivity growth gap to the US, the considerations on the respective levels and their sources need to be complemented by a comparison of the respective growth rates and their components. In this regard, it has first to be observed that the growth rates of hourly productivity were in the period 2000-2005 on average 0.6 percentage points lower in the EU than in the US, as illustrated by Graph 1.5, so that the existing gap regarding the hourly productivity has obviously even widened since the year 2000. The growth gap is overwhelmingly generated by total factor productivity (growth gap of 0.8 percentage points) while the growth difference in terms of capital accumulation is only slightly negative and the one on labour quality is even positive (which shows a catching up process of the EU in this field).

While the absolute numbers in a growth accounting framework depend heavily on the specification chosen, there is no doubt that the EU has a comparative deficit regarding the level of total factor productivity and that this deficit has even significantly widened between 2000 and 2005 . On the positive side, the acceleration of total factor productivity growth in the EU in 2006 (see Section 1.2.3) and the catching-up process in terms of the quality of labour provide some encouraging signals.

[5] A detailed quantified growth accounting has been carried out for the period 2000-2005 by the Commission services in the framework of a working group of the Economic Policy Committee (working group of the Economic and Finance Council of the European Union). Brussels, 6 March 2007, ECFIN/EPC(2007)REP/51206.

Graph 1.5: Decomposition of average hourly productivity growth 2000-2005



Source: Mourre (2007), using data from ECFIN-AMECO, US Bureau of Labour Statistics and Eurostat.

The economic policy implications deriving from these observations are that the EU policies tackling total factor productivity, such as ICT, research, innovation, competition, product market reform and better regulation policies, should be prioritised. They have obviously a high potential impact on overall labour productivity and the room for improvement regarding this component is particularly high, as shown by the comparison to the US.

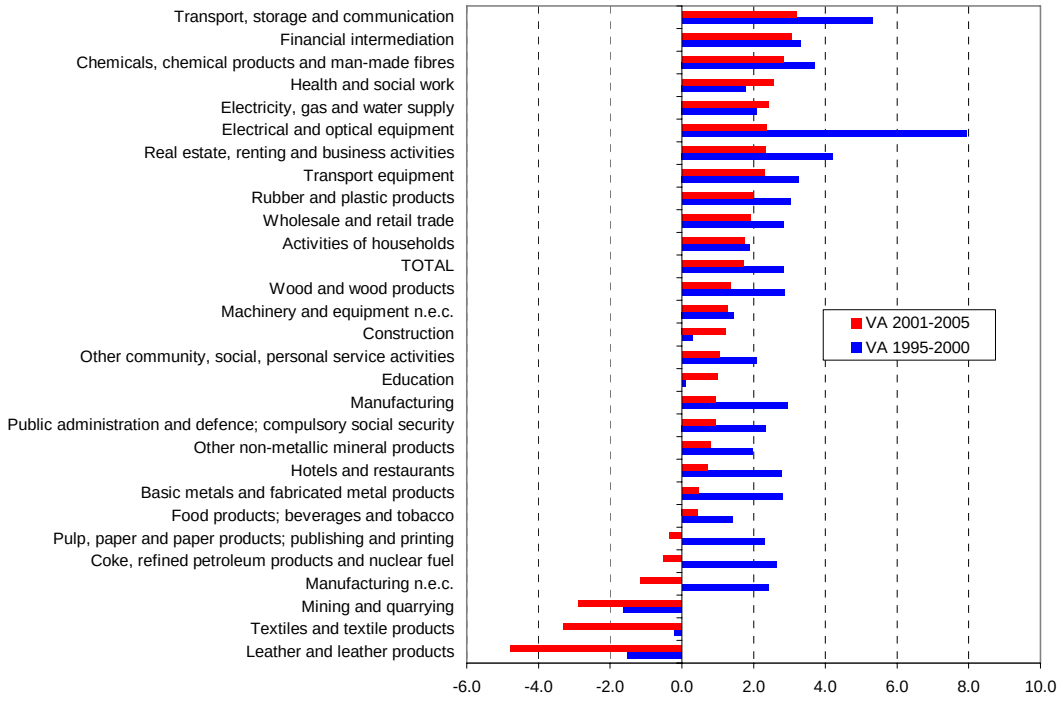
1.4. Growth, employment and productivity at sector level

The objective of this section is to review the contribution of the different sectors (from agriculture through non-market services) to GDP, employment and labour productivity growth, over the period 1995-2005 and to look into some aspects of the labour productivity differential between the EU and the US. Contrary to Chapter 4 of this Report, which carries out an in-depth analysis of the performance of European manufacturing over the same period, the emphasis of the present section is on the latest developments.

1.4.1. Economic growth seen from the sectors

As seen in Section 2, the EU economy decelerated in 2000-2005 relative to the second half of the 1990s. This deceleration is common to all sectors, with a few exceptions: health and social work; electricity, gas and water supply; construction; and education (Graph 1.6). In 2006 a change seems to take place, as growth, employment and labour productivity show a recovery relative to the previous years.

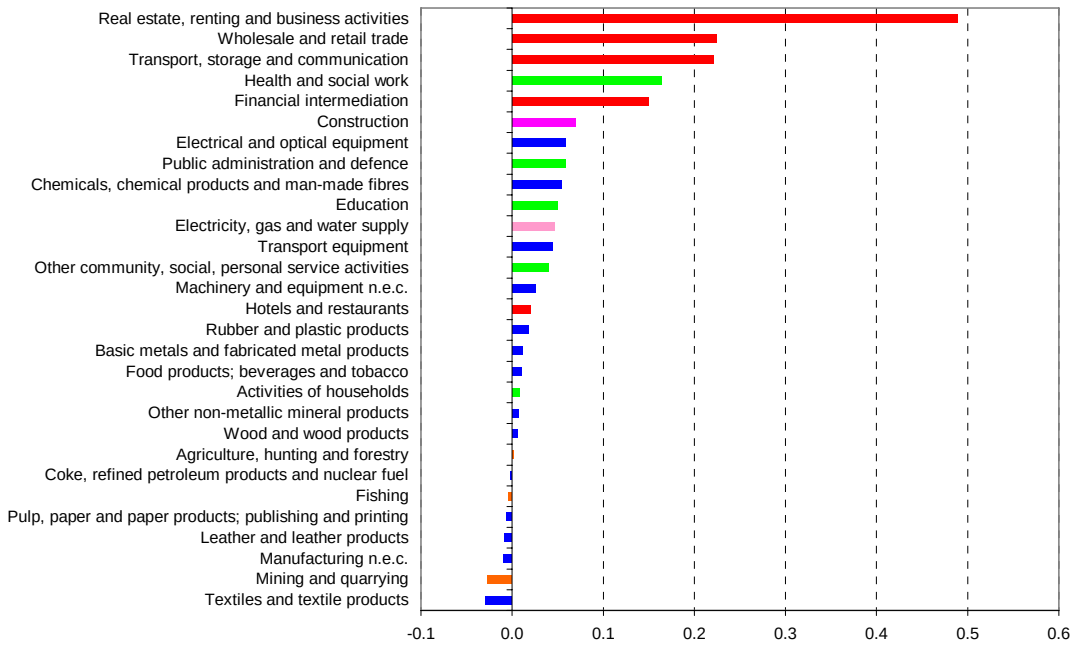
Graph 1.6: EU-27 value added growth 1995-2005



Source: calculated with Eurostat data.

GDP growth in the EU is *concentrated* in a few sectors, which account for a large share of total growth (Graph 1.7). Particularly, the role of services sectors in EU growth is substantial. Among manufacturing, only two sectors (electrical and optical equipment and chemicals) can be mentioned, even if their contribution to GDP growth is much lower than the one of the top sectors. The uneven contribution of manufacturing and services to GDP growth, and particularly the modest contribution of manufacturing sectors, is explained, to a large extent, by the substantially lower share of these sectors in the economy.

Graph 1.7: Contribution of sectors to EU GDP growth, 2001-2005

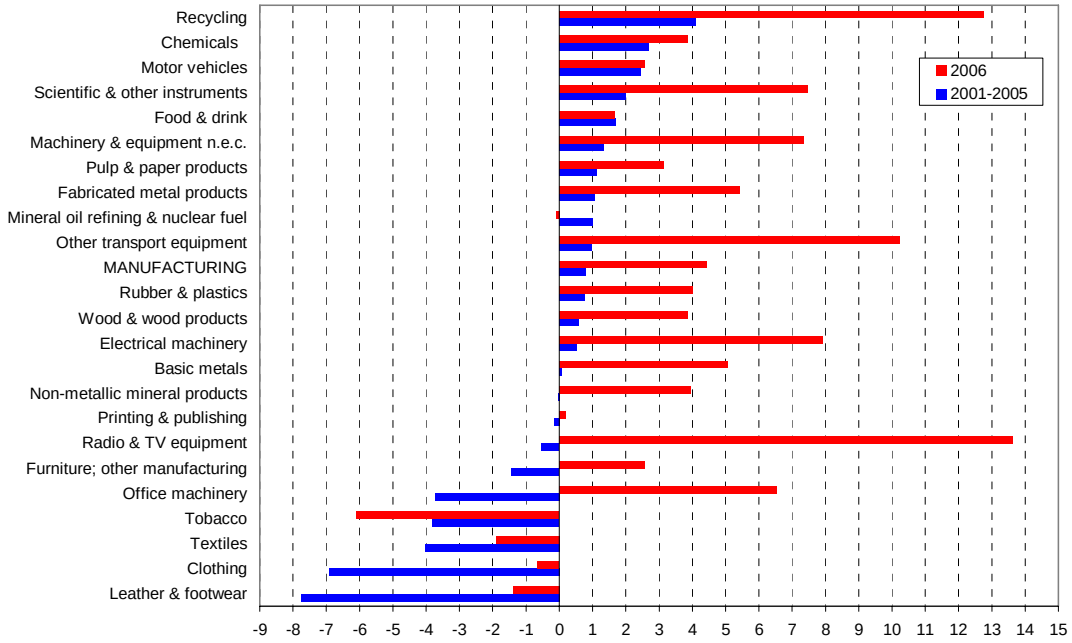


Source: calculated with Eurostat data.

As indicated above, all manufacturing sectors, with the exception of tobacco, exhibit substantially higher growth rates in 2006, thus contributing to the up-turn in EU growth in the last year (Graph 1.8). Even textiles and clothing, two sectors with negative growth over the last decade, have improved their performance, although they still show negative growth rates in 2006[6].

[6] In this section sectoral developments are tracked using two data sources, namely National Accounts and short-term indicators (production and employment monthly indexes). The two are complementary in that National Accounts covers all sectors in the economy (from agriculture to non-market services) over 1995-2005, although for a relatively aggregate sectoral classification (sections and sub-sections of NACE Rev.1 nomenclature of economic activities: 1 and 2 digit alphabetical codes respectively). Short-term indicators cover 1995-mid 2007 with monthly data for a more detailed list of sectors (divisions, two digits, of NACE Rev.1).

Graph 1.8: Annual growth rate of production of manufacturing sectors, 2001-2005 and 2006

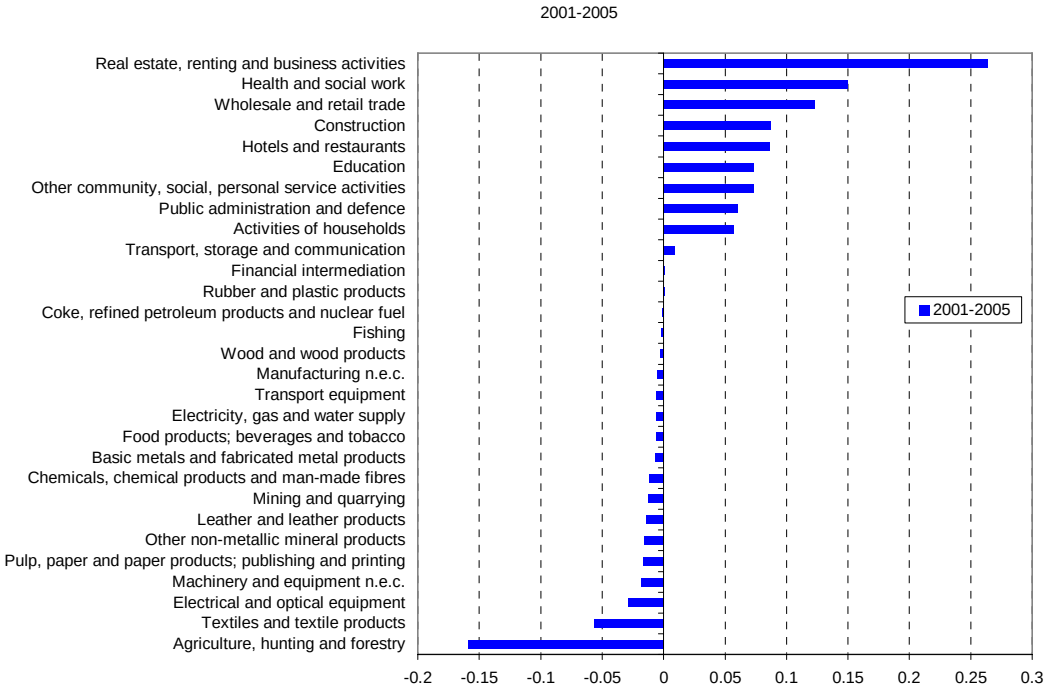


Source: calculated with Eurostat data.

1.4.2. Employment

Although positive, EU employment growth in 2000-2005 was lower than in 1995-2000 (Section 2). At sectoral level, most of the employment growth is explained by the performance of a small number of sectors (Graph 1.9). Business services, health and social work and wholesale and retail trade account for more than 80% of total employment growth over 1995-2005. Manufacturing sectors contribute negatively, with the only exception of transport equipment.

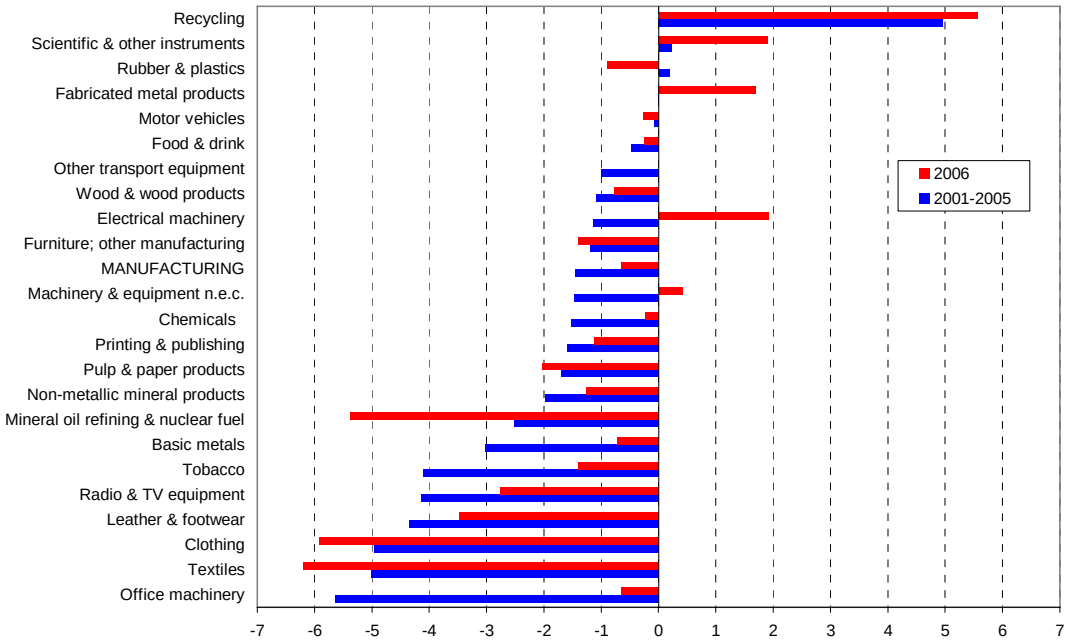
Graph 1.9: Contribution of sectors to total employment growth rate 2001-2005



Source: calculated with Eurostat data.

The latest employment developments by sector, including 2006, can be measured only for manufacturing sectors. Contrary to what is seen in value added growth, employment shows a mixed picture, with much variation across sectors and time. However, in 2006 employment in manufacturing improves, with higher growth rates than in the previous five years (2000-2005) and even positive growth rates in sectors like instruments, metal products, electrical and non-electrical machinery, and recycling (Graph 1.10).

Graph 1.10: Manufacturing employment annual growth rate 1995-2000 and 2006



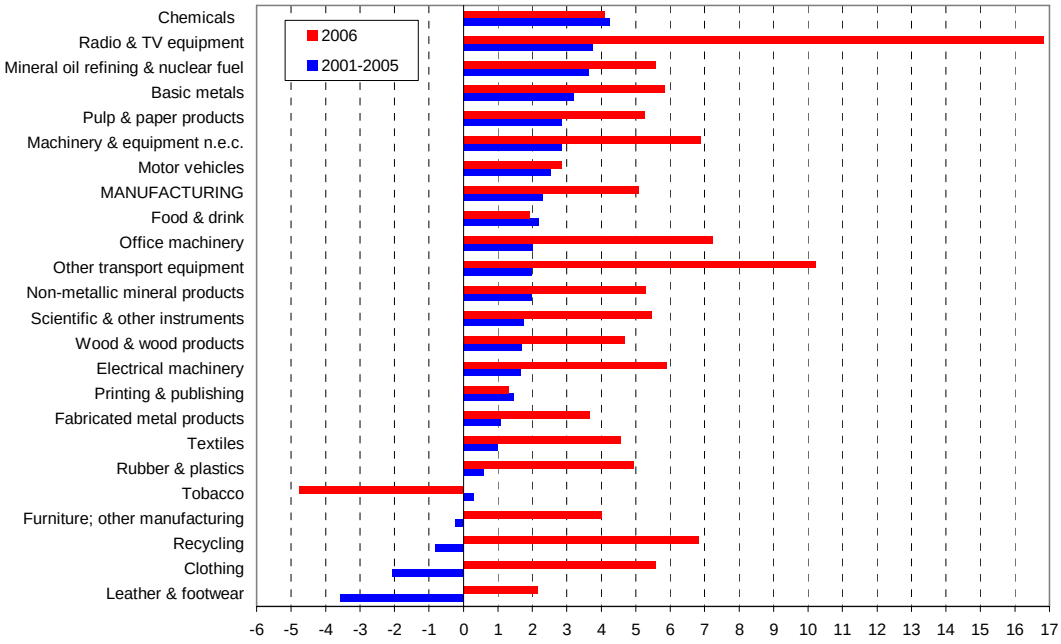
Source: calculated with Eurostat data.

1.4.3. Productivity at sector level – recent evolution of the EU-US productivity gap

As for the whole of the economy, labour productivity decelerated in nearly all sectors of the economy in the first have of the 2000s but recovers in 2006[7], in which growth rates are significantly higher than in 2000-2005 and even than in 1995-2000 (Graph 1.11). In general, the strongest growth in labour productivity takes place in manufacturing sectors. The services sectors that have above-the-average growth rates in 2000-2005 are electricity, gas and water supply, financial intermediation, and wholesale and retail trade (data for all sectors can be found in Table 4.1, Chapter 4, for the period 1995-2004).

[7] Like for other indicators of sectoral growth in this section, labour productivity developments for manufacturing sectors at two digit level of NACE Rev.1, covering up to 2006, are based on indexes of production and employment from Eurostat. Labour productivity calculated in this way tracks closely the more usual measure "value added per person employed". Over the period 1995-2005 the two series show a similar profile over time and the correlation coefficient between the annual growth rates is 0.93.

Graph 1.11: Labour productivity annual growth (%) 2000-2005 and 2006



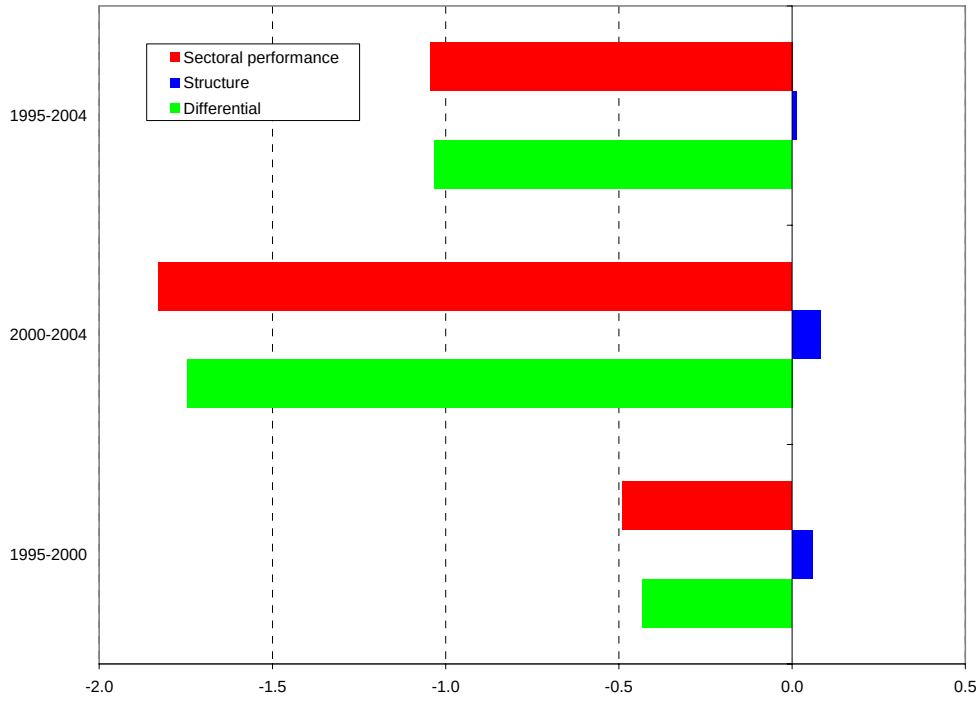
Source: calculated with Eurostat data.

Sector level data from the EU KLEMS data set[8] give some additional insights in the comparison of productivity developments between the EU and US. For instance, they confirm that the lower labour productivity growth in the EU economy in the period 1995-2004 and the two sub-periods considered, is due mainly to the poorer performance in labour productivity growth in EU sectors and not to the sectoral composition of the economy (industry mix), which exerts a slightly positive influence in the results (Graph 1.12)[9].

8 The EU KLEMS database is the result of a three year, European Commission funded research project involving 16 European research institutes, which has recently become available for free public use at http://www.EU KLEMS.net. See Timmer et al (2007) for further details on the construction of the database.

9 The graph is based on the following simple decomposition of the labour productivity growth differential between the EU and the US: $Lp_{eu} - Lp_{us} = \sum(SH^{i}_{eu} - SH^{i}_{us})\, Lp^{i}_{us} + \sum(Lp^{i}_{eu}-Lp^{i}_{us})\, SH^{i}_{eu;,}$ where: Lp = labour productivity growth; SH = sectoral share in the total number of hours worked; i = sector. Relative to the US, sectoral performance measures the contribution to the EU-US gap of the different growth in labour productivity by sector. Industrial structure captures the effect of the different industry shares. The source used is EU KLEMS. EU labour productivity growth for "computers and office machinery" and "electronic valves and tubes" has been calculated using the deflator for France. This does not affect substantially the aggregated results because of the low share of these sectors in the economy. Yet the estimate of labour productivity growth in these sectors varies significantly with the deflator chosen.

Graph 1.12: Decomposition of the EU-US differential in labour productivity growth between sectoral performance and sectoral composition (structure) of the economy, 1995-2004



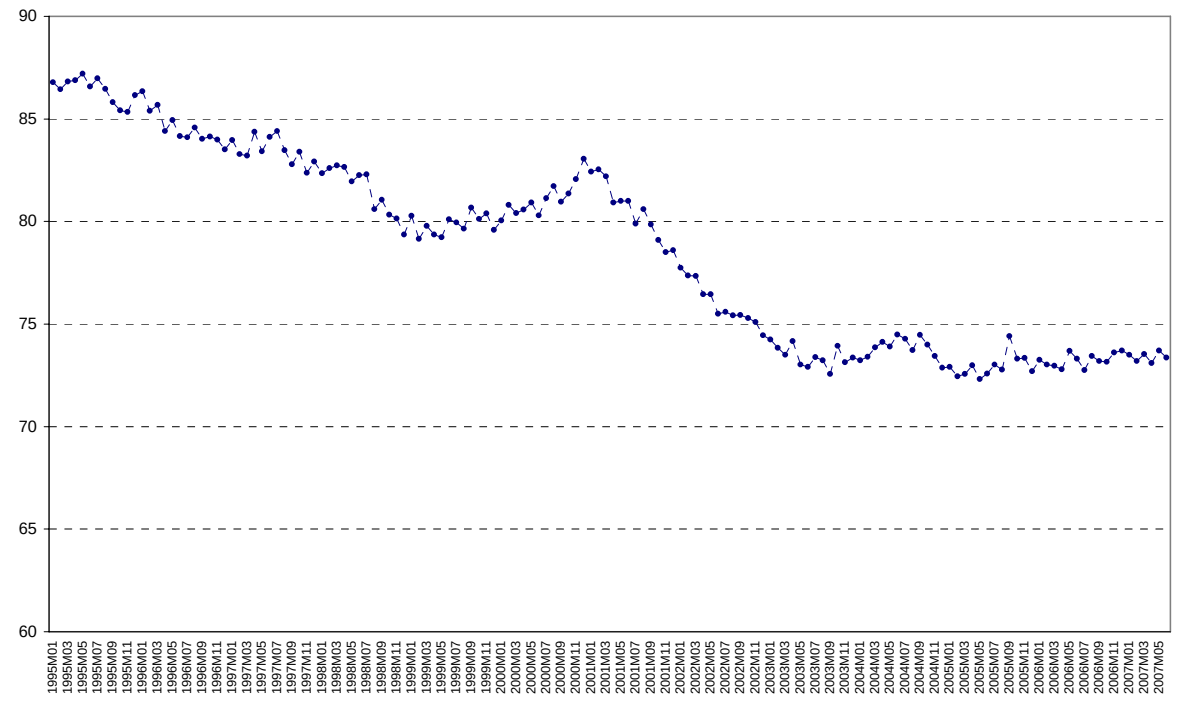
Source: calculated from EU KLEMS data.

The use of average annual growth rates in the two periods 1995-2000 and 2000-2005 is to a certain extent dictated by data availability regarding the EU. By focusing on manufacturing alone, one can obtain a finer view of developments over time and an indication of what might be happening in the near past by using short term indicators.

Graph 1.13 presents the evolution of the EU-US productivity level gap in industry, estimated with monthly production data, between January 1995 and June 2007[10]. It can be seen that the deterioration of the gap had already started at the beginning of the period but seems to have stabilised since 2003.

[10] The series is calculated by applying labour productivity growth in "mining, manufacturing and energy" to the gap in absolute values in 2000. The latter is calculated from the comparison for 1999-2001 presented in O'Mahony and van Ark (2003) for manufacturing in EU-14.

Graph 1.13: EU labour productivity in industry(*) (US = 100), January 1995 - June 2007

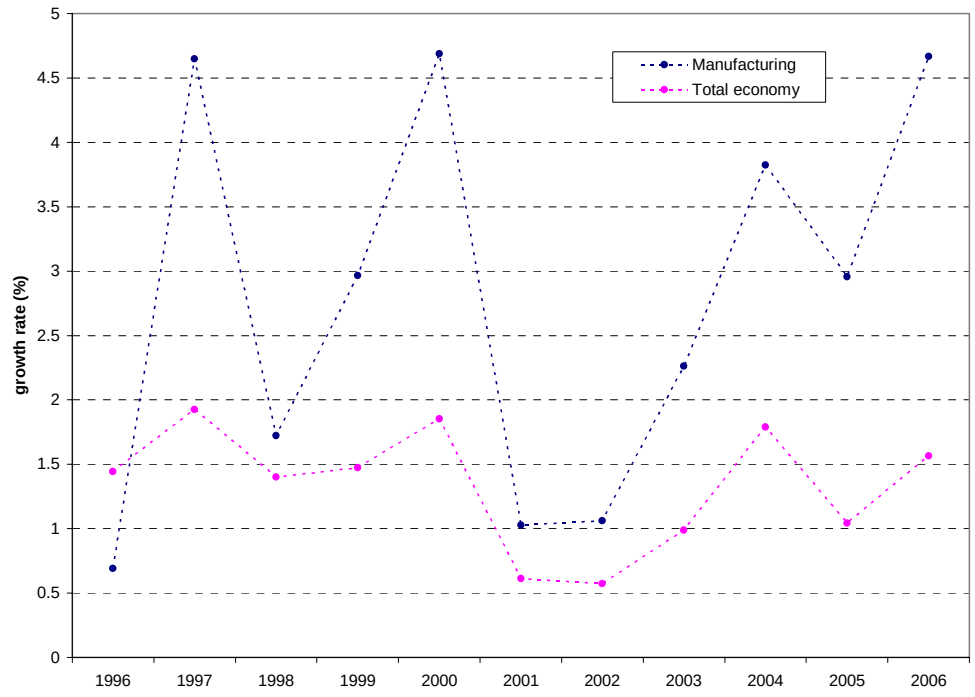


Note: (*) Mining, manufacturing and energy.

Source: calculated with data from Eurostat and O'Mahony and van Ark (2003).

Manufacturing accounts for a small part of the EU total economy (17%). Yet the productivity performance of manufacturing is of interest in tracking developments in the whole economy. Indeed, Graph 1.14 shows the labour productivity growth in manufacturing and in the economy at large exhibit a similar profile (smoother for the whole economy, although productivity growth rates are, in general, higher in manufacturing. Manufactured goods are more tradable than services; the sector is more exposed to international competition, and more intensive in R&D. Therefore, productivity developments in manufacturing are a good indicator for capturing the capacity of the economy to react and adjust to globalisation challenges. This should not, however, shift the attention from the fact that productivity increase in services industries (72% of EU GDP) is crucial to improve competitiveness of the EU economy as a whole.

Graph 1.14: Labour productivity growth in manufacturing and the whole economy



Source: Calculated with data from ECFIN-AMECO.

Growth rates (Graph 1.15) explain this development in EU-US industry productivity: since 2003 labour productivity growth rates in the US have been decreasing, while they were increasing in the EU[11]. Although labour productivity growth is still higher in the US, the relative performance of the EU improves steadily during these years. In other words, the growth differential in favour of the US decreases and becomes negligible at the end of 2006.

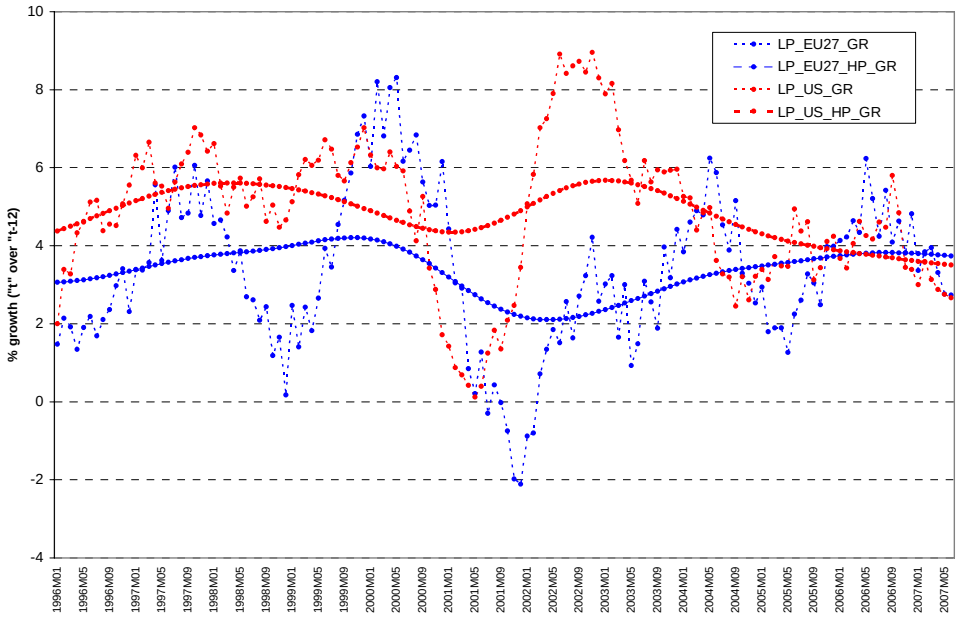
However, this does not necessarily show a structural change in the EU performance relative to the US. As a matter of fact, US labour productivity growth leads EU's and the lag in EU's productivity growth explains partially the convergence in growth rates observed in the second half of the Graph. Yet, there is some persistence in labour productivity growth in the EU, which, nevertheless, might have attained a maximum at the beginning of 2007[12]. The influence of the business cycle on the relative labour productivity developments is shown in Graph 1.16, which presents the growth differential[13] in GDP and manufacturing labour productivity between the EU and the US, where, with the exception of the period 2001-2003, the differential in GDP growth is mirrored closely by the differential in labour productivity growth. The correlation coefficient between the two series is 0.32.

11 For each area the graph shows the growth rates calculated from both the original series and the trend series. The latter is obtained using the Hodrick-Prescott filter.

12 The interpretation of the latest data shown in the graph should be done cautiously due to the end-of-sample problem that characterizes the Hodrick-Prescott filter.

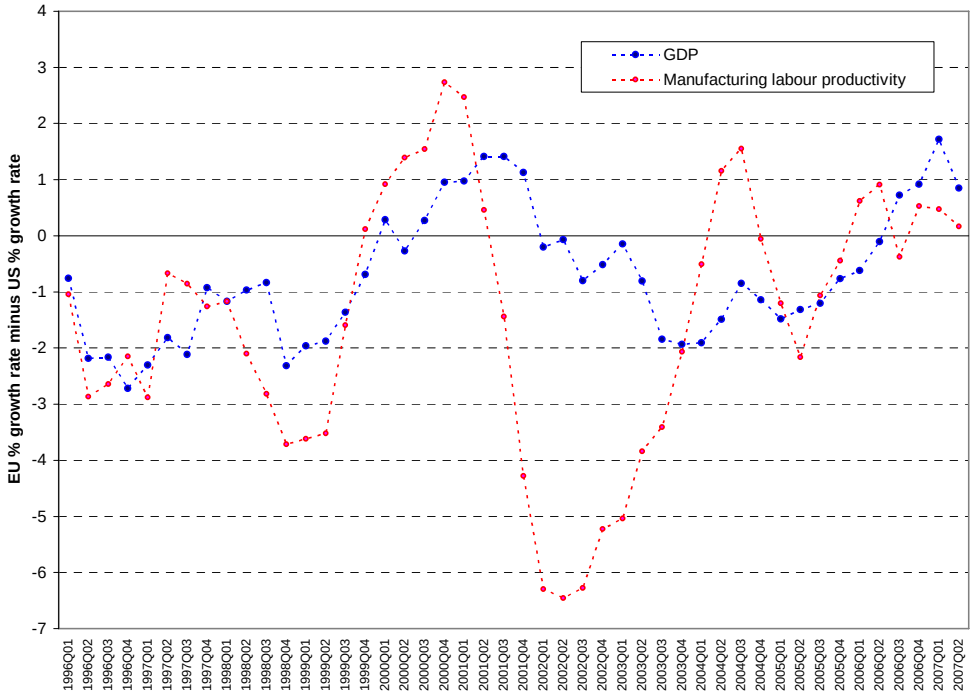
13 growth differential in GDP and labour productivity is expressed as the growth rate in the EU minus the growth rate in US. Growth rates are calculated on quarterly data between "t-4" and "t".

Graph 1.15: EU and US industry labour productivity growth



Source: calculated with data from Eurostat

Graph 1.16: Growth differential between EU and US



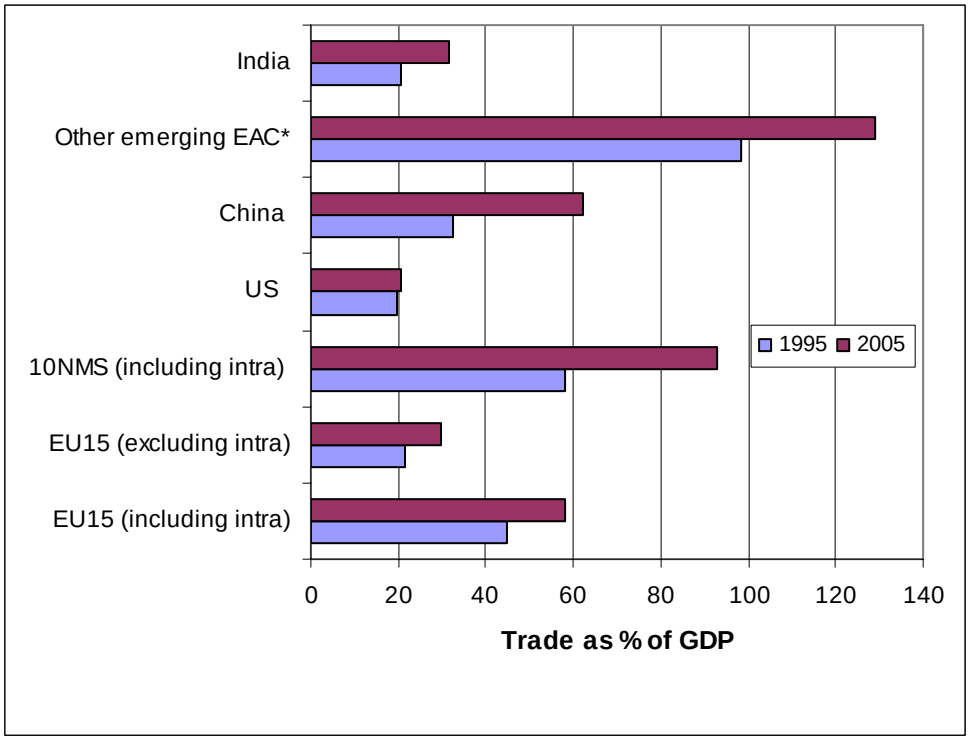
Source: calculated with Eurostat national accounts and short-term indicators data.

1.5. Globalisation and productivity

Openness increases productivity. By expanding exports, firms learn new technologies to compete in foreign markets and they could reduce unit production prices from the expansion in production resulting from exports. Imports expose domestic firms to greater competition and forces less productive firms out of the market. More competitive firms can then better compete in international markets. Access to foreign inputs also improves the product mix of intermediate inputs raising productivity at the firm level. Foreign inputs could furthermore be of superior quality relative to domestic inputs resulting in another channel through which imports impact productivity. Imports could in addition provide an important access to new technology embodied in goods and services. The increase in productivity improves a country's international competitiveness in price and quality boosting its exports.

Although not a new phenomenon the current wave of globalisation has enhanced the role of international competition, i.e. competition from abroad and competition abroad, in determining a country's prosperity measured by its productivity growth. The acceleration of globalisation in the last decades is illustrated by Graph 1.17, presenting the increases of trade openness across countries and regions between 1995 and 2005 and Graph 1.18 presenting Foreign Direct Investment stocks compared to GDP. Trade openness has increased by 8 percentage points in the EU-15 despite its size, and in the EU-10 by 34.5 pp. The figure shows the brisk pace of China's integration into the world economy, doubling its trade openness in only ten years. In fact, China's contribution to world-wide growth in the more recent past has been impressive. China's share in global output has risen from 1.7% in 1990 to 5% in 2005. Since 2000, the country has contributed about one third to overall worldwide GDP growth.

Graph 1.17: Trade Openness, 1995-2005

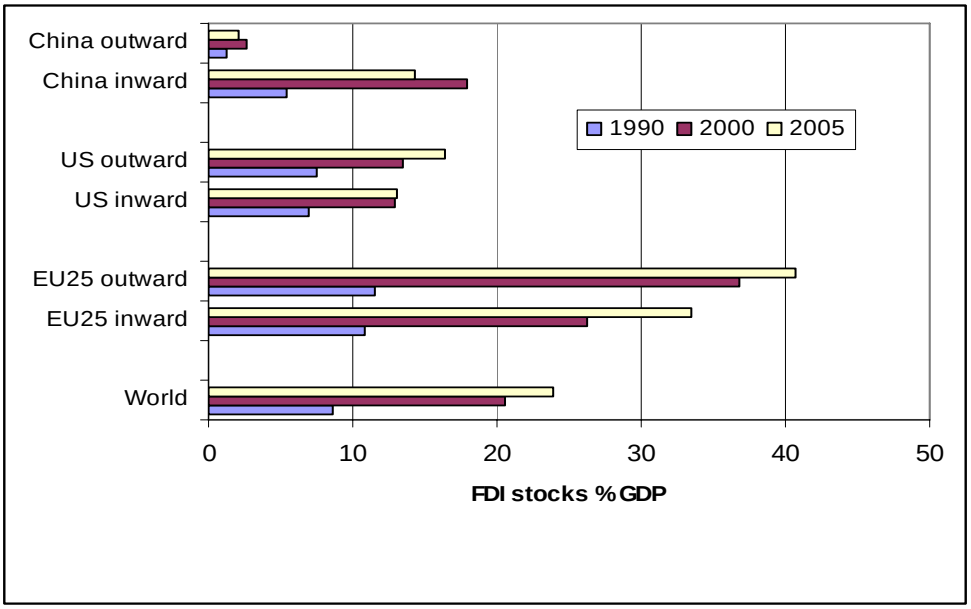


Note: Exports and imports over GDP. China excludes Hong Kong. (*) EAC is East Asian Countries.

Source: Data from IMF DOTS, WEO, IFS.

The increasing trade openness has been accompanied by a strong rise in foreign direct investment (FDI)[14]. Graph 1.18 shows the increasing stocks of inward and outward FDI stock as a share of GDP for selected countries and regions. The high degree of internationalisation of the EU economy (both as a *home* and as a *host* region) is striking when compared to that of the US. Interestingly, in comparison to the large inward FDI stock into China, outward FDI stocks from China are still small[15]. But the rising intensity of outward investment activities by Chinese enterprises signals a new stage in China's integration to the global economy as Chinese tries to reduce its dependence on multinational corporations and is becoming a more proactive player[16].

Graph 1.18: FDI stocks over GDP, 1990-2000-2005



Note: China excludes Hong Kong. EU figures include intra-EU activity.

Source: UNCTAD World Investment Report.

Given the growing size of globalisation, its effects on a country's performance are of the utmost importance. The positive relationship between aggregate productivity and globalisation is depicted in Graph 1.19. The data, covering OECD countries, reveal that trade openness and labour productivity tend to move together[17]. A word of caution is needed here since while openness may increase productivity, the reverse also seems likely. Box 1.2 below summarises selected empirical findings on the causal relationship between productivity and globalisation.

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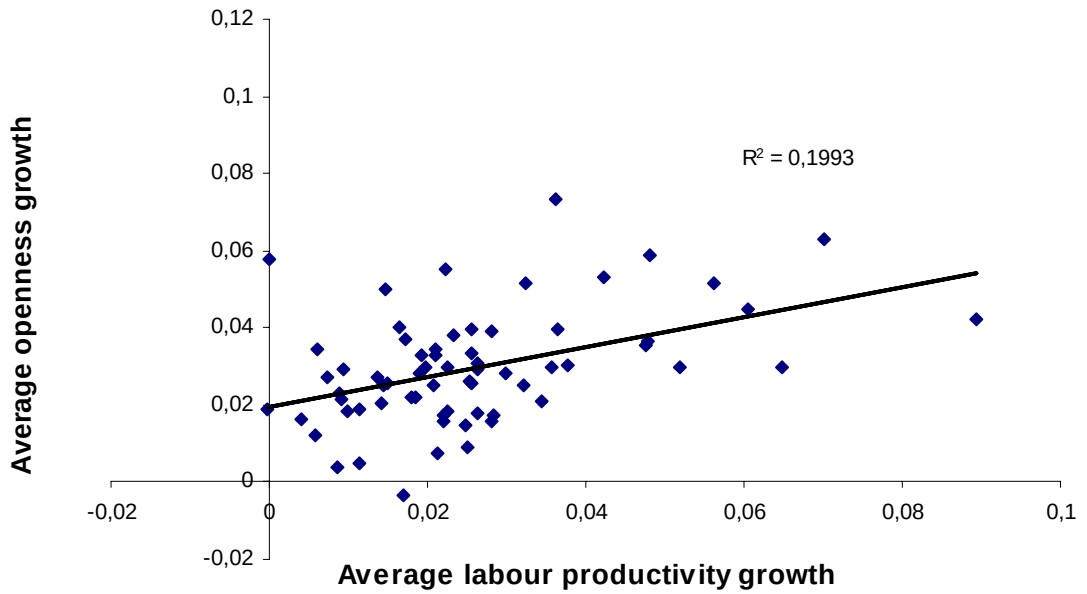
14 In 2005, inflows of foreign direct investment rose by 29%. The rise in FDI reflects cross-border mergers and acquisitions, higher growth in developed countries as well as strong economic performance in many developing economies.

15 Given that many large M&A deals by Chinese companies are financed outside China, their outward investment might be underestimated (UNCTAD, 2006).

16 The decrease of the FDI stock over GDP ratio (both inward and outward) between 2000 and 2005 in China hides the fact that FDI inward stock in China increased by 64%, and outward FDI stock by 67%, during the same period.

17 Adding emerging Asian countries (e.g. China, Malaysia, Taiwan, Singapore) reinforces the results. In contrast, in some less-developed African and Latin-American countries the relationship is weaker.

Graph 1.19: Openness and Productivity



Note: Openness is exports and imports over GDP. Labour productivity is real GDP per worker. Sample includes Australia, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, and United States. For most countries 10 years averages are calculated (1960-1970; 1970-1980; 1993-2003).

Source: Summers-Heston data set, Version 6.2.

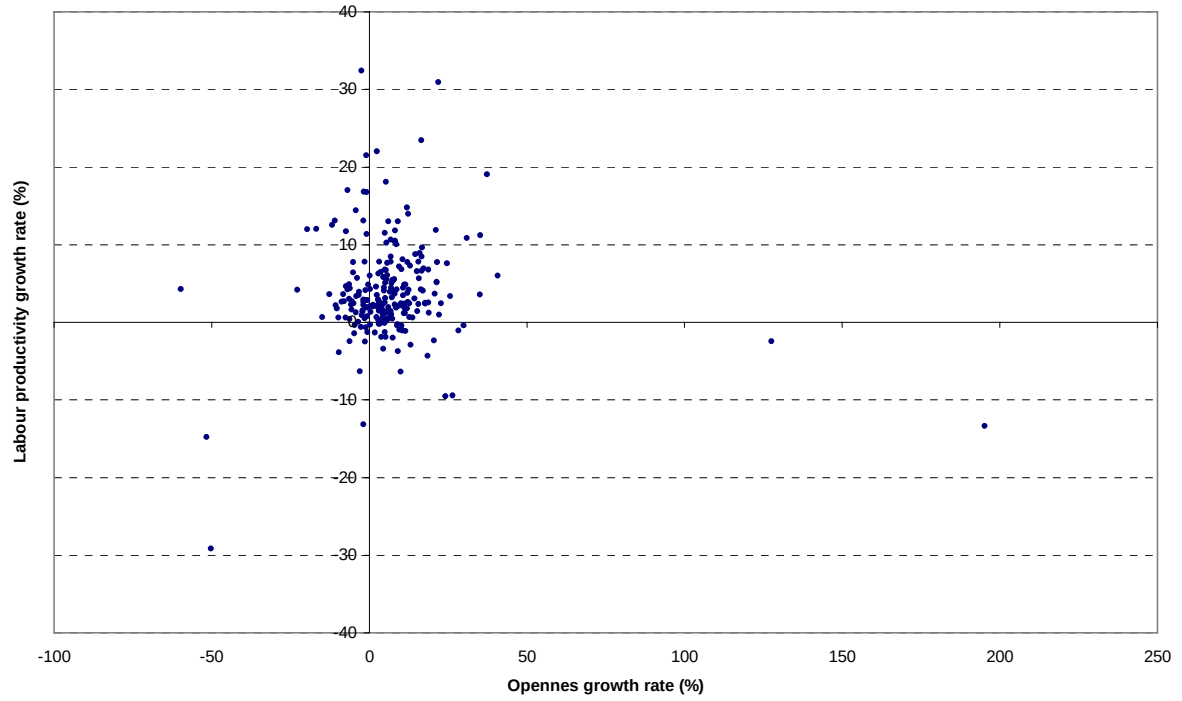
The same positive relationship is found when looking in detail at more disaggregated sectoral data. Graph 1.20 plots labour productivity growth in manufacturing sectors in the EU against openness, defined as the ratio of imports to the value added of the sector, over the period 1995-2004[18]. A fixed effects panel regression of the labour productivity annual growth rate on the annual growth rate of the openness of each sector (lagged one period) shows a positive significant coefficient for the variable openness[19]. On average, a 1% increase in the openness of the economy, as measured by the ratio imports to value added, results in an increase of 0.05 percentage points in the labour productivity growth rate in the following year. These results should be taken only as a preliminary indication of the effect of the openness of the economy on sectoral productivity performance, as other determinants of labour productivity are not included in the regression and higher productivity might also lead to more openness[20].

[18] The graph is based on the *stacked* data of cross-sections (sectors) and time (annual data from 1995 to 2004).

[19] The equation estimated is: Labour productivity growth (%) = 3.8 + 0.053 Openness (-1) growth, with 26 cross-sections (sectors) and 208 observations. A regression using data for 16 countries over 1962-2003, provides an estimate of the same order of magnitude for the elasticity. In this case, openness is measured as the ratio (exports + imports)/GDP.

[20] The use of imports as openness indicator should reduce the reverse causality problem between openness and productivity.

Graph 1.20: Labour productivity growth and openness in EU manufacturing sectors



Source: calculated from EU KLEMS and COMTRADE databases

Too often, globalisation is associated with job losses - or with some undefined and hypothetical opportunities. The resulting social costs and anxiety are real and call for appropriate policy response to accompany and anticipate transition. However, they should not lead to losing from sight the positive effects that opening up and integration into world markets have in a country's economic performance, i.e. productivity gains from the resulting specialisation, from scale effects, from the greater competitive pressures that forces less efficient firms out of the market, and from the greater ability to absorb technological advances and new ideas developed in the rest of the world. Taken together, these factors suggest that openness to trade can play an important role in raising the rate of productivity growth of an economy; with the full benefits of openness accruing to economies that can easily redeploy factors of production between firms as well as from declining to growing industries.

Gains through more efficient production

With the increase in the tradability of services and fragmentation of production processes, companies can reconfigure their production to boost their overall competitiveness. This has led to global production systems and the development of international production sharing. While the range of activities suitable of international outsourcing has widened, the economic logic of these activities are similar to the well-known process of declining transportation costs which is contributing to increasing the range of goods subject to import competition. Once reduced to national dominion, the playing ground for relocation has now become a world wide ground.

Now it is easier for firms to move parts of their production to foreign locations-a process referred to as offshore outsourcing or, more simply, offshoring. Numerous studies have shown the positive impact of outsourcing and productivity (see Box 1.1).

But although international production-sharing is an increasing phenomenon, the scale of offshoring compared to the economy as a whole is still quite limited[21]. However, trends across regions differ markedly. China, and to a lesser extent the new EU Member States and South East Asia, are an important part of this process. The share of intermediate imports (goods) as a share of total imports in China has gone up from around 55% in 1992 to almost 75% in 2003. For the EU-10 the increase has not been as impressive but it reached almost 5 pp to around 60% during the same period. In fact, intermediate goods are the largest component of trade by stage of production both in China and in the NMS-10 (exports of intermediates represented 38% of total exports in 2003 in China and 54% in NMS-10); and trade deficits in intermediates has gone up to 8% and 5,7% of GDP in China and NMS-10, respectively. In contrast, the share of intermediate goods in imports has been decreasing continually in Japan, the US and EU-15 (for the EU-15 by 4pp to 50% in 2003)[22] [23].

BOX 1.1: Empirical evidence on the link between Globalisation and Productivity

There are plenty of studies analysing the relationship between productivity and different forms of globalisation. A growing body of empirical work has documented the superior performance characteristics (including productivity) of international firms (i.e. FDI firms, outsourcing firms, exporters, but also importers) relative to only-domestic firms. The issue is whether good firms choose to go international or whether globalisation improves firm performance. Both theory and empirical evidence show that causality goes both ways.

Empirical evidence showing that firms exposed to international competition are different as there seems that more productive firms self-select into exporting and outsourcing include, among others, Bernard and Jensen (1999) who show that good firms become exporters (but that the benefits of exporting for the firm are less clear). Antrás and Helpman (2004) also show how high-productivity firms source overseas by engaging in FDI while low-productivity firms acquire domestic intermediates. Kurz (2006) finds that outsourcers are "outstanding" performers –larger and more productive organisations. Similarly, Tomiura (2007) also shows that international firms in general (FDI firms, outsourcers and exporters) are more productive than domestic firms. Muuls and Pisu (2007) find that a process of self-selection applies also to importing firms.

Overwhelming empirical support is found in the literature for the positive effects that globalisation can bring to a country in terms of productivity. Using trade as a proxy for globalisation many studies have found the significant benefits of international trade on productivity (e.g. Alcalá and Ciccone (2004), Miller and Upadhyay (2000)). A number of studies have focused on outsourcing and its effects on productivity. For a sample of EU countries Egger and Egger (2006) find a long-run positive impact between international outsourcing of goods and low-skilled workers productivity. Amiti and Wei (2006) find that service outsourcing has a significant positive effect on productivity in the manufacturing sector. Similar results have been found regarding the productivity impact of outsourcing on the Irish electronics industry by Görg et al. (2007). Mann (2003) analyzes the role played by

[21] Imports of intermediate manufacturing and services inputs (excluding energy) accounted for about 5 % of gross output in advanced economies in 2003(IMF 2007).

[22] European Commission (2006).

[23] Intermediate goods imported do not represent all activities offshored. Excluded are, for example, imports of final goods used in domestic production; imports of final goods sold under the brand-name of a domestic firm; imports of goods that could potentially be produced domestically for export purposes but are produced abroad and exported to third markets.

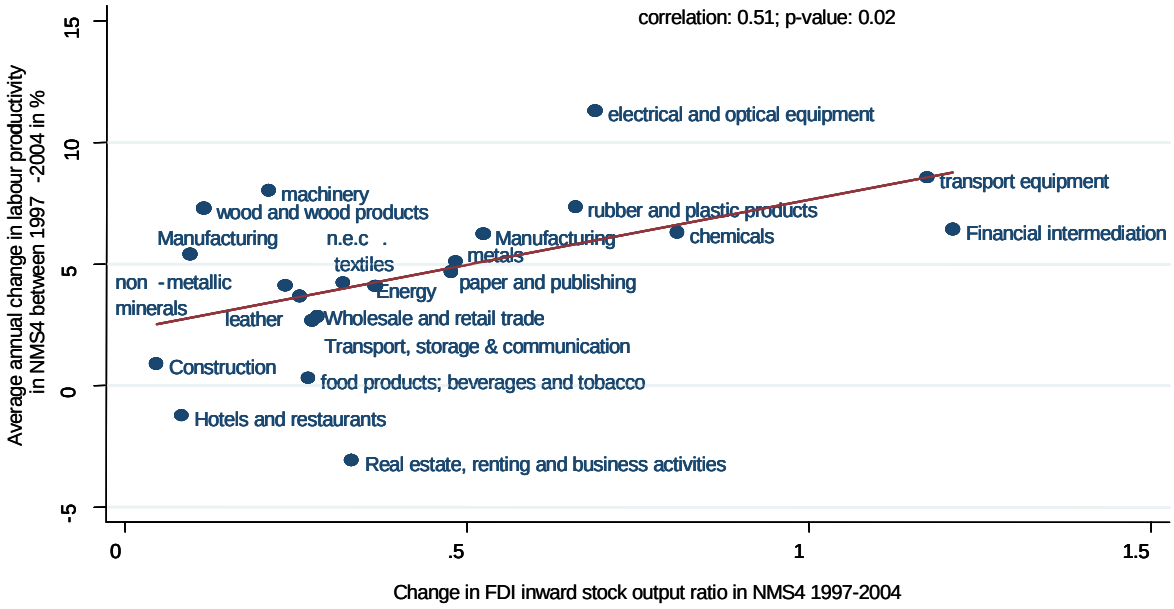
international outsourcing of IT hardware in stimulating productivity growth during the last decade. She advocates a similar model of global competition for IT software and services that will deliver more cost-effective IT services and will prompt the next wave of productivity growth. ECB (2007) shows that changes in the sectoral shares in value added are related to changes in intermediate imports (from low-cost locations) for the EU area. This result is consistent with the story that industries that outsource production inputs could have beneficial effects in terms of value added. Positive results are found particularly for machinery and equipment, vehicles, and electronic and communications equipment sectors.

Finally, many studies have looked at the positive effects of globalisation on productivity via technology spillovers. Egger and Pfaffermayr (2001) find that the transfer of production know-how improves overall productivity of FDI-receiving firms and to some extent also that of the other firms due to spillovers. Buckley *et al*. (2002) also finds that the presence of multinationals generates spillovers to locally-owned firms. Coe and Helpman (1995) estimates indicate that foreign R&D has beneficial effects on domestic productivity, and that these are stronger the more open an economy is to foreign trade. Moreover, the estimated rates of return on R&D are very high, both in terms of domestic output and international spillovers. Sinani and Meyer (2004) disentangle the positive effect of technology transfer on the productivity of domestic firms from that of competition. They find that the size of the spillover effect depends on the characteristics of incoming FDI and of the recipient firm. Spillovers have a positive or negative impact on the productivity of local firms depending on whether the negative competition effect outweighs the positive effect of demonstration and imitation, the training of employees, and the positive effect of backward and forward linkages.

Gains through technology spillovers

The relocation of production activities also has benefits for the *host* or *insourcing* economy. The beneficial effects for the *host* economy occur through a number of channels: imitation via the adoption of new production methods or management practices; higher competition in the domestic market due to the entrance of foreign firms; human capital spillovers; "export-spillovers" through collaboration or imitation with the foreign firm so that domestic firms learn how to penetrate export markets. Graph 1.21 depicts the change in the foreign direct investment inward output ratio and the change in the labour productivity for a sample of selected new Member States (the Czech Republic, Hungary, Slovakia, and Slovenia) and the significant robust correlation with a coefficient of 0.51 (p-value of 0.02).

Graph 1.21:Relationship between the change in labour productivity and change in the FDI inward capital stock in selected new Member States



Note: Sample includes Czech Republic, Hungary, Slovakia, and Slovenia.

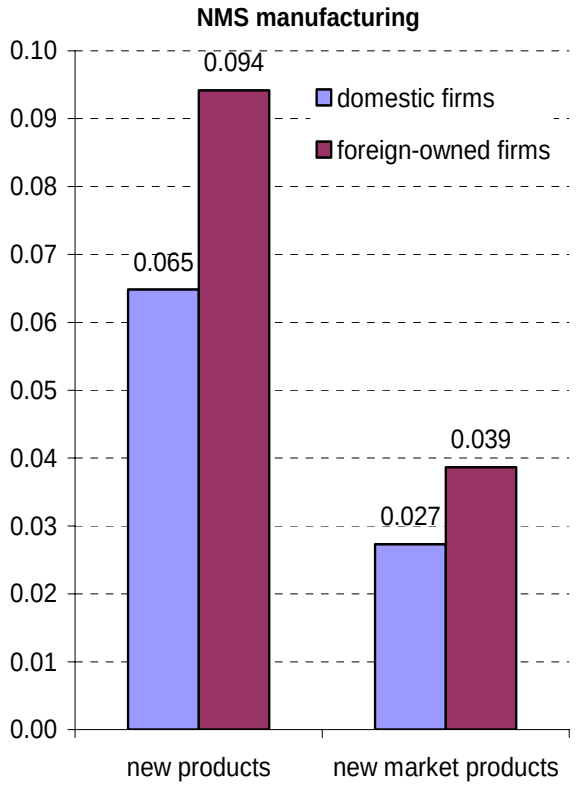
Source: WIIW FDI database, Eurostat (New Cronos).

One of the main channels for productivity increases in the *inshoring* country come from technological spillovers. Empirical evidence shows that foreign-owned firms tend to be more technologically advanced than domestic firms and have a higher propensity to innovate[24]. As shown in Graph 1.22 for a sample comprising Czech Republic, Latvia, Estonia, Hungary, Lithuania, and Slovakia, the share of innovative sales is higher for foreign-owned firms than for domestic ones. For these NMS countries, estimates from a probit model on the probability that a firm introduces a new product or production process show that foreign-owned firms are significantly more likely to innovate than domestic firms[25]. Some studies suggest that the positive technology spillovers are stronger on a vertical, not horizontal level (thus associated with intermediate trade and outsourcing). A possible explanation for this is that multinationals are able to "hide" their new technology from competitors in the same industry but their (vertical) suppliers profit from their technology (Gorg and Greenaway, 2004; Smarzynska 2004). Box 1.1 above provides a selected summary of empirical studies corroborating the positive effects of globalisation via technology spillovers.

Graph 1.22. Share of innovative sales between foreign-owned and domestic firms

24 Among others, Sinani and Meyer (2004), Gorg and Strobl (2001).

25 Estimations using Community Innovation Survey (CIS3) micro-aggregated data. Regressors include ownership, education level of work force, size, indicators of firm's openness degree, country and sector dummies.



Notes: Sample includes manufacturing sectors in CZ, EE, HU, LT, LV and SK. Number of observations is 6349. The category "new products" represents new (or significantly improved)-to-firm products (but not necessarily new to the market). The category "new market products" are new (or significantly improved) not only to the firm but also to the market.

Source: Community Innovation Statistics (CIS) 3 micro-aggregated data.

1.6. Summary and conclusions

In 2006, the EU had its best economic growth performance since 2000, supported by a simultaneous acceleration of employment and labour productivity growth. At the same time, the productivity growth differential vis-à-vis the US, which had bottomed out in 2003-2004, turned positive. These very encouraging results, which are also reflected at the sector-specific level, should n distract from the fact that there is still a very large productivity gap vis-à-vis the US, taken as a benchmark of the technological frontier.

The main source of this gap is total factor productivity, i.e. the part of productivity growth that cannot be assigned to an easily measurable factor such as capital deepening or improved labour quality, but must be attributed to less tangible factors such as technical and organisational progress. The policies most directly relevant to total factor productivity are those covered by the microeconomic pillar of the Lisbon strategy: those fostering technological progress (through more investment in – but also better uptake of the results of - R&D), the use of ICT, competition and product markets reform and infrastructures. The fact that the recent productivity upswing in the EU was fuelled also by an acceleration of TFP and that it was widespread across setters, including the services, leads to the suggestion that these reforms are starting to bear fruit. However, it is too early to be able to confirm the structural nature of this development.

In this context, it is worth noting that trade openness and competitiveness go together. While the causality link might be ambiguous, there are well visible productivity gains associated with the resulting specialisation, the scale effects, the greater competitive pressures that forces less efficient firms out of the market and the greater ability to absorb technological advances and new ideas developed in the rest of the world.

These results suggest that both increased intra-EU trade as a result of improving the Single Market and ambitious external policies – such as concluding the Doha Development Agenda, the new generation of bilateral free trade agreements, rebalancing the trade relationship with China, removing barriers to EU exports and a stepped-up market access strategy – hold out the potential of significantly contributing to productivity growth in the EU.

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Annex

Annex Table 1.1: Employment growth and 2006 employment rate				
EU-27	**Average annual employment growth**			**2006 Employment rate:** Employment as percentage of population 15 to 64 years.
	1995-2000	**2000 - 2005**	**2006**	
Austria	0.7	0.3	1.4	70.2
Belgium	1.1	0.6	1.1	61.0
Bulgaria	-0.3	1.5	2.4	58.6
Cyprus	1.3	3.0	1.5	69.6
Czech Republic	-0.8	0.3	1.6	65.3
Denmark	1.0	0.0	1.9	77.4
Estonia	-2.0	1.1	5.5	68.1
Finland	2.3	0.9	1.4	69.3
France	1.4	0.6	0.8	64.8
Germany	0.8	-0.2	0.7	67.2
Greece	0.6	1.3	1.5	68.6
Hungary	1.2	0.2	0.7	57.3
Ireland	5.7	2.9	4.2	63.0
Italy	1.0	1.2	1.7	58.4
Latvia	-0.5	1.7	4.6	66.3
Lithuania	-1.1	1.7	4.6	63.6
Luxembourg	4.1	3.1	3.9	63.6
Malta	-	0.9	0.7	54.8
Netherlands	2.6	0.2	1.2	74.3
Poland	-0.4	-0.6	3.3	54.5
Portugal	1.9	0.8	0.7	67.9
Romania	-1.9	-0.3	2.8	58.8
Slovakia	-0.8	0.6	2.3	59.4
Slovenia	-0.4	0.5	1.2	66.6
Spain	3.9	3.2	3.3	61.0
Sweden	0.8	0.3	1.8	73.1
United Kingdom	1.3	0.9	0.8	71.5
EU-27	1.0	0.5	1.6	64.3
US	2.0	0.5	1.9	71.5
Source: National accounts (EUROSTAT) for employment growth and structural indicators (EUROSTAT, Labour force survey) for the employment rate. Status: July 2007.				

2. RECENT MICROECONOMIC REFORMS IN THE EUROPEAN UNION

2.1. Introduction

The renewal of the Lisbon Strategy in 2005 as the Partnership for Growth and Jobs focused the efforts of the European Union on more effective responses to the challenges of demographic change and globalisation. The National Reform Programmes and the Community Lisbon Programme designed to carry this reform effort over the three-year cycle 2005-2008 aim at increasing employment rates and productivity growth at the same time. This combined effort to act on labour supply and productivity growth should help ensure that the European Union will continue to have the wherewithal to sustain its social model and to secure the prosperity to which Europeans have grown used over the decades, and which in good measure has been the fruit of European integration, in particular the single market.

Raising the long-term economic potential by increasing productivity growth is one of the fundamental objectives of the renewed Lisbon strategy. Reforms in pursuit of this objective are being undertaken mainly in the microeconomic policy pillar of the integrated strategy, although reforms in the macroeconomic and employment policy pillars also impact productivity growth. It is in the microeconomic policy area where Member States identified the largest number of key challenges in their 2005 National Reform Programmes. This chapter aims to provide a broad assessment of whether the types of reforms engaged by Member States since 2005 are likely to have the desired effects on growth in total factor productivity, given what is known about the relationship between microeconomic structural reforms and productivity growth[26].

The results of productivity-enhancing structural reforms can rarely be captured in the short term and the measurement of their effects is complex. In view of that, the relaunch of the Lisbon strategy in 2005 is too recent to allow for a quantitative assessment of progress in the microeconomic pillar of the strategy. However, based on the literature on the relationship between structural reforms and productivity growth, it is possible to determine whether Member States and Community level are engaged in the right kinds of activities in the pursuit of productivity growth. This chapter finds that the priorities identified and the reforms pursued by Member States and at Community level under the Community Lisbon Programme in their majority target higher productivity growth. There is clear progress with the key reforms under the microeconomic pillar of the strategy. While it is too early for quantitative assessments, the most recent data on productivity developments presented in chapter 1 seem to be consistent with a positive view of the structural reform effort to boost productivity growth.

Section 2.2.1 presents a literature review of the links between structural reforms and productivity growth and in Section 2.2.2 estimates found in the empirical literature on the likely quantitative impacts of certain types of structural reforms across the microeconomic pillar of the Growth and Jobs Strategy. In the light of these findings, Section 2.2.3 looks at

[26] The forthcoming The EU economy: 2007 Review (European Commission, 2007) addresses the same issues more empirically.

reform measures taken by Member States and at the Community level and assesses to what extent they promise an increase in productivity growth in the European Union in the years ahead. Section 2.3 considers the role of spillovers between reforms pursued by Member States individually as compared to joint reform action by all Member States in this context. Section 2.4 concludes.

2.2. Productivity Growth and Structural Reforms

2.2.1. Preconditions for boosting productivity growth

Europe's underperformance vis-à-vis the United States over the last decade or so in terms of per capita income and the question of how this underperformance can be overcome has been the subject of a considerable body of literature focusing on the role which structural reforms can play in raising potential output and productivity growth in European economies[27]. Differences in total factor productivity are generally regarded as the main variable for explaining differences in par capita income across countries with similar capital intensity and labour input[28]. As the residual in the growth accounting equation, total factor productivity growth captures the overall increase in efficiency achieved through technological progress and the improvement in production processes that cannot be attributed to capital deepening[29].

The analysis of factors explaining cross-country differences in productivity growth provides an important point of reference for any reform agenda aiming to raise the long-term growth performance. Europe's competitiveness over the long term can only be ensured through stronger and sustained productivity growth. To achieve higher productivity growth is therefore a key objective of the renewed Lisbon strategy, the partnership for growth and jobs. The empirical literature on structural reforms has produced numerous quantitative estimates of the potential impact of "Lisbon-type" reforms[30] on productivity, economic growth, and employment. While productivity growth depends also on macroeconomic stability and well functioning labour markets, its immediate foundation is the quality of the microeconomic business environment and the sophistication with which firms operate.

Michael Porter et al. (2006) present the microeconomic business environment of the firm as the interplay of four elements: factor conditions (human and capital resources, administrative, scientific and technological infrastructure, natural resources), context for firm strategy and rivalry, demand conditions (sophistication of demand), and related and supporting industries (quality suppliers, presence of clusters). Increasing productivity growth can be achieved to varying degrees by influencing these elements of the business environment through appropriate policy measures, but it ultimately depends on the sophistication of the companies.

Catching up with the United States on productivity growth – past trends

The basic types of policies required to boost growth and employment in Europe have changed considerably over time, and the recent widening of the gap between the United States and the European Union in terms of productivity growth are in part a reflection of an insufficiently

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27 Aho et al. 2006; Cotis/Elmeskov 2006; European Commission (2005); Jimeno et al. 2006; OECD 2007. Pyythiä 2007; Sapir et al. 2003; Van Bart et al. 2006.

28 See Aiyar/Dalgaard 2003, TFP revisited; Stiroh, Kevin J. (2001).

29 For an assessment of the empirical evidence on growth see Temple 1999. The New Growth Evidence.

30 See Boxes 3.2.1 – 3.2.4 below. For an overview of estimates on the impact of Lisbon-type structural reforms. Much of this material was contained in Dierx et al. (2005): The economic costs of non-Lisbon.

rapid adaptation of policies in Europe. This becomes clear when looking at the broad trends over the past 50 years. Aghion (2006) points out that Europe's success in achieving sustained economic growth during the post WWII era was associated mainly with policies of capital accumulation and the imitation or adaptation of innovations made elsewhere[31]. The economic institutions of the time were well suited to support this catching up process through incentives based on limited competition in product markets, a focus on education below the tertiary level, and labour market arrangements favouring the accumulation of experience within firms rather than labour mobility.

Once the catching up process was complete by the 1980s, capital deepening and the imitation of innovations produced elsewhere were no longer sufficient to boost growth, and home-grown innovation was needed. Michael Porter et al. (2006) describe such transitions in more general terms as moving from the investment-driven phase of economic development to the innovation-driven phase. They attribute an economy's difficulties in making such transitions to the "wholesale transformation of many interdependent aspects of competition" that is required to advance to the next level and to the complication that previously successful strategies may no longer be efficient under the new circumstances.

The role of efficient ICT use

The widening of the gap in productivity growth between the United States and Europe since the mid-1990s has been attributed to a large extent to innovations in the ICT sector and their rapid spread across the entire economy in the following years. Contrary to the United States, Europe has not been able to keep up with regard to the production but also with regard to the use of ICT across all sectors of the economy. The services sector in particular has lagged behind in Europe vis-à-vis the US in terms of productivity growth since the late 1990s[32]. Van Ark (2005) has shown that the productivity gap in ICT using sectors has widened sharply since 1995.

It is however interesting to note, that capital deepening in ICT has accelerated in all the 26 OECD member countries investigated in van Ark (2006), even in those countries where productivity growth remained slow. This seems to suggest that increases in ICT investment as such do not guarantee stronger total factor productivity growth, but that general framework conditions, such as the degree of competition prevailing in a market and the general conditions for restructuring the productive sector, are likely to be of more fundamental importance for the innovative capacity of an economy.

This view is supported by Crespi et al. (2007) who have analysed the relationship between productivity growth, ICT investment and organisational change based on firm-level panel data for the United Kingdom. While the authors present a note of caution in view of measurement and data issues, their findings are consistent with previous studies which have shown that ICT investment has high returns in terms of growth accounting, when organisational change is omitted from the equation[33]. These returns fall sharply once organisational change is taken into account. The authors also find that periods of above-average ICT investment tend to be associated with slowdowns in TFP growth in the short run. These results are consistent with the suggestion that ICT investment and organisational change together boost productivity and

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31 Aghion (2006).

32 Bloom et al. 2007; Gordon (2004); Kox and Rubalcaba (2007); Van Ark (2005); Van Ark et al. (2006).

33 See also Bresnahan, Brynjolfssonand Hitt 2002 as well as Brynjolfsson and Hitt 2003.

that in the absence of organisational change higher ICT investment would imply a slowdown in measured TFP growth.

The relationship between competition and innovation

Europe needs to boost its innovative capacity continuously in order to raise productivity growth and to be able to sustain its standard of living in the face of the challenges posed by globalisation, ageing societies, as well as changes in technology and skill composition of demand for labour and climate change. The empirical literature on structural reforms and productivity supports the view that the focus of public policy on areas crucial for future productivity growth - such as investment in R&D, ICT, and higher education - where the United States have outperformed the European Union, is not in itself sufficient, but that framework conditions and the right incentives for economic actors are decisive in raising productivity growth, and that in absence of such conditions all other efforts would go to waste.

The importance of well functioning and competitive markets as an essential foundation for a good business environment are generally recognised and well understood today. Increased competition tends to have a positive effect on productivity and employment by improving allocative efficiency (static), productive efficiency (work organisation), and dynamic efficiency (innovative products and processes). Crespi et al. (2007) cited above with regard to the positive productivity effects from ICT investment when accompanied by organisational change also confirm the fundamental role of a competitive environment for productivity. When measuring competition by lagged changes in market share they find that firms having lost market share in the previous period are significantly more likely to introduce organisational change in the current period.

Crespi's firm-level analysis confirms the well established positive correlation between competition and productivity and explains one mechanism at work in bringing this about, i.e. the direct impact of increased competition on organisational change. This study based on UK firm-level data also seems to confirm findings by Bloom et al. (2007) according to which US management practices are generally of better quality than European ones, although Germany and Sweden perform almost as well as the US. Both studies find a positive correlation between intense competition and better management practices both in terms of quality and productivity.

While the positive correlation between competition and productivity is well established, the effect of competition on innovation, which has been a focus of theoretical and empirical research in economics, is not quite as clear cut. Many economic studies indicate that there is a relationship between market structure and innovation, though the direction of the effect is not consistently the same (for literature surveys, see Ahn 2002 and Symeonides 1996). The effects of demand and market structure may vary in significance for different types of innovations depending on whether regulatory protection measures are in place.

When considering the effect of competition on innovation it is important to distinguish between new entrants and incumbent firms, as well as pre- and post-innovation market structure. In the traditional Schumpeterian model innovation happens through new firms entering. Less competition in the market increases incentives for innovation, given that the expected returns to innovation (and market entry) are higher if competition is lower. For incumbent firms, lower levels of competition can be conducive to innovation if capital markets are imperfect and R&D has to be funded with firm's internal resources.

On the other hand, intense competitive pressures may provide firms with incentives to innovate in order to avoid bankruptcy. Where competition is intense, the incentive to innovate may also arise from attempts to gain competitive advantage over rivals. In this case the post-innovation market may be less competitive than the in pre-innovation market.

Aghion et al. (2005) suggest that competition may provide both incentives and disincentives to innovation, depending on the proximity of firms to the technological frontier. The joint presence of both effects is presented as resulting in an inverted U-shaped relationship between innovation and the degree of competition. Innovation in this model is a step process - first the company has to catch up with the technological leader before becoming a leader itself. Therefore the quality of competition also matters: only companies which are sufficiently close to the frontier of productive efficiency will innovate since for them innovation produces considerable rents. Thus when firms have relatively equal production costs (neck-and-neck competition), innovation increases with competition as the effect of firms trying to overtake competitors dominates. When companies are far behind the technological leader an increase in competition will reduce incentives to innovate as it reduces post-innovation rents.

In addition to producing innovations, the adoption of new technologies by non-innovators is essential for improving productivity in the long run. The process of technology adoption has attracted less attention in the economics literature but firms appear to follow broadly similar considerations of costs and returns when choosing to adopt existing technologies.

Vandenbussche et al. (2006) find that growth-enhancing policies might change once countries move closer to the technological frontier. Stringent protection of intellectual property can be more important for productivity growth in countries close to the frontier which are more heavily engaged in innovation rather than imitation. Given the public good aspects of knowledge, protection of intellectual property can be necessary to retain the incentives for innovation.

Different sectors across the EU vary widely in terms of their distance to the respective technological frontier. A one-size-fits-all approach to regulation and innovation would therefore be inappropriate. Instead, a sector-by-sector approach is preferable when determining the appropriate course of action. When aiming to provide the right incentives for innovation, it is important to take account of industry-specific characteristics and of the prevailing efficiency levels in each country. Some countries may still find themselves in a position where the adoption of technologies produced elsewhere would still be considered as appropriate in some sectors, while improving the conditions for the creation of new technologies may be the policy of choice for others. Both adoption and creation of technologies are efficiency improving, but the impact of regulation and competition might be different in each case.

The topic of regulation and innovation is the subject of several ongoing policy debates. The Commission recently presented a Patent Communication "Enhancing the patent system in Europe" (European Commission, 2007A). A more comprehensive Intellectual Property Rights (IPR) strategy that will complement the Patent Communication is planned for 2008. A second example is the Better Regulation agenda, which should foster competition and promote competitiveness. Work on strengthening the Internal Market and the new framework for the Internal Market in goods should contribute to the functioning of the EU's single market. Finally, the Commission’s 2006 Annual Progress Report concludes that European standard-setting must be accelerated, particularly in fast-moving markets, whilst ensuring inter-

operability. The Commission will conduct a review with the standardisation organisations, industry and stakeholders and issue an action plan in October 2007.

The role of product market regulation for competition and innovation

Most empirical evidence suggests a negative relationship between the intensity of regulation and indicators of economic performance such as innovation or productivity. There is however some degree of ambiguity concerning the effect of product market regulation on firms' innovative activity. Care is especially warranted in case of sectors which rely heavily on R&D and where spillovers in that area are potentially large. Schiantarelli (2005) points out that the availability of cross-country data and a deeper understanding of the nature of a country's industrial structure and distance to the technological frontier are requirements of a more refined empirical assessment of the interplay between product market regulation and innovation.

The OECD has conducted several studies on links between regulation and productivity, employment and economic growth. OECD (2007) finds that labour productivity has accelerated since the mid-1990s in lightly-regulated economies while it either grew more slowly or declined in highly-regulated countries[34]. Nicoletti and Scarpetta (2005) analyse possible links between product market regulation and total factor productivity growth in the OECD area over the past two decades. Their results suggest that lower barriers to trade and less regulation have increased the level and rate of productivity growth by stimulating business investment and promoting innovation and technological catch-up[35].

Griffith et al. (2006) in a study carried out for the Directorate-General for Economic and Financial Affairs suggest that product market reforms led to increased competition (reduced average mark-ups) which, in turn, positively impacted the incentives to innovate. They study the impact of product market reforms on innovation in the EU and find that intensifying competition tends to increase R&D investment, but mainly through increased innovative activity by incumbents rather than by new entrants[36]. Another study for the Directorate-General for Economic and Financial Affairs by Cincera and Galgau (2005) finds an insignificant relationship between firm entry and R&D investment as well as R&D intensity, which could suggest that firm entry is not a key transmission channel of product market reforms on R&D.

Aghion et al. (2005), whose theoretical contribution is discussed above, find that their empirical analysis supports the "inverted U" hypothesis for the relationship between competition and innovation. Their data consist of a panel of UK companies in 1968-1997. During this period, a number of reforms were implemented and there were considerable changes in the market structure. Their measure of innovation is based on patent data. Bassanini and Ernst (2002) use the OECD indicators of product market regulation and investigate their effect on industry's R&D intensity. Their cross-country evidence also suggest that product market reforms would have positive effects on innovation. They also

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34 See OECD (2007), p. 147.

35 The regulation indicators used include OECD indicators of product market regulation for 1998 and sectoral indicators available for a longer period of time. The OECD indicators are based on a large set of questions regarding different aspects of regulation which are then summarised into higher level indicators. See Conway et al. (2005).

36 The product market measure used by Griffith et al. (2006) is an indicator constructed from the single market programme, but they also use the WEF/Fraser Institute measure of time spent on government bureaucracy by senior management.

conclude that labour market regulation can have effects on innovation. Conway et al. (2006) study the effect of product market regulation on the international diffusion of new technologies. They find that anti-competitive product market regulation has a negative impact on the adoption of information and communications technology and on the location decisions of multi-national enterprises. The review by Schiantarelli (2005) of a large number of cross-country studies on the macroeconomic impacts of product market regulation concludes that less stringent regulation has generally a positive effect on productivity growth and that most studies that include measures of regulation directly in the regression tend to find a negative effect of tighter regulation on total factor productivity or per capita output growth.

SMEs tend to be affected disproportionately by unnecessarily burdensome regulation and market failures associated with information asymmetries, such as those that may occur in the context of the availability of innovation financing and venture capital. The high cost of patents in the European Union also tends to put a brake on the innovative capacity of SMEs. SMEs have more difficulties than large enterprises with embarking on cross-border activities. Only 28% of small companies and 36% of medium-sized ones trade cross-borders. Approximately 25% of SMEs claim to be prepared to do it even if they do not trade yet[37]. There is thus no doubt that SMEs hold considerable untapped potential for the European economy in terms of productivity improvements, in particular if the business environment were to facilitate their market entry (and exit) and faster growth.

Recent literature has confirmed that higher levels of competition have a positive effect on management practices and thus on productivity. Using firm-level data on management practices in medium-sized enterprises for the US, France, Germany and the UK, Bloom and Van Reenen (2006) find that poor management practices are more prevalent in the presence of weak product market competition. They tend also to be more prevalent in family-owned firms passed on from one generation to the next. The authors find that these two factors combined can largely explain the difference in the quality of management practices, which is generally higher in medium-sized firms in the US than in European ones. These factors may also hold an explanation for the insufficiently realised growth potential of European SMEs.

Labour market reform

The present chapter focuses on productivity-enhancing structural reforms in the product and services markets. It should not lead to underestimate the importance of structural reforms of the labour market which are necessary to fully reap the benefits of the former. In particular, implementing the flexicurity agenda has the potential to smoothen the reallocation of the production factors and allow workers to progress in their work, thus permitting an increase a country's productivity level (growth rate) while reducing involuntary unemployment. Moreover, flexicurity is a good example of the need to develop an integrated and comprehensive policy package, covering simultaneously flexible contractual arrangements, comprehensive lifelong learning strategies, effective active labour market policies and modern social security systems. Indeed, by now it is generally accepted that flexicurity is a very important instrument to promote more and better jobs by combining flexibility and security for workers and companies.

[37] Flash Eurobarometer « Business attitude towards cross-borders sales and consumer policy », December 2006.

2.2.2. Likely effects of structural reforms

The previous section has given an overview over recent literature on theoretical considerations and empirical findings on the relationships between productivity, innovation, and competition as well as the role of ICT investment and ICT use in this context. It has also discussed the importance of the regulatory environment for productivity growth. This discussion has shed some light on where structural reforms may be most needed in Europe to improve the productivity performance and to bring about a significant increase in TFP growth. This section presents some of the likely quantitative impacts of Lisbon-type reforms in the areas of R&D and innovation, internal market and competition policies, and product market reforms based on estimates found in the empirical literature. Some estimates gauge the likely impact of actual legislative projects such as the Services Directive and the EU's target to reach an R&D intensity of 3% by 2010. Others provide an orientation with regard to the potential economic effects of structural reforms that would render competition in European economies as intense as in the United States or bring about the dismantling of remaining internal market barriers. The estimates show which types of reforms promise the greatest rewards in terms of growth and jobs. This section also raises general issues that have emerged from the experience with the implementation of reforms since the renewal of the Lisbon Strategy in 2005 and that are relevant for achieving some of the objectives reflected in the estimates.

R&D, Innovation, and ICT policies

The importance of increasing R&D investment for boosting productivity growth is well established. The European Commission has estimated that the impact of reaching the European Union's R&D intensity target would lead to increases in total factor productivity of 0.8% and could boost real income by 3% (see Box 2.1). However, there is today a clear recognition that additional progress in this area will in part depend on better integrating the elements of the knowledge triangle: R&D, innovation and education and training.

Box 2.1: Investing in Knowledge and Innovation

Educational attainment

European Commission (2003A)

Reforms increasing by one year the average attainment of the population aged 25–64 would lead to:

– a TFP level increase of 4% to 6% (with an additional 3% in the long run)

– a GDP annual growth increase of approximately 0.3 to 0.5 percentage points

R&D Investment

European Commission (2004)

Measures to increase total EU R&D spending from 1.9% to 3% of GDP in 2010 (in order to reach the Lisbon target) when compared to a status quo situation (i.e. no increase in R&D spending) would lead to:

– a GDP level increase of 1.7% by 2010 (0.25% per year).

TFP, employment and real income levels increase of 0.8%, 1.4% and 3% respectively by 2010

GDP level increases of 4.2%, 7.5% and 12.1% in 2015, 2020 and 2030 respectively

Wobst (2006)

If Member States achieve their targets for R&D investment by 2010, which would lift EU R&D intensity from 1.9 to 2.6% of GDP, R&D activities will rise by 50% in 2025 and will produce:

– an increase of 2.6% in GDP on the basis of conservative assumptions.

European Commission (2007)

If Member States achieve their targets for R&D investment by 2015 and maintain the achieved R&D intensity over the medium to long term, GDP will increase by 4.1 % over the baseline and TFP by almost 6%, by 2025 (results using the QUEST III R&D model).

The relevance of improving the skill level was shown by European Commission (2003A). An average increase of one year in educational attainment would produce a level increase in TFP of between 4 and 6%. The issue of a sufficient supply of qualified researchers may represent the most important bottleneck for boosting R&D and innovation in some countries. Apart from strengthening the integration of the knowledge triangle, overcoming the fragmentation of regional, national and European research and innovation systems is also important to avoid duplication, to reach critical mass and to optimise spill over effects.

The importance of clusters for cutting edge technological development, innovation and productivity has been widely recognised. Their innovation and productivity enhancing effects may partly be attributable to the facilitation of new firms' market entry which results from the presence of material and immaterial production factors in close geographic proximity. It is less clear how public policy can contribute to cluster creation, except through providing propitious conditions for all elements of what Michael Porter calls the diamond structure of the microeconomic business environment[38]. One of the challenges in reaching the European Union's R&D intensity target is how sufficient private R&D spending can be induced.

Internal Market and Competition Policy

The importance of a functioning internal market and competition for the quality of the business environment generally and for productivity growth more specifically has been well established by theoretical and empirical literature, as discussed in Section 2.2.1. Considerable benefits can still be reaped from dismantling remaining barriers to the functioning of the single market, as is shown in European Commission (2007E), which estimates that their removal would increase GDP by 2.2% and induce the creation of 2.75 million new jobs, which is equivalent to an increase in the employment rate by 1.4%.

[38] See Porter et al. (2006), Figure 3.

Despite considerable progress being made towards integration in goods markets, considerably fewer service industries yet benefit from a single EU-wide market. There is clear evidence that market integration in services has advanced at a much slower pace than in the goods sector. While services account for close to 70% of the EU-15 value added, they represent only some 20% of intra EU-15 trade. Price convergence in services is also much lower than in the goods sector, even when the more tradable nature of goods is accounted for. In the service sector, weak competition is further illustrated by the low frequency of price changes and the downward inflexibility of prices. Strengthening the internal market for services is therefore an urgent task.

Increasing competition through a pro-active competition policy and the completion of the single market, especially in services holds considerable economic potential. The Services Directive, which aims at facilitating the exercise of the freedom of establishment for service providers and the free movement of services, was adopted in December 2006 but has yet to be implemented. A Copenhagen Economics study calculated that the Services Directive could create up to 600.000 extra jobs, while the welfare gains would amount to about 0.6% of GDP.

The functioning of the single market is often hindered by sector specific barriers. Market monitoring exercises might hold remedies for some sector specific problems in the single market. Based on the analysis, there may also be scope for action at Community level through infringement procedures, competition policy, the legislative approach and the coordination mechanisms of the Growth and Jobs strategy to improve competition in sectors that are crucial for growth and jobs.

The markets for retail banking, mortgage lending, insurance, pensions and long-term savings are still rather fragmented. Creating a strong and competitive single market across all of these financial services industries would increase competition and ensure efficiency amongst service providers, increase the availability and reduce the cost of capital to non-financial firms, provide a common high level of consumer protection, ensure financial stability, and create a dynamic, innovative European market with top class regulation and regulators.

Overall, completing the single market for financial services will reduce the cost and improve the availability of financing for investment and innovation. An independent London Economics study estimated the effect on the cost of capital for EU companies at about 0.5 percentage points and raising EU GDP by 1.1%[39]. The resulting increase in investment and R&D spending could have important dynamic effects in raising the growth rate of the EU economy.

Box 2.2: Improving the Functioning of the Internal Market & Competition

Removing remaining Internal Market barriers

European Commission (2007E)

The removal of remaining Internal Market barriers would double the effect the enlarged Internal Market had over the period 1992-2006 and bring:

– a 2.2% increase in the EU-25 GDP and the creation of 2.75 million additional jobs

[39] London Economics (2002).

(equivalent to a 1.4% increase in total employment).

Implementation of the Services Directive

Copenhagen Economics (2006A)

The implementation of the original proposal of the Services Directive would lead to:

– the creation of 600,000 new jobs;

– an increase in total consumption by 0.6%.

European Commission (2006F)

The implementation of the original proposal for the Services Directive would lead to:

– a GDP increase of about 0.2%.

Product Market Regulation enhancing competition

Dierx et al. 2004

Product markets reform aiming at increasing competition would lead to:

– a GDP increase (relative to its baseline level) of about 2% in the medium run (acceleration of output growth by almost a quarter of a percentage point annually over a period of 7 to 8 years).

IMF 2003

Competition-friendly product market reforms reducing the price-mark-up in the Euro area by 10 percentage points would produce:

– a long term increase in the GDP level in the Euro area of 4.3%.

Bayoumi et al. 2004

Product market reforms reducing the price mark-up in the Euro area to US levels:

– a GDP level increase in the Euro area of 8.6% (relative to its baseline level) in the long run.

Full market opening in network industries

Copenhagen Economics (2006B)

A full market opening in network industries for the EU-15 would result in an increase of:

– between 1.0 and 1.6% increase in value added (equivalent to €80 to 130bn);

– between 140,000 and 360,000 additional jobs.

Greater financial market integration

London Economics (2002)

Greater financial market integration producing greater efficiency and competition would produce:

– GDP and employment level increases of 1.1% and 0.5% respectively in the long run.

Giannetti et al. 2002

Greater financial-market integration with efficiency gains and access to a larger and deeper market should lead to:

– a sustained increase in value-added growth in manufacturing increase by 0.8%-0.9%.

The potential of such action is highlighted by the results of studies on the likely impact of broadly defined pro-competitive product market reforms. They suggest increases in the level of GDP of between 2 and almost 9% relative to the baseline, depending on the degree of increase in competition effected by the reforms. Greater financial market integration is estimated to lead to a level increase in GDP of about 1% and of a similar increase in value added in the manufacturing sector. Its potential benefits for facilitating R&D investment and innovation have already been discussed**.**

Areas which appear to hold considerable potential for improvements in productivity are the retail and wholesale sectors[40]. Together they account for 10% of the total value added of the EU economy and employ about 30.5 million people in the EU-25, which is about 15% of the total EU employment. The productivity gap between the EU and the United States is particularly pronounced in these sectors. Closing this gap could increase labour productivity growth in the EU, given that "more than 50% of the economy-wide productivity growth lead for the United States since 1995 is accounted for by these two sectors"[41]. Improved productivity in retail and wholesale markets is also critical for the competitiveness of manufacturing industries that rely on efficient distribution networks. The productivity performance of distribution in the EU has significantly lagged the US. The major reasons for this seem to be linked with restrictive regulation at several levels of government, resulting in limited competition.

Competition in the network industries

The efficiency of energy markets is of key importance to the overall competitiveness of the EU economy and the fight against global warming. High levels of competition, an enhanced regulatory regime and the removal of barriers to market integration will be necessary to ensure that the investments in the energy system needed until 2030 are made. The electricity and gas industries have a turnover of more than €500 billion and employ more than a million people in the EU. They provide direct services for consumers and essential inputs for other industries. Currently, the EU energy market is characterized by fragmented national markets with powerful incumbents.

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[40] Retail and wholesale trade made the strongest contribution to US labour productivity growth between 1995 and 2002. See Van Bart (2005), p. 12. For an illustration of the productivity gap in the retail and wholesale sectors see ECB 2006, figure 8, p. 21.

[41] McGuckin; Spiegelman, and van Ark, Bart (2005), p.5.

Effective unbundling between energy generation, network operation and sales is important for creating an open and competitive energy market, where incumbent firms are prevented from using their network assets to make the entry of competitors more difficult. The absence of effective separation may distort investment incentives, since integrated network owners have few incentives to invest in interconnections that would open themselves up to new competition. National regulators will only be efficient if they hold sufficient powers and are independence from government. There are questions as to whether national regulators and regulations are fully appropriate to deal with cross-border issues.

The insufficient interconnection of national networks and the insufficient integration of European energy markets hamper competition in some parts of the European energy markets. The implementation of the National Reform Programmes has not yet had a satisfactory impact on connecting the national markets. Effective energy market integration would have an important impact on growth and jobs though. A recent study by Copenhagen Economics estimated that the effects of market opening in electricity could reduce prices for electricity in the EU-15 by 13% and increase cross- border trade by 31%[42]. This would have significant positive effects on consumers and producers further down the value chain, overall increasing EU GDP by 0.5-1.0% and creating some 50,000-120,000 jobs[43].

As Schiantarelli (2005) points out, the issue of how the effect of product market reform depends on the rules and regulations in labour markets as well as the regulatory structure and level of development of the financial sector is not well researched. That the joint pursuit of reforms in product and labour markets can bring about synergies in terms of stronger effects on growth and jobs is undisputed. A combination of macro- and microeconomic structural reforms along with labour market reforms corresponds to the logic of the key objectives under the renewed Lisbon strategy, which aims to raise and sustain productivity and employment growth at the same time, while maintaining fiscal sustainability. Section 2.2.4 below analyses in more depth the role synergies play for reaching the objectives of the Growth and Jobs strategy.

The European Commission (2002) has found that the interplay of pro-competitive product market reforms and of labour market reforms which increase the participation rate and facilitate employment-friendly wage setting could bring about a level increase in GDP of between 3 and 4% in the medium term, as well as an employment increase of between 5 and 6 million. Studies for the Euro area estimate even stronger impacts on GDP from combined product and labour market reforms.

The Business and Regulatory Environment, Product Market Reform, and Better Regulation

The empirical literature shows that the level of product market regulation has an important bearing on economic performance via the channel of increased competition and the consequent effects on innovation and productivity growth discussed in Section 2.2.1 above. The pro-competitive productivity-enhancing impact of product market reforms reducing the level of regulation comes about mainly through the facilitation of market entry or exit of firms.

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42 See Copenhagen Economics (2006), p. 4.

43 Impact Assessment on the Commission's Energy Package. Forthcoming 2007.

Box 2.3 summarises the estimates of a number of studies on the effects of product market reforms, which show that lower levels of product market regulation are correlated with significantly higher productivity growth, output and employment. Cincera (2004) analyses the impact of increasing market entry rates of firms and finds that a one percentage point increase in entry rates would push up the growth rate of labour productivity by 2.2% in the short run, while the same increase in exit rates would have a considerably smaller effect on productivity with some time lag.

Box 2.3: Effects of product market reforms (PMR)

PMR reducing levels of regulation

Salgado 2002

Product market reforms in OECD countries over the period 1985–1995 contributed to:

– an increase of 0.2 – 0.3 percentage points in total factor productivity growth in the long run, while being weak in the short run

Nicoletti and Scarpetta 2005A

Regulatory reforms aligning the overall regulatory stance with that of the most liberal OECD country could induce:

– an increase the annual rate of TFP growth in continental EU by between 0.4 and 1.1% over 10 years.

Bayoumi et al. (2004)

Reforms aiming at reducing regulation in product and labour markets to US levels would increase competition and reduce mark-ups in prices and wages over marginal costs while increasing the substitutability of goods and inputs. These reforms would lead to:

– a GDP level increase in the Euro area of 12.4% (relative to baseline) in the long run

PMR facilitating firm entry

Nicoletti and Scarpetta 2003

Reducing barriers to entry in some European countries towards the OECD average:

– entry liberalisation in service would boost annual multi-factor productivity growth in the overall business sector by about 0.1 to 0.2 percentage points in certain countries;

– indirect effects would boost manufacturing-wide annual productivity growth by 0.1 to 0.2 percentage points in certain European countries, most notably Germany, France, Italy and Greece.

Cincera & Galgau (2005)

Product market reforms increasing the current firm entry rate by one% lead to:

– a contemporaneous increase in labour productivity by 0.60%,

– an increase in employment growth of 2.67%.

Cincera (2004)

Reforms aiming at facilitating the entry and exit of firms lead to:

– a 1% increase in the entry rate leads to a contemporary increase in output, employment and labour productivity growth rate of 2.2%, 2.7% and 0.6% respectively,

– a 1% increase in exit rate reduces output growth rate of 0.8% (one year lag), while it increases labour productivity growth by 0.7% (2-year lag).

Nicoletti and Scarpetta (2005B)

Product market reforms that would reduce the level of state control and entry barriers to entry to the best OECD practice would:

– increase long-term employment rates by between 1.3 and 2.5 percentage points (lower-bound estimate).

Reduction in administrative costs

European Commission (DG Enterprise) 2006A

A 25% administrative cost reduction may bring:

– a real GDP level increase of up to 1.5% - equivalent to some € 150 bn.

Nicoletti and Scarpetta (2005A) estimate that product market reforms that bring the overall regulatory stance among OECD countries in line with the most liberal countries among them would lead to an increase in Total Factor Productivity by between 0.4 and 1.1% per year for a period of 10 years. The European Commission (2006A) expects a level increase in GDP of 1.5%, which would be equivalent to € 150 billion in absolute terms from a reduction of administrative burdens by 25%.

Smaller but not insignificant effects can also be expected from the reduction of corporate tax barriers and related compliance costs. As Copenhagen Economics (2004) and Bettendorf et al. (2007) show providing a solution for the remaining tax problems in terms of double taxation and facilitating the restructuring of group companies foster the functioning of the Single Market and the adoption of a Common Consolidated Corporate Tax Base where groups of companies would be able to compute the taxable base for all their EU operations according to a new common tax code applicable across the EU could, on the basis of preliminary estimates undertaken before the details of the proposal have been defined, have an impact on EU GDP of up to 0.15%.

2.2.3. Structural reforms in the European Union

The previous section has presented some estimates for the potential impact on economic growth, productivity, and employment of microeconomic structural reforms in the areas of investment in R&D, knowledge and innovation, improving the functioning of the internal

market and enhancing competition, as well as reducing product market regulation. Some of these studies relate to concrete legislative or policy projects, which are being pursued in the context of the renewed Lisbon strategy, such as the Services Directive or policies to reach the national R&D spending targets. Others provide useful reference points in terms of defining expectations for Europe's future growth potential if a coherent microeconomic structural reform agenda is being followed.

The partnership approach of the renewed Lisbon Strategy clearly attributes the responsibility for implementing policy actions both at the national and the Community level. While Member States outline their economic reform efforts at the national level in national reform programmes (NRPs), the Community Lisbon Programme covers policy actions at Community-level. Actions are planned at the Community level when they can complement, facilitate or strengthen policy actions envisaged at the national level. In such cases, purely national action is insufficient because important cross-border externalities or economies of scale are concerned. The Community adds value to Member State action by:

(1) providing a common legal framework to create a level-playing field;

(2) using budgetary resources to supplement the resources of the Member States;

(3) leveraging its weight in international negotiations;

(4) coordinating Member State action to reap economies of scale and scope in policy areas with shared competences.

This section looks at key areas of microeconomic reforms being implemented by Member States and at EU level since the renewal of the Lisbon strategy in 2005 and relates them to the discussion of the literature and the empirical estimates presented in the two preceding sections. The key challenges that were identified by Member States within the microeconomic pillar of the Growth and Jobs Strategy centre around the issues of R&D, innovation, and ICT policy (raised by 24 Member States), competition policy (17) as well as the business and regulatory environment (18) (see Graph 2.1). This indicates the Member States' intention to focus on policies with the greatest potential of bringing about higher growth in total factor productivity. The environment is also an important key challenge in the microeconomic area (12).

The role of the policy measures under the Community Lisbon Programme (CLP) is to act where the benefits from a concerted, community wide intervention are clearly superior to un-coordinated national action. 102 actions were announced in 2005 for the CLP. The actions were focused on:

– making Europe a more attractive place to invest and work (51 actions);

– knowledge and Innovation (20 actions);

– more and better Jobs (26 actions).

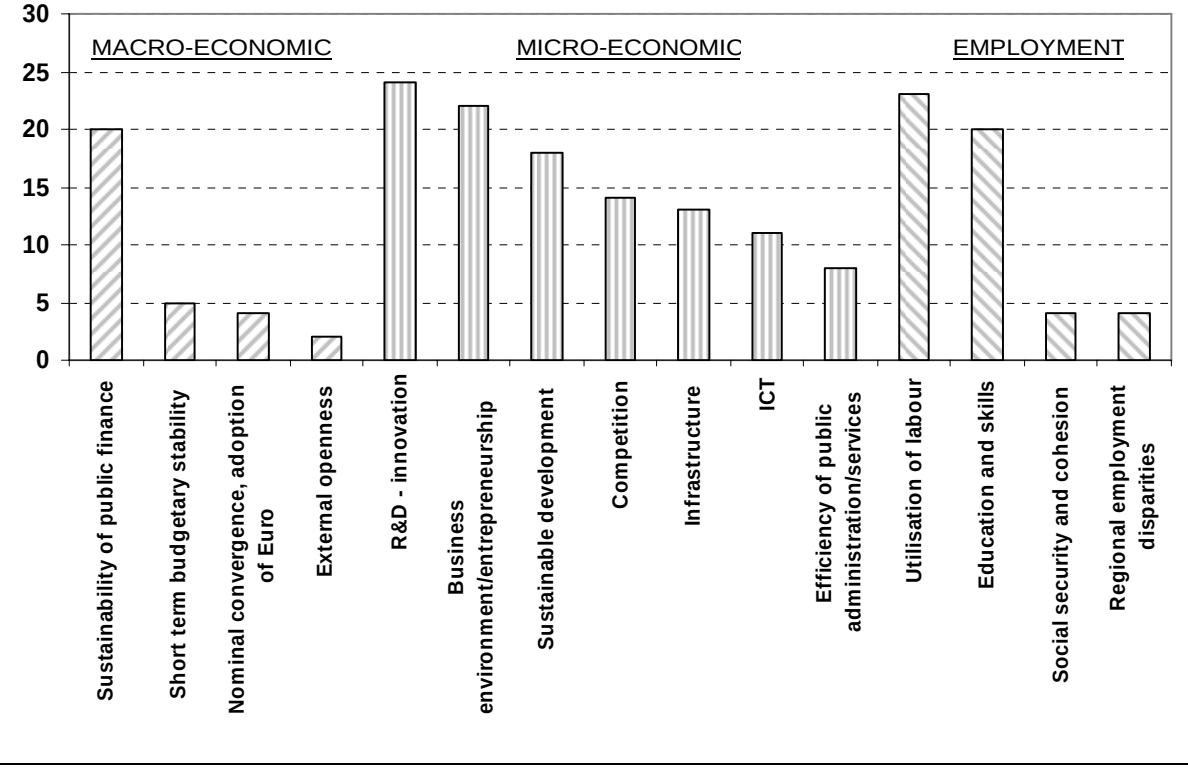
Therefore, up to 70% of the actions undertaken at the Community level focus on microeconomic reforms. Progress on the Community Lisbon Programme has been satisfactory. Most recent data show that by mid 2007 87 of the 102 announced in the CLP have been implemented. Behind these statistics the Community actions have complemented and facilitated significantly the efforts of the Member States. Community financing

mechanisms such as the renewed Structural Funds and the Cohesion Fund, the Competitiveness and Innovation Framework Programme (CIP) and the 7nth Research Framework Programme (FP7) are complementing the funding of the growth and jobs strategies of the Member States. The better regulation agenda facilitates the better regulation efforts of the Member States and has positive effects on the economy by cutting unnecessary costs and removing obstacles to innovation. The services directives is an important step towards extending the internal market to services.

The recommendations and points to watch endorsed by the 2007 Spring European Council confirm the European Union's focus on productivity-enhancing policies. Country-specific recommendations in the microeconomic pillar focus almost entirely on R&D and innovation (8) and competition policies (6). While recommendations of this type reflect important concerns that all is not well with regard to performance and reform implementation, the so-called "points to watch" represent a somewhat less formal hint that more action would be desirable and that implementation may be falling behind the objectives set out in the National Reform Programme. In this latter category, R&D, innovation, and ICT policies (points to watch for 19 Member States), internal market and competition policies (17), and policies to improve the business and regulatory environment (22) receive the largest attention[44]. While this picture demonstrates the seriousness of the European Union's focus on productivity-enhancing policies in the context of its annual multilateral surveillance exercise, the large number of points to watch also suggests that the implementation effort needs strengthening in the coming years.

Graph 2.1: Key challenges by broad policy area

[44] Annex Tables 2 and 3 provide information on the country-specific recommendations and points to watch raised during the multilateral surveillance exercise in spring 2007 and endorsed by the 2007 Spring European Council. See the Council Recommendation of 27 March 2007 for the complete text of the recommendations for all three pillars of the Growth and Jobs Strategy, i.e. for macroeconomic, microeconomic, and employment policies. Annex Graphs 1, 2, and 3 give an overview of the distribution of key challenges, country-specific recommendations, and points to watch about the three pillars of the renewed Lisbon Strategy.



Source: Commission Annual Progress Report 2006.

In this context, it must also be emphasised that enhancing the productive potential is a long-haul effort that will need to be sustained for years before its full results can be felt and systematically measured. The results of structural reforms can, in any case, rarely be captured in the short term. The measurement of their effects is complex for various reasons. Microeconomic reforms cover a large and heterogeneous range of sectors of the economy in a European Union whose Member States also display a large degree of heterogeneity. Quantitative indicators for most of the relevant variables needed to measure progress in the microeconomic area are only available with considerable time lags. Once they are available care must be taken to disentangle cyclical from structural developments.

Given that the National Reform Programmes under the renewed Lisbon strategy were only launched in the autumn of 2005 and that their implementation is ongoing, it is not yet possible to provide a rigorous assessment of the reform outcomes. The Commission's Annual Progress Reports provide an assessment of progress in the implementation of reforms. The key areas of reforms programmed and being implemented by Member States do however provide a yardstick of whether and to what extent the right policy levers are being moved to bring about the desired effects on productivity.

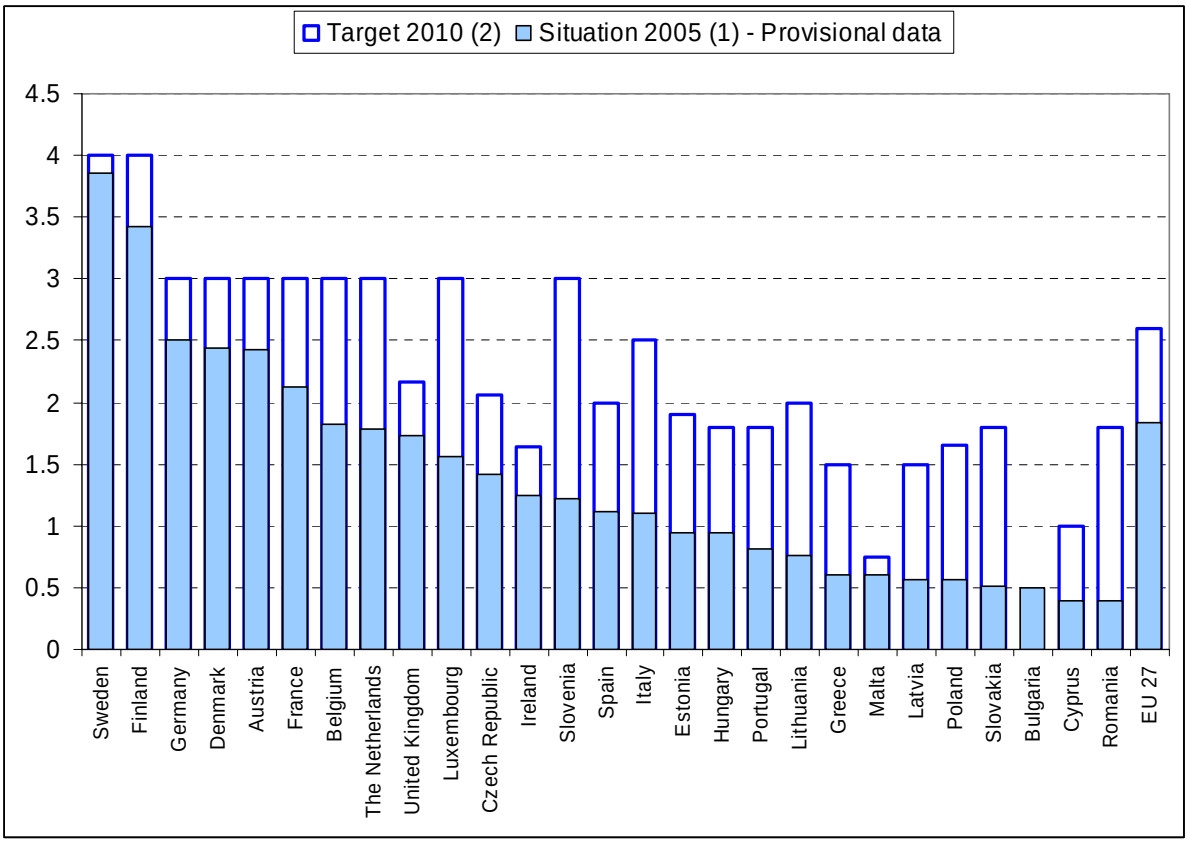
R&D, Knowledge and Innovation

The Member States of the European Union have committed themselves to reaching national targets on R&D spending in the aim to boost R&D intensity for the European Union as a whole to 3% of GDP by 2010. The challenge is to provide the right framework conditions and incentives to leverage public R&D spending and bring about a large share of business R&D spending. Given the link between investment in R&D and innovation, pro-competitive structural reforms should in general also support conditions for reaching the R&D intensity

targets at least in sectors that are close to the global technological frontier (see also the discussion in 2.2.1).

The commitments made by Member States in terms of national R&D investment targets would bring the EU's overall R&D intensity to about 2.7% of GDP in 2010 (see Graph 2.2). The commitments of the Member States are complemented by the adoption of FP7, which increased EU level funding compared to the previous programming period by 75%. Moreover, FP7 provides a framework and financial support for major public-private partnerships which allow the generation of spill-overs and economies of scale. Also, the adoption of the new R&D and innovation state aid framework allows Member States to further support R&D and innovation. While the envisaged level of 3% would probably not be reached for some time, an R&D intensity level of 2.7% would still represent a major improvement of almost one third compared to the average over the last eight years. Wobst (2006) has estimated that reaching this level of R&D intensity in 2010 would translate into a level change in GDP of 2.6% by 2025. Even if Member States were to reach their targets with considerable delay depending on the ambitiousness of the specific targets in relation to current R&D intensity levels, the GDP likely impact would still reach 2.4% by 2025.

Graph 2.2: Gross domestic expenditure on R&D (GERD) as% of GDP - levels & targets



Notes:
(1) IT, NL, RO, UK: 2004; AT, FI: 2006
(2) IE; PL, UK: R&D intensity targets for 2010 were estimated on the basis of data provided by these countries.
(3) IE: The target is 2.5% of GNP in 2013
(4) EU-27: The EU-27 R&D intensity for 2005 was estimated by DG Research.
The EU-27 R&D intensity for 2010 results from aggregation of the targets set by the Member States (including estimated targets for IE, PL, and UK, but excluding BG)
(5) Member States have been ranked according to the current level of R&D intensity from left to right.

Source: Eurostat, Member States

It is conceivable that R&D spending growth may not have kept up with the acceleration in GDP growth in 2006 and that R&D intensity might therefore have fallen, at least temporarily. While this is partly a statistical problem, there are more significant bottlenecks for some countries in terms of matching their R&D intensity targets with the number of qualified researchers available in the near term. The importance of ensuring the availability of a skilled workforce cannot be overstated in this context. The practical need for a closer integration of the knowledge triangle becomes obvious in view of these concerns.

One of the key factors affecting Europe's ability to innovate is the availability of financing for innovative companies both for early stage seed capital, start-up financing and, as importantly, venture capital for any subsequent expansion. Given the known market failures affecting the availability of market financing for innovative start-ups (the public good character of knowledge and information asymmetries), there is a clear justification for action on behalf of governments and the European Union in facilitating access to finance, particularly for SMEs. Much can however also to be done through internal market policy aiming at establishing an efficient financial services sector in Europe.

Member States' innovation policies combine a number of elements, among which support for innovative start-ups is prominent in many National Reform Programmes. Most Member States are working on improving the access to finance of innovative start-up companies for example through the introduction of seed and venture capital funds and loan-guarantee schemes for SMEs. At the EU level loan guarantee schemes for SMEs are provided at the order of € 1.1 billion under the new CIP programme (2007-13). This almost doubles the amount of yearly funding compared to the current situation. It is expected that this will result in a funding of €30 billion for SMEs. Business incubators, business angels networks, and technology parks are also used to pursue this objective. In addition, in the context of Structural Funds programmes 2007-2013, JEREMIE ("Joint European Resources for Micro to Medium Enterprises"), a joint initiative between the Commission, the European Investment Fund and the European Investment Bank aims to provide improved access to finance for SME's. It includes the supply of micro credit, venture capital, loan or guarantees and other forms of innovative financing.

The promotion of excellence in education and research is pursued by many Member States also with a view to ensuring that there will be a sufficient supply of researchers, which for many Member States represents a serious potential bottleneck in reaching their R&D intensity targets. Among the measures taken in this area is the identification of centres of excellence where public funding is being concentrated. In some cases, such as Denmark, this has also involved a certain degree of consolidation with the aim to have fewer but bigger universities, which are better capable to compete internationally. Some countries also have policies to support existing high-performing clusters. Financial support of the Structural Funds has been used by Member States to assist a wide range of activities in relation to research, innovation and the development of skills. Of interest are also two successful science education reform initiatives, in Germany and France, aiming at addressing the decreasing interest of young people in key science and technology fields (European Commission, 2007F). At EU level, the Commission's proposal to establish a European Institute of Technology (EIT) represents a challenging initiative to boost the innovation capacity of Europe and improve competitiveness. The EIT will seek to integrate the three elements of the knowledge triangle (education, research and innovation) and to promote excellence, attract talent and integrate business expertise in all aspects of research and education.

While there are areas of notable progress, the efforts to increase R&D and innovation in the services sector, where the EU is significantly behind the United States, have not yet gone far enough. Framework conditions to allow R&D-intensive SMEs to grow into large companies fast need further improvement. A comprehensive intellectual property rights (IPR) strategy that fosters innovation and allows taking maximum advantage of the R&D potential of the EU is being developed. Efforts to overcome skill shortages in the ICT sector and to satisfy the demand for more qualified researchers through a single, open, efficient and attractive labour market for researchers need to be strengthened. This is an issue where the benefits of joint reform efforts both in product and services markets and in labour markets are evident.

Few Member States have so far formulated sufficiently forward-looking policies regarding the availability of digital content and related policies (IPRs), digital skills requirements, standardisation, next generation networks, and security of electronic payments, privacy, and interoperability. Efforts to overcome skill shortages in the ICT sector and satisfy the demand for more qualified researchers through a single, open, efficient and attractive labour market for researchers need to be strengthened.

Internal Market Policies

The Commission is continuously monitoring and updating the community acquis that ensures the internal market. For example, a new package of measures aimed at improving the free movement of goods within the internal market was adopted by the Commission in 2007.

A review of the quality both of the reform plans and of their implementation in the area of internal market policy shows considerable variation among the Member States. While the transposition deficit in the EU has been reduced considerably, there are also deficits in several Member States when it comes to ensuring high-quality transposition, implementation and enforcement of internal market legislation, the functioning of public procurement markets and, at the Community level, the development of a well balanced framework for intellectual property rights. More progress is needed to remove the remaining barriers which hinder the free movement of capital, economic restructuring and the free movement of goods.

While the systematic implementation of the Services Directive should in due course lead to a fully operational Internal Market for services, the use of other policy instruments such as competition policy could support this. The integration of financial markets, in particular in the area of retail financial services, has so far remained inadequate. Another key area where progress in implementing the reforms has been insufficient are measures to increase external openness.

Competition Policies

As in the area of internal market policy, there is also considerable variation with regard to planning and implementation of reforms in the area of competition policy. Clearly, the level of ambition and process in the area of competition reforms has varied – sometimes considerably – between Member States. The measures that were introduced in the National Reform Programmes and that have subsequently been implemented concerning competition policy have in general been rather broad in scope and have rarely been linked to concrete indicators or success criteria. Most of the undertaken reform measures address network industries, followed closely by the enforcement of competition policy in general. Issues such as state aid and competition in professional services have not figured prominently in the

National Reform Programmes. Other measures relating to the field of competition policy have been presented in the context of better regulation or infrastructure policy.

The experience in the competition policy enforcement area is largely positive, although there is scope for facilitating more private enforcement. While there are positive signs in the area of competition screening and removing obstacles to competition, these activities would need to be more comprehensively set out and reported by the Member States. One of the implementation weaknesses in the area of competition policy is the insufficiently targeted and integrated approach. A more coherent policy approach would require also a deeper knowledge of the functioning of markets and the economy as a whole. Member States' competition screening activities could be expanded and their results reported in the implementation reports.

The Commission has completed sector inquiries into a number of sectors, such as financial services and energy, which are of key importance from a competitiveness perspective. The inquiries aim at identifying obstacles to effective competition in order to allow the Commission to tackle these restrictive practices by an appropriate policy mix. As a result of the enquires a number of more specific competition enquiries have been opened already.

State aid

The picture on 'less and better' State aid is mixed. Policy deficits and in particular implementation deficits remain in certain key network industries (especially gas, electricity and rail). The Commission, in its assessment of progress, has made more comments in the area of competition policy than in any other policy area.

Network industries and services

Clear implementation deficits still remain in areas such as network industries (notably gas, electricity and rail) as well as certain service sectors (in particular professional services), where considerable opportunities for more growth and jobs are being missed. Competition in retail and wholesale sectors, where productivity differentials vis-à-vis the US are particularly large, has not received the prominence on the reform agenda that it deserves. This is the case in particular when it comes to ensuring that retail markets are fair, open and transparent, and respond to consumer needs.

Financial Markets

A fully integrated financial market is vital for the functioning of modern economies and a key for EU's global competitiveness. The functioning of the market for financial services in the EU reveals that although there is progress towards a fully integrated internal market, it has not yet been fully achieved.

One of the last important parts of the Financial Services Action Plan still to be implemented is the Markets in Financial Instruments Directive (MiFID). The MiFID together with the Market Abuse, Prospectus and Transparency Directives eliminate most of the existing barriers for the efficient functioning of the Single Market in the securities markets sector. MiFID covers most of the financial instruments in which European investors invest (only insurance products and plain vanilla deposits are outside the scope of the MiFID). It establishes a single set of rules applicable in all Member States leaving very little room to national discretion. All European investors and firms have the same rights and obligations no matter where they are located –

this will enhance the perception of the market participants of being part of a single integrated market. MiFID is in the process of being transposed by Member States and it will be fully operational on 1st November 2007.

Better Regulation policies

As part of their National Reform Programmes under the Strategy for Growth and Jobs, Member States have been strengthening their Better Regulation policies in recent years. Given that the formation of a fully-fledged institutionalised Better Regulation system can only be brought about by laying basic foundations, gathering practical experience, and establishing the required institutions, Member States find themselves at varying stages of this process depending on their starting points, the ambition of their programmes, and the degree of implementation.

Regulations have an important positive role to play in market economies. They are generally used to fulfil legitimate policy goals regarding environmental, consumer or health protection, and for dealing with social equity concerns. A considerable amount of regulation is also undertaken for economic purposes. For instance, at EU level, legislation played an essential role in establishing the single market. Moreover, economic theory suggests that regulations should tackle externalities and correct other market failures such as information asymmetries, low levels of competition or public goods. By dealing with market failures regulations can positively influence the sources of productivity growth.

Regulations are however also often found to have unwanted side effects that may pose unnecessary burdens on economic actors and constrain economic activity through wrong incentives unrelated to the substantive purpose of the regulation and at times possibly in contradiction with it. To avoid such negative effects of regulation through a systematic approach toward lawmaking, governments in various countries have begun to pursue various types of actions that are commonly referred to as Better Regulation. The aim is to strengthen the effectiveness and efficiency of regulation in fulfilling its substantive purpose while systematically avoiding unnecessary side effects.

Better Regulation is thus the outcome of a comprehensive approach to reforming existing regulatory management practices on the basis of three building blocks: policies, institutions and tools (such as impact assessments on new legislative proposals and simplification of existing regulatory framework). Better Regulation aims to ensure that existing and future legislation is of high quality, i.e. that it is concise, straightforward, used only when necessary, and that the burdens it imposes are proportionate to its aim.

Better Regulation activities are a key ingredient in building and sustaining a good business environment, ideally through a systematic and institutionalised effort. One may reasonably expect that the systematic application of Better Regulation policies would lead over time to leaner and less burdensome regulation. While this may be so, the concept of Better Regulation must not be confounded with the notion of de-regulation. Levels of regulation have fallen consistently in recent years both in the United States as well as in the European Union[45]. This seeming narrowing of the differences between regulatory approaches may itself be the consequence of increased competition between them in the context of globalisation.

[45] Conway et al. (2005).

The task of improving the EU regulatory framework is a shared responsibility between Member States and EU Institutions. According to national measurements and information available to the Commission, approximately 30-40% of the administrative burdens on businesses stem for international and EU legislation. This division varies substantially, however, depending on the policy area.

There has been a progress across the EU in developing impact assessment systems with a majority of Member States introducing obligatory assessment of regulatory impacts. However, so far only the UK and Denmark carry out impact assessments covering all three dimensions of economic, environmental and social impacts, on a systematic basis, and make them publicly available.

Systematically mapping and measuring the costs of regulation will provide a clear picture of the most troublesome requirements and thus a good basis for removing the burdens where possible. Based on national measurements, it is expected beforehand that Company Law (including accounting and auditing) will be amongst the most burdensome legislative areas in the EU. While simplification and reduction of administrative burdens can help improve the existing regulatory framework, integrated impact assessments can analyse the most efficient ways of designing new policies.

All Member States acknowledge the role of better regulation in improving the business environment and reducing the administrative costs borne by businesses and a majority among them considers the business environment to be a key priority.

Simplification measures are being increasingly implemented as a part of a simplification programme or plan that unlike ad-hoc simplification measures establishes criteria for a systematic and continuous assessment of the existing legislation, preventing it from becoming obsolete, unnecessarily burdensome and costly for business, citizens and public administrations. Nevertheless, the implementation of simplification programmes has been in most cases only recently launched. Moreover, the absence of timetable and targets as well as lack of subsequent progress monitoring and evaluation of the results might slow down the materialization of economic impacts of these programmes.

Among Member States there are varying degrees of advancement with regard to a systematic and institutional approach for simplification. Several Member States have begun or are about to begin systematic screening of legislation, albeit using a sectoral rather than a comprehensive approach. Many Member States are using a range of ad hoc simplification measures, such as improved e-government and administrative simplification more generally. E-government is already well developed in a number of Member States, where government services for enterprises and citizens are well developed, widely accessible and used. In most Member States public authorities are in the process of improving their use of ICT. In a few cases, these efforts are yet in the planning stage.

As regards the reduction of administrative burdens in Member States, most Member States have adopted the Standard Cost Model[46] as their methodology for measuring administrative

[46] The EU Standard Cost Model (EU SCM) is a methodology used to asses the administrative costs incurred by businesses as a result of legislation. According to the EU SCM, administrative costs should be assessed on the basis of the average cost of the required action (Price) multiplied by the total number of actions performed per year (Quantity). The average cost per action will be estimated by multiplying a tariff (based on average labour cost per hour including prorated overheads in a given country) and the

costs. However, only six of them have actually conducted a baseline measurement, while 11 are preparing partial measurements. Only six Member States currently envisage reducing administrative burdens by 25% or more. The evaluation of progress with regard to the reduction of administrative burdens has not yet advanced in many Member States.

The task of improving the EU regulatory framework is a shared responsibility between Member States and the EU Institutions: The Commission's rolling programme for simplification is well on track and, for the period 2006-2009, no less than 43 new initiatives were added to the initial set of 100 initiatives. The bulk of the simplification proposals tabled by the Commission are currently pending before the European Parliament and/or Council. The role of the co-legislator is critical for the timely delivery of simplification objectives. The Commission will further pursue and strengthen its simplification efforts. A second progress report is planned for early 2008 which will take stock of progress and enhance the programme with a new set of initiatives.

Moreover, the implementation of the 2007 Action Programme on the reduction of administrative burdens has commenced. In parallel, the Commission is launching a dedicated website for stakeholders' contributions to the administrative burdens programme together with the creation of a high level group of independent stakeholders to provide further advice on its implementation.

SME and entrepreneurship policies

The European Commission assists European SMEs with a large number of instruments reaching from the provision of information and networking opportunities to the facilitation of start-up and venture capital financing[47] and, more generally, it promotes the implementation of the *Think Small First* principle in Community and national policies. In the context of the renewed Lisbon Strategy, the March 2006 European Council formulated a number of specific targets that Member States should reach until end-2007 in order to help unlock the business potential, particularly of SMEs[48].

Member States are making important efforts in creating a favourable business environment for SMEs. SMEs representative are widely consulted in the law-making process and involved in the preparation of the Lisbon progress reports. Specific provisions to alleviate the burden of legislation on SMEs are sometimes planned but they are not systematically proposed in all countries.

Member States have made considerable progress in reducing the start-up times to less than one week. In most Member States it is already possible to register a company much faster than that. While start-up costs still vary considerably among Member States and considerable scope for further reductions in some countries, the progress made so far is significant. In the

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time required per action. Where appropriate, other types of costs such as equipment or supplies' costs will be taken into account. The quantity will be calculated as the frequency of required actions multiplied by the number of entities concerned.

47 See http://ec.europa.eu/enterprise/sme/index_en.htm.

48 "The Member States should establish, by 2007, a one-stop-shop, or arrangements with equivalent effect, for setting up a company in a quick and simple way. Member States should take adequate measures to considerably reduce the average time for setting up a business, especially an SME, with the objective of being able to do this within one week anywhere in the EU by the end of 2007. Start-up fees should be as low as possible and the recruitment of a first employee should not involve more than one public administration point." 2006 Spring European Council. Presidency Conclusions. (7775/1/06 REV 1), paragraph 30.

past, both the costs and their variance among Member States were much higher. In 2002, the average cost of setting up a limited company was €830, with the highest cost in one country of €2,232, while company registration was already then completely free of charge in another (Denmark)[49]. The reduction of start-up times and costs already achieved should make firm entry into the market easier and thereby contribute to a better and more competitive business environment conducive to improved management practices and higher productivity.

One of the concrete objectives set out by the 2006 Spring European Council concerned the establishment in all Member States of one-stop shops for start-up companies[50]. The availability of a single contact point not only for the provision of information but also for processing company registrations in full would help facilitate start-ups and thereby market entry. The implementation is in many cases not yet at an advanced stage and it is unlikely that the target will be reached by most Member States by the end of 2007.

It appears that in some cases, the complexity of providing a one-stop shop for company registration that is easily accessible across the entire territory of the Member State has been underestimated, which may have led to a late start of implementation. However, serious efforts have already been made and significant improvements can be noted in many Member States, including through a greater availability of online information for companies. The involvement of the chambers of commerce in a number of countries has apparently helped to speed up progress with setting up one-stop shops.

Facilitating recruitment procedures for the first employee is another objective set by the 2006 Spring European Council in the light of their importance as a barrier to company expansion for many SMEs.

Only few countries (e.g. Spain, Malta, and Portugal) have a special one-stop-shop system for recruitment or one-stop-shops for start-ups that can also take care of recruitment. Some few countries have procedures that are so simple that only one contact with a public administration is required (Ireland, Lithuania, Sweden). Belgium is a special case, in Belgium "social secretariats" take care of all employment related procedures for businesses, including the registration of new employees etc. However, these secretariats have to be paid by businesses.

In some countries at least the social security registration is organised as a one-stop-shop or one-window-system, i.e. one branch of the social security collects the registration and distributes the information to the other branches (e.g. Germany or the UK where all procedures can be taken care of by the Treasury). On average there are still 2 ½ mandatory contacts and 3 procedures required. In almost all countries the social security organisations have to be informed about the new employment, often the employer himself also has to register. Frequent are also contacts/registration procedures with the tax authorities (for payroll taxes). In several countries a notification of the employment agency is necessary.

Finally Member States are taking measures to simplify and make the public procurement rules more transparent and thereby also facilitate SMEs' participation. Almost in all countries the access to information on public tenders has been simplified while single electronic access points (webportals) containing relevant information on individual tenders and the tendering

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[49] European Commission, 2002A.

[50] The targets were specified in European Commission, (2007C) Assessing Business Start-up Procedures in the context of the renewed Lisbon strategy for growth and jobs. Commission Staff Working Document.

process are widely used. The simplification of the procurement by introducing electronic procurement is also under way in many countries.

Taxation reform

So far, academic research has produced mixed and ambiguous results on the impact of taxation on economic growth at the macroeconomic level. This is however not surprising given the technical difficulties of finding adequate variables able to summarize all the subtleties of tax systems. Instead, the effect of taxation on growth shall be rather looked at at the microeconomic level. This is because taxes have the potential to directly affect economic decisions and hence impact on the various channels that are conducive to growth. Taxation may have effects on investment and saving behaviours, on the incentive to pursue R&D and innovation activities, on the attractiveness of countries of foreign direct investment, on entrepreneurship, on the incentives to participate to the labour market or to get education, on consumption patterns, etc.

Recently, the European Commission, while fully recognising the sovereignty of Member States in choosing their tax system, has engaged in a broad reflection with Member States through the European Policy Committee on the tax reforms that could be carried out to make our tax systems more growth-enhancing. Some analytical work has also started at the OECD on the links between taxation and growth. This is also to be seen in the context of growing challenges of ageing and globalisation that are likely to put pressures on our social systems.

2.3. Spillovers across Member States and Synergies across policy areas in the context of the Growth and Jobs Strategy

The success of the Growth and Jobs Strategy, with its emphasis on job creation and economic growth, relies on the implementation of the National Reform Programmes and the Community Lisbon Programme. An important aspect of the strategy is the coordination of these national reform policies across Member States and with policies at EU level. Actions are planned at the Community level when they can complement, facilitate or strengthen policy actions envisaged at the national level. In such cases, purely national action is insufficient because important cross-border externalities or economies of scale are concerned. An assessment of the benefits of coordination contributes to the full understanding of the gains to be reaped from the full implementation of the reforms envisaged under the Growth and Jobs Strategy.

There are several reasons why coordination of Member States' economic reforms may bring benefits. Countries can learn from each other, joint efforts are stimulating reform implementation, coordination can help overcome national resistance against reforms, and joint efforts may increase the benefits from reforms. This section focuses on this last reason. Thus, the central question here is to assess the benefits for the EU Member States of jointly implementing the Lisbon reforms, compared with an alternative scenario where each country pursues these reforms unilaterally. Do structural reforms in products and labour markets in one Member State have externalities in other Member States? Are there complementarities or trade-offs between reforms depending on the policy field?

The spillovers associated with joint action in the EU are illustrated here with regard to four policy areas and assuming that Member States will reach targets set in these areas as planned: the 70% employment target, several skills targets (less early school leavers, more graduates from secondary education; increased reading literacy and more lifelong learning), a 2.7% R&D expenditure target, and a 25% decrease in administrative burdens on companies.

To assess the magnitude of the spillovers associated with these policies a comparison is made between the outcomes resulting from simultaneous policy implementation by all Member States and the outcomes when an individual Member State conducts these policies unilaterally. This approach allows an assessment of the benefits from coordination for each individual Member State. This comparison is made for each of the reform targets set out above. The exercise allows an analysis of the various inter-country linkages and the identification of the channels, the magnitude and the distribution across Member States of potential spillovers[51]. It also provides insights into potential synergies and/or trade-offs between the different policies.

2.3.1. Reforms leading to skills upgrading

The increase in skills implicit in five targets set in the 2003 Spring Council will increase significantly human capital levels in the long run[52]. The impacts of this policy, especially those on employment, vary significantly across countries. The effects of implementing the skills targets by 2010 materialize in the long run and by 2040 would represent an extra 2.1% increase in GDP of which 0.1 percentage point on average can be attributed to international. This means that spillovers of a joint EU-wide policy represent roughly a 4% increase in output and consumption. All countries would make consumption gains when acting together, and would experience an increase in real wages. The effect on consumption is less than on output as the skills programme by increasing labour efficiency increases the need for capital, and in an open economy this induces capital inflows, matched by a current account deficit to finance the capital accumulation, and net foreign assets fall. As a consequence income increases less than GDP. Moreover, simulations show that when countries act alone they may turn the terms of trade against themselves, as in Sweden and Finland where consumption falls when acting alone. There are clear gains from acing together as the terms of trade effect is moderated significantly.

2.3.2. Decreasing administrative burdens by cutting red tape

Output and consumption could increase by 1.1% to 1.9% in the EU if a 25% reduction in administrative burdens were achieved jointly by all Member States. Across countries there is relatively little variance in terms of gains from the reduction in administrative burdens. Only a few new Member States would reap benefits larger than 3%. Variation in the impact of the administrative burden reduction is associated in part with the openness of the country, with a larger impact being felt in those countries whose economies are more open. The international

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51 The interactions between these Lisbon policies and the rest of the economy are complex. The effects of reaching a Lisbon target can only be meaningfully considered by taking account of these interactions which requires a formal analytical framework. The outcomes presented in this section result from simulations using WorldScan, an applied general equilibrium model developed at CPB (Lejour et al., 2006) and NiGEM, the macro GE model with rational expectations developed at NIESR (Barell et al., 2007). See Lejour (2007) for a full description of this exercise and a more detailed exposition of the results.

52 The May 2003 Council agreed on five targets by 2010 (see European Commission, 2004) : EU average rate of no more than 10% early school leavers; at least 85% of 22 year olds in the European Union should have completed upper secondary education or higher; decrease by at least 20% relative to 2000 the percentage of low-achieving 15 year olds in reading literacy; EU average level of participation in Lifelong Learning at least 12.5% of the adult working age population; total number of graduates in mathematics, science and technology (MS&T) in the EU should increase by at least 15% by 2010 and the level of gender imbalance should decrease. Jacobs (2005) presents the model used to incorporate the various aspects of skill-formation needed to simulate these targets. The model contains a cohorts' structure to compute the impact of reaching the targets on the skill structure of the labour force in the period 2010-2040 and calculates a time path of the increase of labour efficiency. See also Lejour (2007) for more details on this simulation.

spillovers for this simulation are on average 0.1 percentage point in GDP and 0.2 percentage point in consumption. In other words, acting together brings an extra 5% gain in GDP and an extra 10% in consumption relative to unilateral actions. The spillovers estimates are higher when the demand effects of higher employment elsewhere and the impact of lower import prices are significant.

2.3.3. Achieving announced R&D intensity targets

If Member States achieve the R&D intensity targets announced in their National Reform Programmes R&D expenditures in the EU will increase from 1.9% of GDP in 2004 to 2.7% in 2010[53]. This could lead to an increase in output of 2.6% for the European Union as whole. Cross-border knowledge spillovers would account for roughly half of these gains[54]. In the new Member States and the Scandinavian countries output gains from spillovers caused by increases in R&D intensity brought about by other Member States are even higher than the gains they would reap from their own increase in R&D spending. These significant spillovers are obtained as direct consequence of the huge increases in R&D expenditures implicit in the national R&D spending targets.

The high cost of financing the R&D targets has dampening implications for consumption. Reflecting the larger amounts of savings needed to finance the investment in R&D, the increase in consumption is only about half that seen in GDP rates. The importance of international spillovers is also clear in terms of consumption. When Member States act alone, consumption increases on average by less than one percentage point. When they act together consumption registers an increase of more than a 2 percentage points.

The scale of the increase in public spending and taxation is relevant for the level of real interest rates. That level would rise by more than 50 basis points in the European Union as a whole, if public spending on R&D were to rise as implied by the national targets. As the private sector capital stock depends on the user cost of capital, which moves with the real interest rate, the level of private sector capital and investment will be lower than it would have been in the absence of the increase in public R&D spending for the given level of output. This crowding out from increased government spending reduces the spillover from the increase in R&D significantly.

2.3.4. Labour market reforms leading to the employment target

Improving the employment performance is an important goal of the Growth and Jobs strategy. A target of 70% for the employment rate has been set for the EU as a whole for 2010. Employment policies are expected to act on two fronts: increasing labour-market participation and lowering unemployment.

For most Member States, the spillovers associated with joint action add less than 0.5 percentage points of extra GDP. The most important channel for this effect is the knowledge spillover: through the increase in GDP caused by higher employment, R&D expenditures

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[53] The results presented assume that the targets are reached in 2010. Given that this represents an overall increase of almost 50% important challenges lye ahead, notably that of attracting or training sufficient researchers in such a relatively short period of time.

[54] The knowledge spillovers channel dwarfs other potential spillover channels, such as terms of trade effects, capital market effects and export demand increases.

increase as well and the output created by these extra expenditures also spills over to the other Member States through trade.

2.3.5. Policy synergies

The claims that labour market reforms and product market reforms are complementary have been corroborated by recent empirical studies[55]. The simulations reported here indicate clear synergies between product and labour market policies. As an example, increasing skills and R&D raises real wages, which in turn should increase participation rates by around one percentage point on average across the EU. Also, the reduction of administrative burdens, through lower mark-ups, has strong synergies with the employment target due to a reduction in equilibrium unemployment. The attainment of the skills, administrative burden and R&D targets, will increase employment, and thereby ease the pressure on policy measures to reach the employment target. There are also clear synergies between the skills policy and R&D policies to the extent that without a sufficient supply of M&ST workers additional R&D expenditures will increase wages for these workers but not output substantially. Overall, combined implementation of measures in the four policy areas discussed above brings an extra 0.4 increase in output and 0.3 percentage point of consumption in the EU-27 relative to the sum of effects of the separate policies.

2.4. Conclusions

The European reform effort will boost productivity

Raising Europe's the long-term growth potential by increasing productivity growth is one of the fundamental objectives of the renewed Lisbon strategy for growth and jobs. Along with the goal of simultaneously raising employment in the European Union, achieving higher productivity growth is part of a strategic response to the challenges entailed in globalisation and the demographic development in Europe. If the European Union wants to sustain its social model in the future, strong productivity growth is one important precondition for being able to do so.

Many reforms in pursuit of raising productivity growth are being undertaken in the microeconomic policy pillar of the renewed Lisbon strategy for growth and jobs both by Member States in their National Reform Programmes and at the European Union level under the Community Lisbon Programme. In their 2005 National Reform Programmes, Member States identified the largest number of key challenges in the microeconomic policy area. This reflects the realisation that stronger and sustained productivity growth is crucial for successfully facing the challenges posed by globalisation and ageing societies.

Enhancing the productive potential is a long-haul effort that will need to be sustained for years before its full results can be felt and systematically measured. The results of structural reforms can, in any case, rarely be captured in the short term and the measurement of their effects is complex. While the full effects of the reform efforts launched under the Growth and Jobs strategy will therefore only be seen in years to come, the analysis presented here suggests that Member States and the European Union level are engaged in the implementation of microeconomic structural reforms that hold, if seen through, considerable potential for raising total factor productivity in the European Union. The fact that Member States have

[55] Bayoumi et al. (2004); IMF (2003).

identified key challenges in policy areas where their productivity growth was comparatively low at the outset suggests that productivity growth is what they have in mind. The endorsement by the European Council of a set of country-specific recommendations and points to watch which also reflects these policy areas shows that the European Union as a whole is serious and ambitious about this agenda. It does however also indicate that Member States and the European Union level need to do much more if they want to reap the benefits of the reforms promised in their National Reform Programmes and the Community Lisbon Programme. It is nonetheless clear that important progress has already been achieved in areas that are of key importance for future productivity growth and that this should, in due course, produce tangible results. While it is too early for quantitative assessments, the most recent data on productivity developments presented in Chapter 1 seem to be consistent with a positive view of the structural reform effort by Member States and the European Union level to boost productivity growth.

Theoretical considerations and empirical studies on productivity growth and structural reforms

There is a rich theoretical and empirical literature on the preconditions for total factor productivity growth, the relationship between competition, innovation and total factor productivity as well as the role of product market regulation in that context, and the factors behind the evolution of the productivity gap between Europe and the United States. While the positive relationship between competition and productivity is confirmed by empirical studies, the interplay of competition and innovation is complex and the relationship largely depends on the proximity of firms and sectors to the technological frontier. The literature explains the widening of the productivity gap between the US and the EU since the mid-1990s mainly in terms of the efficiency of ICT use. Recent empirical studies seem to suggest that the productivity differentials between the US and the EU regarding ICT use may be attributable mainly to the concomitant presence of organisational change, which is found to occur more easily in environments with higher levels of competition. The importance for productivity growth of a well functioning and competitive internal market with external openness is thus well established. Most empirical studies also suggest a clear negative relationship between the intensity of regulation and indicators of economic performance.

The empirical literature has also produced a wealth of estimates for the effects of structural reforms in the microeconomic area on productivity, employment and economic growth. The estimates serve to demonstrate the potential impact of some of the reforms already launched, such as policies to reach the R&D target, and to illustrate the order of magnitude of possible effects of other types of reforms that could yet be implemented. They highlight the importance of investment in knowledge and innovation and in particular of incremental increases in educational attainment for total factor productivity. They also confirm the pre-eminent role of competition and a functioning internal market for productivity, specifying the likely benefits from the implementation of the Services Directive, from greater competition in financial markets and from full market opening in network industries. The intensity and quality of regulation is of great relevance for a good microeconomic business environment and productivity growth. This is shown by a number of studies estimating the impact of pro-competitive product market reforms and the reduction of administrative costs on productivity and growth. Finally, a number of studies confirm the theoretical claim that combined reforms in product and labour markets amplify their benefits.

Structural reforms pursued by Member States and the European Union level

With the re-launch of the Lisbon strategy as the partnership for growth and jobs in 2005, Member States have formulated reform policies in their National Reform Programmes based on the identification of key challenges. The growth and jobs strategy also has a strong Community dimension, which complements and supports Member States' reform efforts in responding to the challenges and opportunities of globalisation wherever collective EU-level action brings clear additional benefits compared to individual actions at the national level. For the microeconomic pillar the key challenges identified focus on the areas of R&D, innovation, and ICT, on competition policy as well as on the business and regulatory environment. This focus clearly corresponds to policy areas which have great relevance for total factor productivity growth.

While Member States pursue broadly adequate policies to raise R&D intensity, including through the promotion of centres of excellence and the facilitation of innovative start-ups, there is still considerable further scope to increase R&D and innovation in the services sector. In the areas of internal market and competition policies, there is considerable variation in Member States' reform plans. The implementation of the Services Directive should in due course lead to a fully operational internal market for services. Member States' reform measures to enhance competition concern in particular the network industries. Other areas of competition policy which also hold important potential for growth and jobs, such as professional services and state aid, received considerably less attention. Experiences with competition policy enforcement are however largely positive. Member States' have made progress with their efforts to improve the business and regulatory environment through Better Regulation policies and the implementation of concrete measures envisaged by the 2006 Spring European Council. The positive impact of the latter should be felt relatively soon, particularly by SMEs.

The success of the renewed Lisbon strategy depends crucially on the implementation of the National Reform Programmes and the Community Lisbon Programme. An important aspect of the strategy is the coordination of these national reform policies at the EU level, where they are subject to multilateral surveillance. Section 2.2.4 on the role of spillovers has clearly demonstrated the value-added of Member States acting jointly in the pursuit of structural reforms in the microeconomic pillar of the strategy. The comparison between individual and joint action has shown for each of the policy areas analysed that the overall benefits will be larger in the case of joint action.

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3. SKILL PROBLEMS IN EUROPEAN INDUSTRIAL SECTORS

3.1. Introduction

There exists an intimate relationship between skills and productivity. At the individual level, a worker's educational background has a strong impact on his or her wage (cf. Sianesi and Van Reenen, 2002). And at the aggregate level there is an emerging literature showing that average educational attainment of a country's labour force is positively associated with aggregate productivity. In other words, human capital contributes to productivity, both at the level of individual workers and at the macroeconomic level. The other side of the coin of this widely established economic importance of human capital is that skill problems can have adverse consequences. Skill mismatches in the economy can lead to a situation where unemployment and unfilled vacancies co-exist. It is obvious that this entails a welfare cost for the unemployed individual, for the industry who cannot fully realise its economic potential, as well as for society at large. Insights into and a deeper understanding of the nature of the skill problems could feed into the design of better human capital policies. This is in a nutshell the topic of this chapter.

The chapter provides new empirical evidence on the importance of skills for competitiveness of European industrial sectors, and looks into the process of skill upgrading. It should be noted that the chapter concentrates on the manufacturing sector, while a comparable analysis for the service sector (which contributes a substantial part to value added in the EU, see also chapter 1) is left for further research. The chapter also reports the results of case studies in relation to two particular industries, textiles and clothing and mechanical engineering. The chapter finally provides a discussion on various types of skill gaps, and of the corresponding rationales of education and training policies.

The main questions addressed here are:

– What is the contribution of skills to competitiveness of European industrial sectors?

– What is the nature of the skill upgrading process as witnessed in the EU?

– How do skill shortages manifest themselves?

– What is the role of education and training policies to combat skill shortages, and which interventions could potentially increase welfare?

This chapter is structured along these four central questions. Section 3.2 recapitulates two phenomena central in the analysis, namely the ubiquitous process of skill upgrading and the matching process on labour markets. An aggregate perspective is chosen to set the general scene before turning to a lower aggregation level in the following sections. Section 3.3 presents new empirical evidence of the relationship between skills and industrial competitiveness. It explores the relationship between skills and some performance indicators. The nature of skill upgrading is investigated in Section 3.4. In particular, it is studied whether skill upgrading mainly reflects increasing demand for skills within sectors, or shifts towards more skill intensive sectors. Section 3.5 reports the insights on skill gaps which have been obtained from case studies. The two industries chosen for these case studies are not the ones which usually get the limelight in the context of analysis of skill shortages, e.g. those in which ICT skills are particularly important. In fact they were deliberately chosen to show that the

issue of skill shortages and the planning of skill acquisition and skill supply is also very relevant in industries which either experience an absolute reduction in employment levels or a fall in their employment shares, but might still be a significant source of income and employment in many parts of the EU. Section 3.6 first identifies different types of skill shortages, and then goes on to discuss roles for education and training policies. The chapter is winded up in Section 3.7.

3.2. General background

Educational attainment (measured by number of years of attending school) shows an upward trend in the EU countries, as well as in most other countries across the world. This is illustrated in Table 3.1 for a selection of countries.

Table 3.1: Development of number of years in formal education of the 15-64 age group

	1960	1980	2000
Belgium	7.39	9.24	10.84
China	2.26	4.10	5.96
France	6.73	9.34	10.73
Germany	9.52	12.65	12.95
Japan	9.48	11.20	12.61
Romania	7.22	8.31	10.00
United Kingdom	9.11	11.57	13.12
United States	10.18	12.19	12.63

Source: Cohen and Soto, 2001.

Between 1960 and 2000, China managed to increase average educational attainment from about two years to almost six years, while the other countries included in the table lifted education levels to ten years or more.

It is widely accepted that more years in formal education enhances a person's skill level. This not only refers to cognitive skills but also to a range of other skills (e.g. social skills and communication skills). A better educated work force is conducive for a country's economic performance. Human capital not only augments the efficiency of labour, it can also help to create absorptive capacity so that firms can more easily adopt technologies developed elsewhere[56]. Both mechanisms would foster productivity and international competitiveness. This is confirmed in econometric research. A typical result from these studies is that an

[56] There exist other benefits of education, which fall outside the scope of this chapter. For instance, there is a negative relationship between educational attainment levels and unemployment rates. Average unemployment in the EU27 among persons with low education levels (pre-primary, primary and lower secondary education) is 10.1% in 2006. Average unemployment for those with upper secondary and post-secondary non-tertiary education is 7.3%, and average unemployment for persons with tertiary education is 4.1% (source: online database from Eurostat).

increase in average educational attainment of the labour force by one year would increase productivity by something like 8-10% (see for instance Cohen and Soto (2001), De la Fuente and Ciccone (2003) De la Fuente and Doménech (2006), Canton (2007)). As an illustration, these estimates imply that a three year increase in educational attainment – which is a fairly representative number for the countries listed in the table – would yield a productivity gain in the order of 24-30%, an enormous effect indeed. In addition, the level of educational attainment is found to impact on productivity growth (see e.g. Benhabib and Spiegel (1994, 2005), Portela et al. (2004) and European Commission (2006)). Therefore, in light of EU's growth and jobs strategy, actions to increase human capital complement the myriad of structural policies discussed in Chapter 2 to strengthen the overall economic performance.

Against this background of increasing educational attainment, concerns about skill shortages are often expressed. Does the education system deliver the skills demanded by the market? Can people easily be re-trained to accommodate shifts in the needed type of skills? Skill gaps can emerge after an increase in demand for (or fall in supply of) a certain skill, but can also indicate a non-optimal mix of skills in the economy. Beveridge curves, i.e. the loci of unemployment and vacancy rates, can give some insight into the importance of both types of skill gaps. Shifts *along* this curve reflect the usual business cycle fluctuations, while shifts *of* the Beveridge curve point at changes that improve or worsen the matching process, and thereby affect the equilibrium level of unemployment. As described in Employment in Europe 2004 (cf. European Commission, 2004), the Beveridge curve shifted to the right in nearly all EU countries from the early 1960s to the mid-1980s, indicating an increase in the equilibrium level of unemployment. After the mid-1980s, EU Member States can be divided into two groups: (i) those for which the Beveridge curve did not shift significantly, and (ii) those for which the Beveridge curve has moved leftwards. Belgium, Germany, France, Austria, Portugal, Finland and Sweden belong to the former group, whereas Denmark, Spain, Ireland, the Netherlands, Hungary and the United Kingdom are in the latter group.

This latter group of countries has apparently been more successful in reducing structural unemployment. While an explanation of these observations with respect to Beveridge curves goes beyond the scope of this chapter, the corresponding analytical framework can serve as a useful point of reference in our discussion on skill gaps due to cyclical versus more structural factors. The sectoral approach adopted in this chapter can help to increase our understanding of labour market dynamics. Such an approach allows us to study employment changes within and between sectors, and this could provide guidance in shaping human capital policies. In particular, insight into the importance of employment shifts across sectors could shed light on the relevance of generic versus specific skills.

3.3. Skills and competitiveness of EU manufacturing industries

3.3.1. Introduction

As mentioned in Section 3.2, there is a substantial macroeconomic literature on the relationship between human capital and productivity growth (cf. Mankiw et al. (1992), Aghion and Howitt (1998), Barro and Sala-i-Martin (1995), Vandenbussche et al. (2006)). The more recent studies who are based on improved human capital data typically find a substantial contribution of skills to productivity. While one would expect similar effects to be visible at sectoral level, this literature is less developed (see e.g. OECD (1996) and Griffith et al. (2004)). In this section evidence is presented of the impact of human capital (skills measured by educational attainment) on indicators of competitiveness. A first indicator is productivity growth, where the underlying assumption is that a better educated work force is

better in adopting, implementing and even creating new technologies. A second measure of international competitiveness is success in foreign markets, i.e. exports. Higher export growth – compared to other countries – can be looked at as gaining competitiveness in world markets, driven by the dynamics of comparative advantages.

To study these issues the recently released EU KLEMS[57] dataset is used (see www.euklems.org). This dataset consists of a cross-section of eleven manufacturing industries (corresponding to NACE 2-digit aggregates) and twenty-four European countries (not included are Bulgaria, Malta and Romania) over the period 1995-2004. The database provides data for growth rates of labour productivity (value added per hour worked) measured at constant prices. A detailed description of the methodology and data issues can be found in Timmer et al. (2007)[58]. These data are combined with information on educational attainment levels using Labour Force Survey (LFS) data (available for the period 1998-2004). Sectoral averages of employment shares of different educational attainment groups (ISCED groups high, medium and low educated) are used over this time interval by sector to avoid data problems (like fluctuations in shares due to small sample sizes and outliers).

The most striking fact is that in a number of countries growth rates of labour productivity in the more skill intensive sectors are indeed higher. This is especially the case for the cohesion countries Greece and Portugal, and for all Eastern European countries except Cyprus. Most of these countries also show higher growth rates in the other sectors as well, pointing towards a catching-up process. In the advanced economies this pattern of higher growth rates in the skill intensive sectors is eminent mainly in Finland and Sweden. Another measure of competitiveness is growth of exports which is typically higher in the skill intensive industries. This is especially the case for Eastern European countries like the Czech Republic, Hungary, Poland, Slovak Republic, Estonia and Latvia.

3.3.2. Skills and competitiveness at the industry level

This sub-section presents in a non-technical way results from an econometric analysis in which the growth of labour productivity at sector level is explained from the skill intensity in that sector (expressed as the share of workers with a certain skill level), and a set of controls. Among these control variables is the initial productivity gap, defined as the log of the productivity level in a particular sector and country divided by the productivity level of the leading industry-country pair. The results are presented in Table 3.2 where each of the skill types is included separately (specifications including the shares of two skill types simultaneously yield similar results). Industry dummies are introduced to account for industry specific characteristics like technology intensity, innovative potential, etc. The first regression model explains the growth rate of labour productivity from the initial productivity gap and the share of high skilled workers at sectoral level. The second and third models use instead of the share of high skilled workers the share of medium and low skilled workers as an explanatory variable, respectively (notice that simultaneous inclusion of the three skill variables is not possible as it would imply perfect multicollinearity).

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[57] The EU KLEMS database is the result of a three year, European Commission funded research project involving 16 European research institutes, which has recently become available for free public use at http://www.EU KLEMS.net. See Timmer et al (2007) for further details on the construction of the database.

[58] It should be noted that the EU KLEMS project is ongoing, and further improvements can be made for instance in terms of coherence with officially published figures from national statistical agencies.

Table 3.2: Labour productivity growth and skills						
Dependent variable: Growth rate of labour productivity						
Initial productivity gap	-0.041	***	-0.035	***	-0.033	***
	(0.000)		(0.000)		(0.000)	
Share of high skilled workers	0.082	**				
	(0.020)					
Share of medium skilled workers			0.040	***		
			(0.001)			
Share of low skilled workers					-0.058	***
					(0.000)	
Industry dummies	Yes		Yes		Yes	
F-value	9.49		12.77		13.08	
R squared	0.40		0.40		0.42	
Observations	264		264		264	

Note: A least square dummy variable (LSDV) regression technique is applied. Industry effects are not reported. Numbers in brackets are p-values from robust standard errors. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

Source: Landesmann et al. (2007)

First, a significant effect of the initial gap on productivity growth is found. A larger productivity gap is associated with higher labour productivity growth. This catching-up effect is known as β-convergence. The implied half-time of closing the gap is less than 20 years. Second, there are significant positive effects of the share of high skilled and medium skilled workers on productivity growth, where the effect of the latter skill group is smaller and amounts to around half of the effect of the share of high skilled workers. These results suggest that a skilled labour force fosters labour productivity growth. This is in line with the earlier mentioned literature on the economic importance of human capital, and on the role of skills to increase the capability of adopting, implementing or creating new technologies (though the latter is mainly relevant for countries already near the technological frontier). The parameter measuring the effect of the share of low skilled workers is significantly negative. According to these results, skill upgrading will have a positive effect on productivity growth.

Some extensions are presented in Landesmann et al. (2007). First, with respect to industry groups (identified by average skill intensity) one finds that convergence is faster in the high-skill intensive industries (machinery, electrical and optical equipment and transport equipment) with an implied half-time of closing the gap of about 15 years as against a half-time of more than 25 years in the low skill intensive industries (textiles, wood, other

manufacturing and recycling). Second, the convergence process is studied in more detail by allowing for an interaction term between skill levels and productivity gaps. It is found that a skilled labour force speeds up the convergence process. If the sample is restricted to the EU-15 countries the interaction term becomes insignificant as these countries are already close to the technological frontier.

Another indicator of competitiveness is export performance. This measures success in international markets. It is estimated whether a higher skill share has a positive effect on export growth, controlling for growth in unit labour costs. Export data are taken from the UN COMTRADE database and are measured at current US dollars. Unit labour costs are calculated as labour compensation divided by gross output in local currency units.

Table 3.3: Skills and export performance

Dependent variable: Growth rate of exports

	Share of high skilled workers		**Share of medium skilled workers**		**Share of low skilled workers**	
Skill share	0.138	**	0.066	***	-0.090	***
	(0.018)		(0.000)		(0.000)	
Growth rate of unit labour costs	-0.628	***	-0.394	*	-0.370	*
	(0.001)		(0.056)		(0.076)	
Industry dummies	Yes		Yes		Yes	
F value	9.33		11.13		11.76	
R squared	0.27		0.27		0.30	
Observations	263		263		263	

Note: A least square dummy variable (LSDV) regression technique is applied. Industry effects are not reported. Numbers in brackets are p-values from robust standard errors. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

Source: Landesmann et al. (2007).

A higher share of high and medium skilled workers spurs export growth. The coefficient of high skilled workers is again higher compared to that for the medium educated workers. The coefficient of the share of low educated workers is significantly negative. In line with intuition, the growth rate of unit labour costs relates negatively to export growth.

To wind up, this part of the analysis has presented evidence for skill compositional effects on two types of competitiveness variables, (labour) productivity growth and export growth. Overall, the results are promising in that the share of high skilled turned out to be a significant factor in explaining productivity and export growth. Furthermore, it was found that the share of high skilled is particularly important for the speed of catching-up. Finally, the findings indicated that a higher share of high and medium skilled workers spurs growth of exports, whereas a high share of low skilled employees has detrimental effects.

3.4. Skill upgrading in the EU

3.4.1. Growth accounting

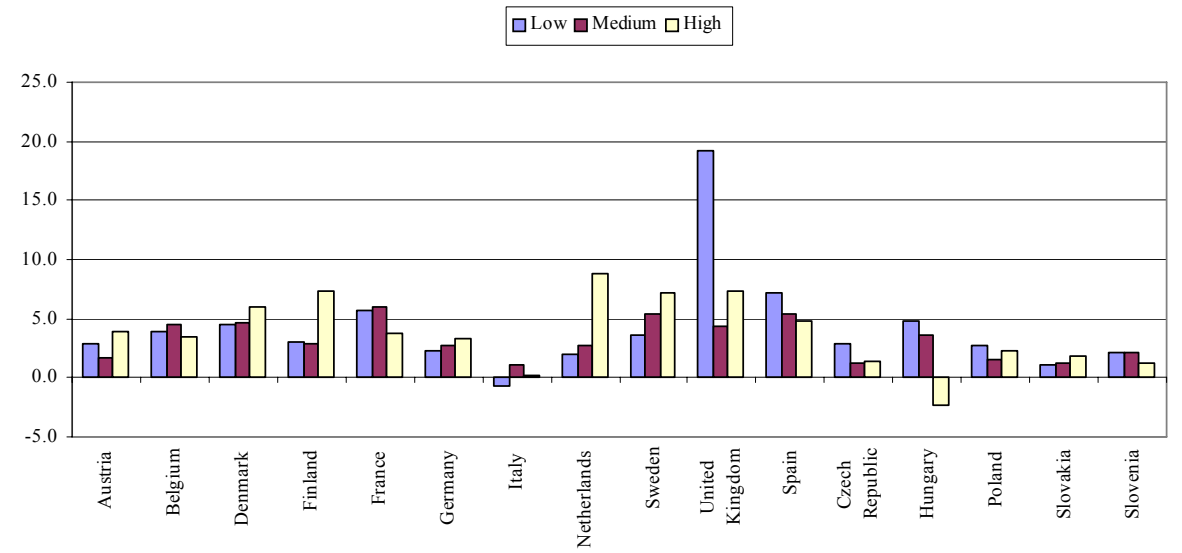
In the previous section we have established the economic importance of skills for sectoral competitiveness in a regression framework. Next we study labour composition changes in light of the upward trend in educational attainment as highlighted earlier. Specifically, results from a growth accounting exercise will be presented. This exercise allows the inclusion of the contribution of changes in skill structures on the overall (value added or output) growth performance. This will consequently reduce the contribution of total factor productivity. We address these issues with a focus on manufacturing industries in a comparative perspective for a number of European countries, relying on the EU KLEMS database. This dataset includes results from a detailed growth accounting exercise for sixteen European countries (but also including Japan and the United States), cf. Van Ark et al. (2007). The countries are Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, the Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. Additionally, information on labour quality is available for the Slovak Republic whereas labour composition variables are not available for Luxembourg. In the following we summarise these results for the period 1995-2004 for which data are available for all sixteen countries (the series for the Eastern European countries only start in 1995). Further, the quality of the data has improved from 1995 on as all countries started to report according to the ESA'95 methodology. As already mentioned above, the EU KLEMS dataset includes data at a rather detailed industry level basically according to NACE 60 industries. However, for reasons of data quality and comparability across countries, growth accounting results are reliable only for a subset of these industries. We concentrate only on the manufacturing sector, for which a further breakdown to eleven industries is available and for which growth accounting results are possible. The methodology to estimate labour services closely follows the method introduced by Jorgenson et al. (1987) and is now commonly used in the literature. The various types of labour which are distinguished in the EU KLEMS database are by qualification (high, medium, low), gender (male, female) and age (15-29, 30-49, 50+) which in total gives 3 x 2 x 3 = 18 types of workers for the eleven industries mentioned above. A measure of labour input that takes into account the differences in productivity of these types of labour are called 'labour services'.

The most important results with respect to changes of hours worked and the role of labour composition are reported in annex table 1. Non-differentiated labour input measured in hours worked was declining over the period 1995-2004 in all countries with the exception of Finland, Ireland, Italy, Spain, and Hungary. The decline was relatively modest in countries like Luxembourg, Sweden and the Czech Republic but reached even 20% in the United Kingdom, Poland, Cyprus and Malta. The results for labour services, i.e. taking compositional changes of labour input into account, are similar. The magnitude of the changes is however smaller in the case of declines and higher in the case of increases of employment pointing to a substitution towards higher quality of labour. This composition change is positive in all cases with the exception of Hungary and the Slovak Republic over the period 1995-2000. Over the whole period the difference of the two indices is between 3 and 6 percentage points and even higher in the United Kingdom with 8.4, Spain with 6.5 and France with 6.1 percentage points. Only small but still positive changes are observed in Italy and the Slovak Republic where the difference is about 1.2 percentage points.

At the more detailed industry level one can see that the labour composition effect, i.e. the difference between the change in labour services and hours worked, is in most cases positive

in all industries (with some exceptions); details can be found in Landesmann et al. (2007). Focusing only on low, medium and high skill intensive industry aggregates one finds that the index of hours worked in 2004 is on average lower in the low and medium skill intensive sectors compared to the high-skill intensive sectors (albeit there are some exceptions like the Baltic states) revealing a between shift towards more skill intensive sectors. A similarly differentiated pattern across industry types is evident when looking at labour service indices. Graph 3.1 presents the difference of the index of changes in labour services and hours worked, i.e. the labour composition effect, in low, medium and high skill intensive industries[59]. The difference is positive in most cases, illustrating a process of substitution towards skilled workers. Notable exceptions are only Italy in the low skill intensive sectors and Hungary in the high skill intensive sectors. However, the pattern that this difference might be more pronounced in the skill intensive sectors is evident mainly in Finland, the Netherlands and Sweden.

Graph 3.1: Labour composition changes 1995-2004



Source: EU KLEMS database, March 2007; wiiw calculations.

Summarising, the labour composition ('quality') effect is positive for total manufacturing and also at the more detailed industry level in most cases. Over the period considered the differences between labour input measured in hours worked and the index of labour services is between 3 to 6 percentage points and even larger in some countries. Skill upgrading turns out to be one of the most important factors in explaining labour composition changes.

[59] The low-, medium- and high-skill industry groupings are defined as follows. Averages of employment shares of different educational attainment groups (ISCED groups high, medium and low educated) are calculated over a longer time interval by industry. The industry groupings are then defined with respect to the share of high skilled workers. The low-skill industries include textiles, textile products, leather and footwear; wood and products of wood and cork; manufacturing, recycling. The medium-skill industries encompass food, beverages and tobacco; pulp, paper, printing and publishing; chemical, rubber, plastics and fuel; other non-metallic mineral; basic metals and fabricated metal. The high-skill industries are: machinery; electrical and optical equipment; transport equipment.

3.4.2. Skill upgrading and employment shifts between sectors

Having established the importance of skill upgrading, we next trace this process in more detail by distinguishing between two types of factors: changes in the composition of the labour force within industries ('within effect') and shifts in employment structures between industries which are themselves characterised by different skill compositions ('between effect'). Furthermore, we analyse and compare these processes of skill upgrading for different country groups, the more advanced EU-North economies, the Southern cohesion countries (EU-South) and the New Member States (NMS).

A simple decomposition algorithm is applied (cf. Berman, Bound and Machin, 1998) which decomposes an aggregate change in skill composition (e.g. skill upgrading in the sense of a higher share of employees with tertiary degrees in the economy as a whole) into a 'within sector' (WS) change and a 'between sector' (BS) change.

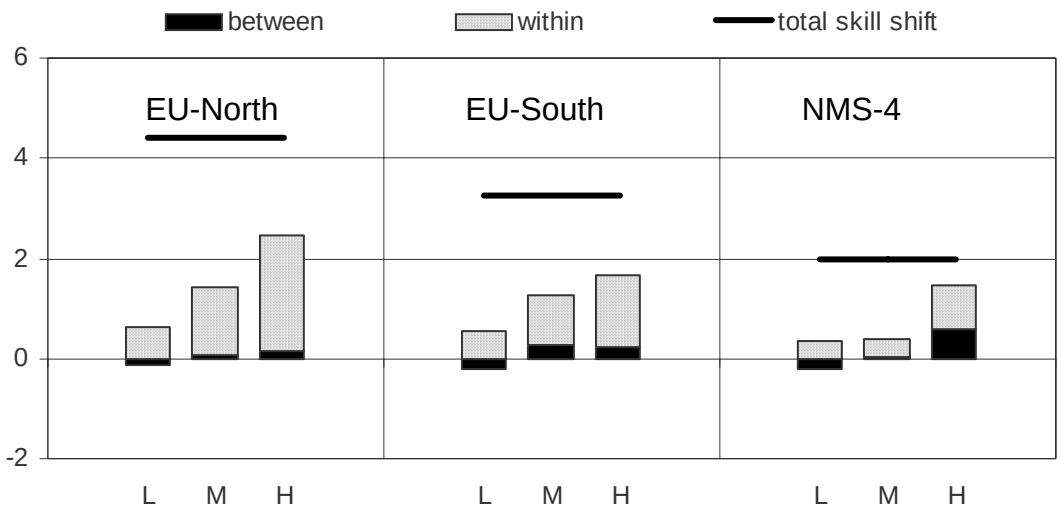
Particularly interesting in this respect is whether skill upgrading takes place to the same extent in different industry groupings, or whether skill upgrading is more pronounced in industries which are already characterised by a high initial level of skills. If employment shifts towards the sectors with a high initial level of skills one speaks of a sector-biased form of skill upgrading. This should be distinguished from the within sector effect which shows the skill-bias of technical change which might take place in any sector of the economy. Skill upgrading in the economy as a whole will obviously take place as a combination of these two effects and will be more accentuated when there is both within sector skill upgrading combined with a between sector bias.

We analyse the 'within' and 'between' effects of skill upgrading using Labour Force Survey data for the period 1999-2005 which allow a breakdown to NACE 2-digit industries. Graphs 3.2.a and 3.2.b presents the results for the industry aggregates where the member countries have been grouped into EU-North, EU-South (comprising Greece, Portugal and Spain) and the New Member States (NMS)[60].

Graph 3.2.a: Summary for share of high-skilled in EU-North, EU-South and NMS-4[61] High education

[60] The grouping into EU-North comprising the older Member States with the exception of the Southern EU members Spain, Portugal and Greece (which form the group EU-South) and the New Member States (NMS) has been adopted in order to identify different patterns which might depend upon differences in income levels and of countries which have undergone dramatic processes of transition and a more recent entry into the European Union (in case of the NMS).

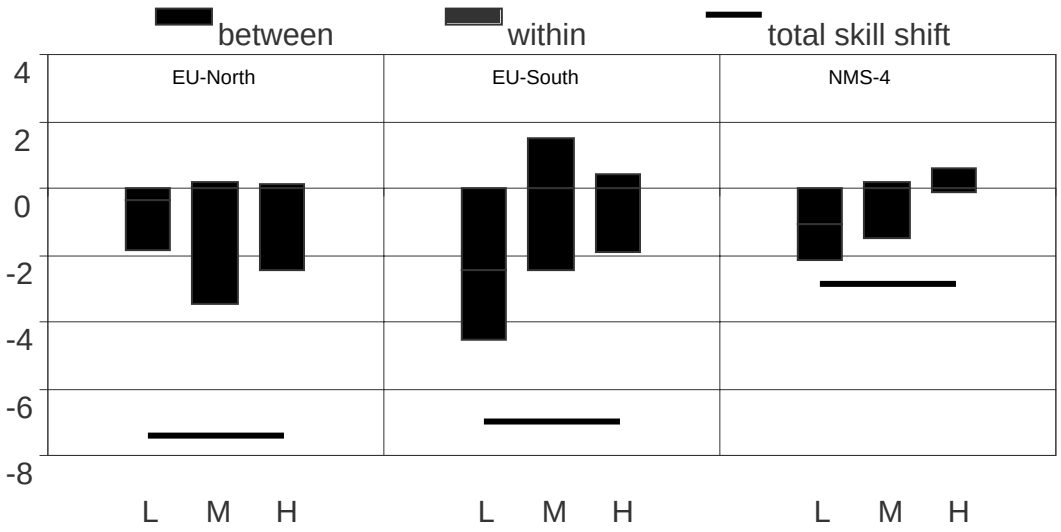
[61] The analysis is restricted here to the NMS-4 (Czech Republic, Hungary, Slovakia and Slovenia) as Polish figures at the NACE 2 digit level did not exist in the LFS statistics and the statistics for two of the Baltic states (Latvia and Lithuania) are affected by classification breaks of ISCED categories.



Note: L=low-skill sectors, M=medium-skill sectors, H=high-skill sectors.

Source: wiiw, calculated from Labour Force Statistics.

Graph 3.2.b: Summary for share of low-skilled in EU-North, EU-South and NMS-4 Low education



Note: L=low-skill sectors, M=medium-skill sectors, H=high-skill sectors.

Source: wiiw, calculated from Labour Force Statistics.

The graphs show the total skill shift and the within and between effects for the three regions and distinguishing low-skill, medium-skill, and high-skill sectors. In general, the upgrading process within industries (i.e. changes in the skill composition within industrial branches) contributes more to the changing demand for high- versus low-skilled people at the aggregate manufacturing level than shifts of overall employment between sectors or industries.

Looking at the between effects it is clear that in all regions, EU-North, EU-South and NMS-4, there is a clear shift of employment away from low-skill industries and towards medium- and

high-skill industries. A more formal econometric test confirms the presence of skill-biased technical change; details are provided in Annex 2. In fact, the strongest shift towards high-skill industries is in the NMS-4. This uniformity of between industry shifts is interesting as it conflicts with a traditional international specialisation story where some countries specialise in low-skill intensive branches and others in high-skill intensive branches.

Furthermore, the 'within shifts' are also clearly staggered in that these shifts are highest in the group of high-skill branches, then in the medium-skilled branches and lowest (though also positive) in the low-skill branches. This pattern is also uniform across the three groups of economies and, in fact, most pronounced in the NMS.

It can be interpreted as evidence of a double-sided catching-up process, i.e. the most pronounced employment shifts towards high-skill industries take place in the NMS, and this is combined with the above-mentioned hierarchy of (within industry) upgrading processes which are strongest in the high-skill branches.

Coming to the other end of the skill spectrum, namely the share of the low-skilled (those with lowest educational attainment levels), we do not observe the same uniform pattern across all country groupings. This is shown in Graph 3.2.b. In absolute terms (i.e. the percentage point decline in the shares of the low-skilled in the labour force), the within effects are larger in the EU-North and the EU-South than in the NMS countries. In the EU-North and EU-South the percentage point shifts are in the order of 7-8% points over the period 1999 to 2005, while in the NMS they are 2-3%. Furthermore, while in the EU-South and the NMS the shifts are again staggered in a similar way, i.e. in that the low-skilled industries experienced also the strongest shifts in employment composition away from the low skilled, followed by the medium-skill and the high-skill industries, in the EU-North the pattern was different in that the strongest shifts were in the medium- and high-skill industries. This pattern is consistent with arguing that while there is pressure towards upgrading of skill structures in all industries, the pressure to reduce low-skill segments is highest in the advanced EU-Northern economies in the medium- and high-skill industries, i.e. those industries in which also the catching-up EU-Southern and NMS economies make their strongest inroads in terms of between and within shifts.

3.5. Skill shortages in the EU: case studies

3.5.1. Introduction

Discussions of skill shortages often have a particular focus on expanding sectors, especially involving new job creation and ICT activities (see for instance European Commission (2007)). However, skill problems can also arise in sectors that are not expanding rapidly and even in those that are in decline. The sectors selected for more detailed study here have been deliberately chosen to include industries that are not necessarily expanding in terms of net job creation but which, nevertheless, remain an important source of income and employment in many parts of the EU.

The industries in question are textiles and clothing (NACE sectors 17 and 18) and mechanical engineering (NACE sector 29). The focus is on skill problems in six selected EU Member States - Germany, France, the UK, Italy, Sweden and Poland - which are in some degree representative of the EU as a whole in illustrating the kinds of problems affecting these industries and which, moreover, are characterised by different education and training systems as well as by different labour market institutions.

National experts in each of these countries were asked to review surveys of employers of skills problems, assess the reasons for these problems, identify the jobs for which skill shortages are seen to be most acute, describe the broad features of education and training programmes which prepare people for such jobs and of any particular initiatives being taken by employers, government and others to resolve the skill shortages in question.

3.5.2. The extent and nature of skill shortages

A first general finding is that skill shortages vary considerably across Member States in the two industries in terms of their nature and scale as well as change over time, reflecting both:

– the overall growth performance of the national economy and the underlying competitive strengths of the sectors concerned;

– the quality of educational and vocational training arrangements - both public and private - and the extent to which existing systems are being adapted to meet changing demands.

Skill shortages are apparent in both industries in most of the countries covered, but, as might be expected, significantly greater problems are evident in the mechanical engineering industry. While statistics vary considerably across countries, as well as over time, it is not uncommon for enterprises to report that 15-35% of their available job vacancies are 'hard to fill', either because of an absolute shortage of people applying or because those who do apply lack the requested skills.

Skill shortages are almost always greatest for technically skilled staff, though not necessarily for those who might be regarded as possessing the highest skill levels such as managers, but more for those classified to the 'associate professional or technician' category in the ISCO classification system. In other words, the shortages are generally more acute for operatives than for ancillary staff. In textiles, however, (especially in the UK) shortages are reported among lower level jobs, such as those in sales or service areas, where the skills in short supply seem to have as much to do with personal attributes - such as communication skills - as with a lack of training as such.

Moreover, shortages of particular skills can co-exist with an apparent excess supply of people who seem to possess the skills in question, where the problem is not so much a shortage of a particular kind of worker but their technical competence to do the job concerned. An example is the apparent shortage of designers in textiles in the UK, which co-exists with a surfeit of designers graduating from colleges (the numbers graduating each year amounting to over a third of the number of designers at present working in the industry).

In addition, the way in which employers perceive skill shortages depends in part on the nature of the labour market and the importance attached to formal qualifications. In the UK employers are likely to attribute recruitment difficulties to a lack of people on the job market with relevant experience, whereas in other countries, where job profiles are much more clearly defined, employers are likely to point to a shortage of people with the requisite qualifications.

3.5.3. Causes of skill problems

As would be expected, the scale of skill shortages tends to vary markedly with the economic cycle - notably in Germany and Sweden. This reflects movements along the Beveridge curve

as discussed earlier. However, even in periods of relatively low levels of economic activity, or pressure of demand, skill shortages in the machinery and equipment industry in particular remain significant. In the UK, on the other hand, the extent of skill shortages both in the two industries covered and in other parts of the economy has remained relatively constant since 2001 or so, despite the apparent pick-up in demand.

The underlying causes of skill shortages in the machinery equipment industry in particular are generally recognised as being structural, arising mainly from insufficient training being provided or the content of training, and education, failing to match job requirements. Although technological advance appears to be important in certain areas (there is a shortage of computer numerical control (CNC) engineers, for example, in a number of countries), it does not seem to have been a primary cause of general skill shortages.

Weaknesses in the existing work force appear to be a cause for concern in a number of countries. These take the form in particular in the textile industry of a low level of education among many of the people employed, which limits their adaptability and their capability of learning new skills. They also take the form of an ageing work force, which may not only restrict the possibilities for adapting to new techniques and new methods of working, but which presage potential skill shortages in the coming years as many employees are approaching retirement. Therefore, although there is the prospect of continuing decline in employment in textiles in most parts of the EU - though less so in the new Member States, which have experienced a significant inflow of direct investment into the industry from other EU countries - the decline in the number of people who possess the technical skills to work in the industry, or are prepared to do so, is likely to be even larger. In machinery and equipment, where the prospects are at best for little or no growth in employment in most countries, demand for labour is even more likely to exceed the diminishing supply of people with the expertise required to perform many of the operative jobs in the industry.

The ageing of the work force in textiles has been accompanied by a change in the nature of jobs, with a shift away from production to ancillary workers - sales and marketing staff, designers, managers and so on - in part as a consequence of the relocation of manufacturing activities to low-wage countries. This is reflected in the changing sex composition of the work force away from women towards men. In Sweden, in particular, less than half of the people employed in the industry in 2005 were women as against almost 70% 10 years previously, while in the UK, there was a reduction in the share of women from 60% to just over half. In Germany and France, the shift was less marked but the share of women still fell by 5-6 percentage points over these 10 years in contrast to an increase of 2-3 percentage points in the overall share of women in total employment. In both countries, therefore, women now make up less than 60% of the work force in the industry in contrast to Italy, where they still account for two-thirds, with little sign of any change, and Poland, where they account for three-quarters (which is the same as in Portugal but still less than in other new Member States - 82% in Bulgaria, 85% in Romania and 86-92% in each of the three Baltic States).

The difficulties both industries face is to replace the workers who will retire within the next 5-10 years, and, in particular, to attract young people into the industry. Since a number of years there has been a general shift away from vocational education and training towards more general academic studies. This tendency is evident not only at the upper secondary level but also at tertiary (university) level, where there has been a relative decline in enrolments in science, engineering and maths programmes in many EU Member States over the past decade or so.

The difficulty is not only to raise the profile of vocational programmes in general and engineering courses more specifically, but to persuade young people to take up a career path in an industry which seems set to decline over the long-term, as compared with going into growing sectors where the long-term prospects seem much more favourable. This is especially so in a context of increasing globalisation and the growing inroads into EU markets made by producers in developing countries, most notably in textiles but also in other parts of manufacturing.

3.5.4. Policy responses

There is evidence of a common tendency to try to ensure that the needs of industry have a greater influence on education and training programmes.

In Sweden and the UK, considerable emphasis is being placed on changing the focus of secondary education, on increasing the vocational element, though at the same time, in Sweden in particular, on increasing the level of general education included in vocational programmes. Conscious efforts are being made to strengthen the links between vocational education and training and the labour market, to involve industry more in the design of training programmes as well as in the provision of practical work place experience. This seems to go further in Sweden where there is a much stronger tradition of social partnership and cooperation between industry and regional and local authorities.

In Germany, there are also moves to reform vocational training arrangements and to make them more relevant to labour market needs. In addition, attempts are being made to create incentives for older workers to remain longer in employment, especially in manufacturing and notably in mechanical engineering.

In Poland, a far more wide-ranging process of reform is underway to redefine job profiles in the market economy and to link education and training programmes more closely with these, to seek to ensure that young people are trained for the specific jobs on offer. The challenge is to match vocational education and training with labour market needs while at the same time ensuring that people are able to adapt to changing demands over the longer-term as restructuring continues. The solution is in part to adopt a modular approach to the design of training programmes, so that different programmes have elements in common and that key competencies are taught in all cases. A major problem to overcome, however, is the seemingly ongoing exodus of young people once they have completed their education.

In France and Italy, reviews are being undertaken of the existing vocational education and training systems and of their links with the labour market. In Italy, the systems developed have very much a regional focus, with a concern to ensure that education and training programmes meet the demand for labour from local employers. Such a focus, however, tends to ignore prospective changes in the structure of local economies and the possibility that students might take up employment elsewhere in the country.

3.6. Skill gaps in the EU: the role for education and training policies

In this chapter empirical evidence has been provided on the relationship between skills and competitiveness. An important implication of these findings was that shortages of skills (or skill gaps) might lead to appreciable welfare costs. If firms cannot attract the workers they need this may seriously limit their production and profit opportunities. Therefore, policies that succeed in improving the matching of workers and firms would increase welfare. Indeed, the

previous section presented some policy responses to adapt education systems to market demands. This section further elaborates on the role of education and training policies in reducing or preventing skill gaps by exploring a number of policy options. Before turning to policy options let us first discuss in more detail what is exactly meant by a skill gap.

3.6.1. What is a skill gap?

The definition of the concept of 'skill' is not unambiguous. A skill could be thought of as a developed ability to perform certain tasks competently. We may distinguish among general and specific skills. General skills are skills that can be used in a large number of other firms (or sectors), and hence are portable across firms as individuals change jobs. Firm- (or sector-) specific skills can be defined as skills that are only productive in the firm (sector) where the individual is employed, and which are not valuable in other firms (sectors). Whereas the distinction between specific and general skills is useful for analytical purposes, its interpretation is not very clear, neither theoretically nor empirically.

The concept of a 'gap' is also not clearly defined. First of all, we may distinguish quantitative gaps and qualitative gaps. A qualitative skill gap exists when the actual skill requirements for a certain type of skill deviate from the skills current workers with that type of skill (occupation) possess. A quantitative gap is defined as an excess demand for workers with a particular type of skill. In this paper, we define two concepts of a quantitative skill gap.

3.6.1.1. Skill gap as an adjustment problem

The first concept defines skill gaps as an adjustment problem. Skill gaps may emerge after an increase in demand for (or fall in supply of) a certain skill. Examples of causes of (structural) shifts in skill demand are trends such as skill-biased technical change, outsourcing and deindustrialisation, whereas shifts in skill supply can be caused by demographic trends such as ageing of the population and shifts in international migration patterns.

A higher demand for skills will drive up wages and the market will reach a new equilibrium in which there is no quantitative skill gap. The path to the new equilibrium involves adjustment costs. As long as (relative) wages can be flexibly adjusted in an upward direction, there are no quantitative skill gaps in this definition. We have no reason to assume that wages will be upwardly rigid as employers will always be able to pay higher wages if they want to. In consequence, skill gaps cannot exist in the form of excess demand, but there is a 'gap' between employment of a skill in the long-run and the short-run.

A typical characteristic of the labour market, however, is that it takes time to acquire skills. Therefore, in a situation of an unanticipated increase in demand for certain skills (or a drop in supply), it is likely that additional workers with the demanded skill are not available in the short-run; that is, the short-run supply of skills is inelastic. Workers will be able to receive higher wages in the short-term equilibrium. The higher wages will induce people to enrol in the demanded types of education (or induce workers in other sectors to retrain themselves) and the market will eventually reach the long-term equilibrium, in which wages are lower and employment of that skill is higher than in the short-term equilibrium.

It can be inferred that total welfare is larger in the long-term equilibrium compared to the short-term equilibrium. Hence, a smooth adjustment from the short-term to the long-term equilibrium will increase welfare. There may be a role for the government in facilitating a smooth adjustment process. This can be done by reducing or eliminating possible rigidities in

education systems or labour markets, or barriers to international movements of workers or goods.

3.6.1.2. Skill gap as a non-optimal mix of skills in the economy

The second definition of a quantitative gap defines a skill gap as a distribution of skills in the economy (in current steady state) which differs from the mix of skills which may generate a higher level of welfare. This definition of skill gaps implies that shortages as well as surpluses of certain skills may exist at the same time. Explanations for the occurrence of such gaps are market failures such as a lack of transparency or (policy-induced) institutions such as barriers to entry in labour or product markets. The market failures and institutions which prevent the economy from reaching a welfare improving mix of skills coincide with the rigidities mentioned in the definition of skill gap as an adjustment problem (the first definition).

3.6.2. What is the role for education and training policies to reduce skill gaps?

This section discusses five remedies to combat skill gaps:

(5) Produce and distribute scenarios on skill prospects

(6) Improve adaptability of education system

(7) Stimulate general skills rather than specific skills

(8) Shape comparative advantage by education policy

(9) Training policies

Whereas the first two options are targeted towards providing a smooth adjustment towards the long term equilibrium after shifts in skill demands (or supply), the latter three are targeted particularly at changing the skill distribution in the economy to obtain a higher welfare equilibrium. These policy options either attempt to facilitate movements along the Beveridge curve, or aim to shift the Beveridge curve to the left.

The first option is to produce and distribute scenarios on the prospects of different skills. This type of information gives students and trainees better opportunities to decide which skills they prefer to acquire. Promoting transparency is a potential task of the authorities as lack of transparency is a market failure. An increase of transparency about the future labour market will facilitate a smooth adjustment of the labour market in cases of shocks. A concrete example of a policy option to increase transparency is to extend the current practice of producing forecasts of occupations to forecasts of skill demands in order to capture changes in skill demands *within* occupations as well, which seem to be rather important. Another policy option is to make the produced information on skill prospects more customer-oriented and less fragmented, that is, to improve the distribution of this information to the relevant actors (e.g. students, providers of education and training, firms). However, predicting the future situation on the labour market is a difficult task. With the exception of particular occupations where demand is to a large extent driven by demographic factors, such as teaching, there is a lot of uncertainty about the future labour market. Hence, it is important to make clear that most of the predictions about the future labour market are associated with much uncertainty.

The second policy option is to improve the national education systems' adaptability to shifts in skill demand or supply. This option also aims to facilitate a smooth adjustment of the

labour market in a changing environment. Examples are apprenticeship or dual education systems in vocational education, removing barriers to entry for new private suppliers of education, and targeted grants for students to stimulate enrolment in particular types of education. Coordination of the (content and quantity of) education programs between the business sector, education authorities and national and regional governments may improve adjustment from the short-term equilibrium to the long-term equilibrium after shifts in skill demand or supply.

The third option is to stimulate education in general skills and discourage education in specific skills. The reason is a potential external effect, because students may insufficiently take into account the possible social costs of unemployment (unemployment benefits, public retraining costs), if they decide which type of skill they want to acquire. This argument is more important for specific skills than for general skills, since generalists are better protected against unexpected shifts in skill demands than specialists. However, there is no clear general case for education policies targeted at stimulating general skills and discouraging the acquisition of specific skills. An important reason is that there are no clear indications for an increasing uncertainty about future demand for skills due to technological progress or other changes in markets. In addition, in most countries, a certain amount of general skills is already taught (and publicly financed) during initial education, which may have already internalised the potentially (larger) negative externalities of investments in specific skills. Moreover, the benefits of this policy should be weighed against its costs, since workers with specific skills are expected to be more productive than generalists in the industry in which they are active.

The fourth policy option is to shape comparative advantages by education policy, for instance by subsidising education of certain skills more than education of other skills. The main argument for government intervention is the occurrence of external effects involved in the employment of the selected skills. Examples of these external effects are agglomeration effects (spillovers) and learning effects. In that case, multiple equilibria may exist, and EU countries may fall in a trap of a mix of skills which is below the welfare optimum in the absence of government intervention. Education policies that promote the supply of particular skills with the aim of shaping EU's comparative advantages is an option in that case. However, this is a risky policy for several reasons. First of all, it is generally unclear whether the social returns of the selected skills exceed the private returns. Moreover, there is a risk that the government may select the wrong skills after all. Further, the government takes risks of an uncoordinated race of countries to attempt to specialise in the same direction. Finally, selective policies often attract interest and lobby groups which will benefit from selection of certain skills and which neglect the negative welfare effects in the rest of the economy.

The fifth option is to address the problem of skill gaps through training policies[62]. Sufficient training participation by employees is important to narrow qualitative skill gaps, that is, to assure that the skills of employees maintain updated to actual skill requirements by employers. Economic theory has identified several possible reasons for underinvestment by private parties in the market for training, of which poaching (general training) and hold up problems (firm-specific training) are the most prominent ones. The market (e.g. social partners) may already provide various solutions to certain market failures, e.g. in the form of sector-based training funds. Moreover, authorities in the EU are already implementing various

[62] For a more elaborate discussion on vocational training policies, the reader is referred to chapter 4 in Employment in Europe 2007 (European Commission, 2007b).

training policies, such as legal frameworks and co-funding schemes of employees and employers. Some of these policies carry risks of deadweight losses, in the sense that training investments are subsidised that would have taken place anyway. This risk particularly prevails when public funding schemes occur in the form of direct contributions, which do not need to be matched by own contributions of firms or workers. Training policies should preferably be targeted at the marginal decision to invest in training. Little is known about the (cost) effectiveness of all these training policy instruments. Further research on their effectiveness and small-scale experiments could contribute to more evidence-based policy making.

3.7. Summary and conclusions

Educational attainment shows an upward trend in the EU countries. A better educated work force is conducive for a country's economic performance. Human capital not only augments the efficiency of labour, it can also help to create absorptive capacity so that firms can more easily adopt technologies developed elsewhere. Both mechanisms would foster productivity and international competitiveness. Indeed, actions to increase human capital complement the myriad of structural policies discussed in Chapter 2 to strengthen the overall economic performance in light of EU's growth and jobs strategy.

Against this background of increasing educational attainment, concerns about skill shortages are often expressed. Does the education system deliver the skills demanded by the market? Can people easily be retrained to accommodate shifts in the needed type of skills? Skill gaps can emerge after an increase in demand for (or fall in supply of) a certain skill, but can also indicate a non-optimal mix of skills in the economy. Beveridge curves, i.e. the loci of unemployment and vacancy rates, can give some insight into the importance of both types of skill gaps. Shifts along this curve reflect the usual business cycle fluctuations, while shifts of the Beveridge curve point at changes that improve or worsen the matching process, and thereby affect the equilibrium level of unemployment. Both phenomena call for different policy responses. While in the former case the rationale for government intervention is typically limited to smoothing the adjustment process, a more active role is warranted in the case of structural mismatches.

Some insight into the quantitative relevance of these adjustment processes can be gained by looking at sectoral data, as this may reveal the importance of skill upgrading related to increasing demands for skills within sectors versus skill upgrading due to employment shifts towards more skill intensive sectors. More insight into these within and between shifts could feed into a country's human capital policy, as it may for instance signal the importance of general versus specific skills.

This chapter has explored these issues in more detail. The first part studies the importance of skills for competitiveness, using the recently released EU KLEMS database at sector level. Two indicators for competitiveness are employed, namely productivity growth and export performance. The econometric analysis revealed that sectors employing a larger share of high skilled or medium skilled workers show higher productivity growth. In contrast, the share of low skilled workers in a sector exerts a negative effect on productivity growth. Furthermore, skills matter for the speed of convergence towards the technological frontier. Convergence is faster in the high skill intensive industries. A second performance measure is sectoral export growth. It is found that a higher share of high and medium skilled workers spurs growth of exports, while a high share of low skilled employees has detrimental effects on sectoral export performance.

The second part concentrates on the nature of skill upgrading. Growth accounting reveals that there is a substitution towards higher quality of labour. This raises the question to what extent skill upgrading of the employed labour force is due to changes in the composition of the labour force within industries and to what extent it is due to shifts in employment structures between industries which are themselves characterised by different skill compositions. The analysis has shown that the upgrading process within industries contributes more to the increasing demand for highly skilled workers than shifts of overall employment between sectors or industries. Nonetheless, there is also a general shift of employment away from low-skill intensive industries towards medium- and high-skill intensive industries, and this shift occurs across all groups of EU countries distinguished in the analysis, i.e. the EU-North, EU-South and the New Member States. The latter phenomenon suggests that technical change is skill-biased, i.e. technical change is faster in skill-intensive sectors. A more formal econometric approach indeed confirmed the quantitative importance of this process of skill-biased technical change.

Such increasing importance of skills can create bottlenecks when there are mismatches between demand and supply on labour markets. The third part discusses the issue of skill shortages in EU industries. A way to explore the underlying causes of such skill shortages is by performing in-depth studies of particular sectors. Case studies on skill gaps have been presented for two industries, textiles and clothing and mechanical engineering, for six selected EU Member States. Skill shortages vary considerably across Member States, both in terms of their scale as well as in rates of change, but greater problems are evident in the mechanical engineering industry. Skill shortages are almost always greatest for technically skilled staff, and more acute for operatives than for ancillary staff. The underlying causes of skill shortages in the machinery equipment industry seem to be of a structural nature, often related to qualitative discrepancies on labour markets. The textiles industry is confronted with a low level of education among many of its employees, which limits the sector's adaptability and the worker's capability of learning new skills. With regard to policy responses there is evidence of a common tendency to try to ensure that the needs of industry have a greater influence on education and training programmes.

Insights from these case studies can support the design of sector-specific or general policy responses, which is the topic of the final part of this chapter on the type of actions to be taken to alleviate such skill mismatches. A profound understanding of the underlying problem is essential for the design of effective and efficient policies. Skill gaps can be seen as an adjustment problem, arising after an increase in demand for (or fall in supply of) a certain skill. In such a situation the government can play a role in order to smooth the transition process. Secondly, skill gaps can also be due to a non-optimal mix of skills in the economy, in which case government intervention is needed to correct market failures or improve institutions which prevent the economy from reaching an optimal mix of skills. Several policy options to reduce skill gaps were discussed. These include for instance promotion of transparency about future labour market prospects, improvement of the adaptability of education systems, stimulation of general skills, and encouragement of training of employees.

As we have seen, most of the labour market dynamics takes place within sectors, rather than across sectors. An issue for further research is whether this would support policies to strengthen the responsiveness of the education system to market needs and to focus more on specific skills. An alternative interpretation is that between sector shifts are hampered by a too strong emphasis on specific skills in the labour force, which may call for an opposite strategy, i.e. a stronger focus on general skills which are more easily portable across sectors.

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Annex 1: Growth accounting

Annex Table 3.1: Index of hours worked and labour services, 1995=100						
	Hours worked		Labour services		Labour composition*	
Country	2000	2004	2000	2004	2000	2004
Austria	91.2	86.2	93.6	89.7	2.4	3.6
Belgium	97.5	89.0	100.3	94.0	2.8	5.0
Denmark	99.4	88.8	102.7	94.4	3.2	5.6
Finland	111.0	103.7	112.2	108.0	1.2	4.3
France	94.9	87.0	98.4	93.1	3.5	6.1
Germany	93.1	87.0	94.0	91.0	0.9	4.1
Irland	108.8	100.9	n.a.	n.a.	n.a.	n.a.
Italy	101.0	100.2	102.0	101.3	1.0	1.2
Luxembourg	99.0	96.8	n.a.	n.a.	n.a.	n.a.
Netherlands	100.0	90.3	102.3	94.1	2.3	3.8
Sweden	101.3	94.2	104.1	100.1	2.8	6.0
United Kingdom	96.2	79.7	101.5	88.1	5.3	8.4
Greece	96.0	89.9	n.a.	n.a.	n.a.	n.a.
Portugal	97.0	90.0	n.a.	n.a.	n.a.	n.a.
Spain	121.1	118.4	123.4	124.9	2.3	6.5
Czech Republic	99.3	94.1	100.6	97.5	1.3	3.4
Hungary	110.6	102.1	109.5	107.0	-1.1	4.9
Poland	91.5	80.0	92.2	83.7	0.8	3.8
Slovakia	90.6	88.4	89.9	89.5	-0.7	1.2
Slovenia	90.9	87.8	95.5	91.8	4.6	3.9
Cyprus	84.1	76.3	n.a.	n.a.	n.a.	n.a.
Estonia	82.1	92.4	n.a.	n.a.	n.a.	n.a.
Latvia	88.4	87.2	n.a.	n.a.	n.a.	n.a.
Lithuania	88.8	87.9	n.a.	n.a.	n.a.	n.a.
Malta	94.6	77.0	n.a.	n.a.	n.a.	n.a.

Note: * Difference between index of labour services and hours worked in respective year.

Source: EU KLEMS database, March 2007; wiiw calculations.

Annex 2: Skill biased technical change

To test the emergence of skill biased technical change, we follow the empirical strategy proposed by Haskel and Slaughter (2002). We estimate the relationship between the change in the relative wage bill (i.e. the labour income share in a sector relative to the total labour income share) and a skill intensity measure in the initial year, i.e.

$$\Delta\omega_j = \alpha + \beta_{BIAS}\frac{S_j}{U_j} + u_j$$

where $\Delta\omega_j$ denotes the change in the relative wage bill, S_j and U_j denote the quantity of skilled and unskilled labour input (measured in hours worked); the subscript j refers to the industry aggregate, i.e. j=H,M,L. We have tested this specification for the two types of aggregates of skills and also included different sets of dummies for countries and industries (we applied Least Squares Dummy Variable estimation). A positive parameter β_{BIAS} indicates that technical change is concentrated in the skill intensive sectors. Results of these estimations are provided below.

Skill biased technical change						
	High skilled		**High skilled**		**High skilled**	
Bias parameter	0.32	***	0.49	***	0.77	***
	(0.000)		(0.000)		(0.000)	
Country dummies	No		Yes		Yes	
Industry dummies	No		No		Yes	
F-value	17.89		70.37		31.39	
R squared	0.24		0.85		0.87	
Observations	48		48		48	

Note: p-values of robust estimation in brackets. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

Source: Landesmann et al. (2007).

The results indicate that technical change was biased towards the high skill intensive sectors which – together with the skill biased nature of technical change – leads to an increasing demand for skilled workers. The econometric estimations confirm that sector bias was indeed significant as regards the high-skilled segment of the labour force[63].

[63] For a further discussion on the development of labour income shares, see European Commission (2007b).

C. COMPETITIVENESS AT SECTOR LEVEL

4. ANALYSIS OF THE PERFORMANCE OF EUROPEAN INDUSTRIES

4.1. Introduction

Economic growth and the generation of income ultimately depend on the competitive performance of *individual enterprises*. The competitiveness of these enterprises in turn depends on the relative abundance (and hence cost) of resources, as well as the incentives and capabilities to use them in a productive and sustainable manner. Even though many determinants, such as macroeconomic stability, the corporate tax rate or the working of factor markets, are thus shaped by the general *business environment*, the relative intensity in factor use, the incentives to pursue opportunities, and the specific capabilities required for transforming them into successful business vary between *sectors*. As a consequence, countries differ greatly in their sectoral growth and performance. Within an identical macroeconomic setting, they show considerable strength in some industries and weaknesses in others.

Based on the goals of the Lisbon agenda, the comparison of aggregate measures can only provide an incomplete picture of European competitiveness. In order to address its driving factors, enterprise and industrial policies require a deeper understanding of competitive performance and its varying sources at the level of individual industries. Within this context, this chapter focuses on the relative strengths and weaknesses of European industries as revealed by our measures of sectoral performance.

To organise the wealth of individual data into a manageable amount of meaningful results, this chapter addresses the following questions:

Which are the best and least performing sectors in the European Union with respect to the selected indicators (i.e. growth of value added and labour input, productivity, profitability, international trade, and foreign direct investments)?

In which industries is the difference in performance between the 'old' and new EU Member States most pronounced?

How do European industries compare to those in the US, and what is their contribution to the aggregate gaps in growth performance?

Additionally, the dataset is used for an integrated analysis of the different dimensions of sectoral performance. In particular, it aims to shed light on the following questions:

– Do the general dynamic characteristics of 'catching-up' or self-reinforced advantages ('dynamic specialisation') prevail among industries?

– What are the major relationships between the different performance variables?

– What kind of economic policies are the most indicated to affect sectoral performance?

A major obstacle to a systematic empirical analysis of the driving factors of sectoral performance is the paucity of available data. In that regard, this chapter takes advantage of the very recent and notable advances that have been made in this arena, in particular the sectoral

productivity measures provided by EU KLEMS[64]. Another advance in this area is constituted by the compilation of EU industrial structure datasets[65]. However, the available data are still far from comprehensive. As the data for the different dimensions of performance come from different sources, these cannot be fully merged into one consistent sector disaggregation or even cover in an entirely consistent way all Member States. The consequence is that the empirical analysis must largely adhere to the boundaries drawn by the data sources, even though from an analytical viewpoint a more integrated mapping of relative strengths and weaknesses would be preferable.

The main databases used for the analysis here are EU KLEMS for measures on sectoral growth and productivity; and UN-COMTRADE and EUROSTAT for international trade. Finally, the data on foreign direct investments were collected from EUROSTAT, the OECD, UNCTAD and the WIIW.

Box 4.1: Measuring sectoral performance

Competitiveness is a multifaceted target for which no single and fully comprehensive measure exists. The multitude of objectives must be taken into account when striving for a 'general' picture[66]. In the following, we assess the competitive performance of European industries along the following set of ten selected indicators:

Growth

- The *growth of value added* indicates an economy's success in creating income and thus its ability to increase material well-being. For given constraints with respect to a society's non-economic goals, such as social fairness or ecological sustainability, it is probably the most straightforward target of economic activity.

- The *growth of employment* or *hours worked* indicates not only success in mobilising productive resources, but also the ability to offer people jobs and participation. As labour input is also a cost factor in production, its growth is not unconditional. If it is meant to be sustained, the growth of value added and productivity must keep pace accordingly.

Productivity

- *Labour productivity* is the ratio of output (either gross output or value added) to labour input (either employment or hours worked). Integrating changes in inputs and outputs into a single measure, it reflects competitiveness more accurately than the aforementioned growth of output and employment. Here, we define labour productivity as value added per hour worked.

- *Total Factor Productivity (TFP)* additionally nets out the returns to all other inputs, i.e. capital (and intermediates in the case of a gross output specification), and is therefore the

64 The EU KLEMS database is the result of a three year, European Commission funded research project involving 16 European research institutes, which has recently become available for free public use at http://www.EU KLEMS.net. See Timmer et al (2007) for further details on the construction of the database.

65 EU Industrial Structure, 2007, European Commission, Directorate General for Enterprise and Industry, http://ec.europa.eu/enterprise/enterprise_policy/competitiveness/2_indics/indics_compet.htm

66 For a discussion on the different concepts of competitiveness, see a recent special issue of the *Journal of Industry, Competition and Trade*, Vol.6, No.2, with contributions, among others, by Aiginger (2006), Grilo and Koopman (2006), or Kohler (2006).

most comprehensive measure of the efficiency of operations. Total Factor Productivity is calculated as a residual, i.e. the gain in output which cannot be assigned to any measurable input[67].

Profitability

For the individual enterprise, profits are the ultimate goal and incentive behind investing resources and undertaking effort. Profitability thus signals how well corporations turn revenue into income that can be transferred to shareholders and owners. From the perspective of society at large, however, high profitability can be an ambiguous objective. In particular, if profits are in excess of appropriate returns to effort, risk and innovation, these may indicate a lack of competition, which in the end turns against consumers and overall welfare.

– The *net profit margin* is the ratio of after-tax revenue net of extraordinary items (and associated taxes) to sales. Indicating the efficient translation of sales into profits, the net profit margin tells how much profit is made for every dollar of revenue generated.

– Indicating the efficient use of assets to generate profits, the *return on assets* (ROA) is calculated as the ratio of after-tax profit net of extraordinary items to assets. The ROA figure offers an idea of how effectively a company is converting its available investment funds into net income, both through debt and equity financing.

International trade

– The *revealed comparative advantage* (RCA) indicator measures trade specialisation. In this chapter, it is defined as the logarithm of the export to import relation of one sector divided by the export to import relation of all sectors[68]. Positive RCA values indicate comparative advantages and negative values represent comparative disadvantages of a particular industry.

– *Export market shares* reflect the capacity to respond to external demand or open up new markets in direct comparison to international competitors. They show how much of the total 'world' export is covered by the export of a particular country for each industry.

Foreign direct investments (FDI)

– The *ratio of inward FDI stock to value added* indicates the contribution of FDIs to capital formation, stimulating value added and employment but also the acquisition of new technology and management practices in the host market. In addition, it offers an indication of the attractiveness of the host country.

– Analogously, the *ratio of outward FDI stocks to value added* reflects a corresponding outflow of capital. However, it can also be an indication of corporate strength, where companies venture abroad to seize opportunities from foreign markets and resources.

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[67] This 'growth-accounting' approach was pioneered by Solow (1956, 1957) and further refined, e.g., by Jorgenson and Griliches (1967) or Jorgenson, Gollop and Fraumeni (1987). For recent expositions, see e.g., Schreyer and Pilat (2001), Jorgenson, Ho, and Stiroh (2005), and Timmer, O'Mahony and van Ark (2007).

[68] Please note that in the statistical annex of the present report is used an alternative definition of RCAs (normalised market shares).

The chapter is organised as follows. Section 2 provides a brief account of the performance of European industries with respect to growth and productivity. Section 3 turns to international trade and Section 4 investigates the sectoral patterns of foreign direct investments. Section 5 considers the interrelationship between the performance variables. Finally, Section 6 summarises and concludes.

4.2. Growth and productivity

The empirical assessment starts with a joint investigation of the growth of value added, and labour input as well as labour- and Total Factor Productivity. Conceptually, these indicators are strongly interdependent, and the available sectoral information stems from a single integrated dataset.

There is much variation between industries (Table 4.1). However, the most consistent difference between the US and the 'old' EU Member States is the role played by TFP in value added growth. In almost all sectors the relative contribution of TFP is considerably higher in the US, especially in electrical machinery, post and communications and distribution (Table 4.2). On aggregate, the TFP contribution amounts to 1.1% in the US, but remains almost flat in the 'old' EU Member States. More precisely, the TFP component accounts for only 5.8% of value added growth in the EU, compared to a share of 35.8% in the US[69].

The major findings from the added sectoral detail in Table 4.1 can be summarised as follows:

– To begin with, the data for the EU-25 show a clear pattern in the growth performance of the broad sectors, with the service industries generally exhibiting the most dynamic development in terms of value added and labour input, followed by total manufacturing, agriculture, and the steadily shrinking mining sector. Even though this is consistent with economic theories of structural change, the observed pattern does not apply universally. Within the EU it is upset by the New Member States' (hereafter referred to as the NMS10) particularly strong performance in manufacturing. The top 4 countries in terms of productivity growth amongst old EU nations (Ireland, Finland, Sweden and Greece, hereafter referred to as the EU4*) exhibit stronger value added growth in manufacturing than the EU-25, although not as high as NMS. In addition, we see strong growth in higher technology service sectors than in the EU-25 aggregation. It should be stressed that the EU4* whilst indicative of the better performances within the EU are not necessarily widely representative of the EU as an aggregate, even if they cover a diversity of growth paths. However, they do reveal some interesting sectoral growth patterns. Conversely, the US data deviate from the European pattern in that mining (and agriculture) are observed to grow faster than manufacturing.

– Apart from mining and the insurance services[70], all consistently declining industries in the EU-25 are in the manufacturing sector. These are, for example, textiles, clothing, leather and basic metals industries, all of which rely upon relatively old or easy-to-copy technological blueprints and are particularly exposed to global competition and structural adjustment. Most of these are declining in the EU-15, the NMS10 and the US. One exception is textiles, where we see a decline in the EU-15 growth rate exactly matched by an increase in NMS10 growth in value added, suggestive of substitution between the two

[69] For a detailed account of the results from the EU KLEMS data, see van Ark, O'Mahony and Ypma (2007).

[70] The latter are notorious for the difficulty to define output and measure prices (see, Triplett and Bosworth, 2004).

areas. In addition, we see strong labour productivity growth in textiles in the EU4*. Another exception is the basic metals industry, where the decline of value added is restricted to the NMS10.

– Within manufacturing, industries where the EU-25 experienced high value added growth include electronic components, communications equipment, computers and office machinery, and pharmaceuticals. In terms of the value added and labour input we again see stronger growth in the EU4* than the EU-25, particularly in high tech manufacturing sectors. In the NMS10, whilst these sectors do show high growth, the strong performance is less concentrated in high-tech industries, with high growth also seen in wood products, rubber and plastics, non-metallic mineral products, and motor vehicles. In comparison with the US, sectors where NMS10 and EU-15 growth are relatively high include refined petroleum and nuclear fuel, precision instruments and, in particular in the case of the NMS10, audiovisual apparatus. Conversely, European growth lags behind significantly in computers and office machinery. In many industries the NMS10 experienced higher productivity growth than the US. However, this phenomenon is likely to be relatively temporary, driven by structural adjustment as the New Member States converge.

– Among the service industries, post and telecommunications and computer and related activities appear to be the fastest value added growth sectors in the EU. The financial services look particularly strong for the NMS10. More than any other sector, the financial services sector appears to be particularly affected by the transition to modern market economies. Compared to the US, Europe mainly has a distinct growth advantage in the network industries, i.e. electricity, gas and water supply as well as transport and communications, with the exception of air transport. In construction a low growth rate in the EU aggregates also compares to negative growth in the US. In all of these sectors, the better growth dynamics of the EU becomes further apparent in terms of labour productivity. A worrying finding from the EU point of view is the weakness of the old EU-15 compared to the US in the areas of wholesale/retail trade, air transport, financial intermediation and, to a lesser extent, real estate/business services. These are sectors that have been thought to be driving US growth since 1995. In contrast, the labour productivity performance of the EU4* in the distributive trades sectors is relatively strong compared to the EU-15. In addition, the EU4* also experience high growth in ICT using sectors such as financial intermediation, research and development and computer related activities.

The growth of labour inputs varies considerably between the NMS10 and the EU-25. We already observed that for manufacturing, despite higher growth of value added in the NMS10, labour input decreased faster than in the EU-15. Among the service industries the stronger decline in labour inputs is especially noticeable in construction and research and development, where we see a considerable reduction in hours worked in the NMS10 as opposed to growing labour inputs in the EU-15. One possible explanation for this (in addition to the extraordinary efficiency gains from transition) is out-migration from the New Member States. It has been observed that migration is sectorally concentrated and these sectors generally tend to show high rates of migrant workers (Kangasniemi, Mas, Robinson and Serrano, 2007). Especially in the case of research and development, the sectoral pattern indicates a certain 'brain-drain' from New Member States to 'old' Europe.

To provide an overview of the role that individual sectors play in overall value added growth, Graph 4.1 shows the percentage contribution each sector makes to overall value added growth over the 1995-2004 period for the EU-25 and the US. Please note that in terms of the absolute levels of value added growth, these are percentage contributions to an aggregate 2.25%

growth in the case of the EU-25 and 3.19% in the US. With this in mind, Graph 4.1 shows that renting of machinery and equipment, wholesale and retail trade and post and telecommunications are significantly contributing to the overall value added growth in both the EU and the US. However, it should be borne in mind that these bars represent the relative contributions to the overall growth rates, which are higher in the US than in the EU-25. Traditional manufacturing sectors such as textiles, mining and quarrying, and miscellaneous manufacturing and recycling make little contribution to value added growth in the EU-25. Whilst in general the pattern between the EU and the US is similar, Graph 4.1 does reveal some sectors where fortunes diverge over the two regions. Chemicals and construction are two such examples of sectors that positively contribute to value added growth in the EU whilst their impact in the US is negative.

Graph 4.2 presents the percentage contributions of sectors to labour productivity growth, again arranged according to the magnitude of their contribution in the EU-25. Labour productivity growth over the period is 1.68% in the EU-25 and 2.39% in the US. The ordering is similar to that observed for value added growth, but wholesale and retail trades account for the largest industry contribution to labour productivity. Whilst this is true for both the EU and the US, the relative percentage contribution to labour productivity in the US is almost double that of the EU-25. In reality, given the higher growth rate in the US, this effect is even larger. Surprisingly perhaps, agriculture, hunting, forestry and fishing contribute more than 15% to the overall growth in labour productivity in the EU-25, much larger than the US contribution from this sector. Finally, turning to sectors that contribute the least in the EU-25, Graph 4.2 shows that the renting of machinery and equipment and hotels and restaurant sectors have a negative contribution to labour productivity growth whilst contributing significantly to the productivity growth in the US.

Table 4.1: Average annual growth by sectors in%, 1995 - 2004																
NACE group	**NACE description**	**Value added**					**Hours Worked**					**Labour productivity (value added/hours worked)**				
		NMS	**EU-15**	**EU-25**	**EU4***	**US**	**NMS**	**EU-15**	**EU-25**	**EU4***	**US**	**NMS**	**EU-15**	**EU-25**	**EU4***	**US**
A to B	**Agriculture, Hunting, Forestry and Fishing**	2.37	1.37	1.49	-0.89	5.44	-1.00	-2.4	-2.3	-3.91	0.07	3.37	3.77	3.28	3.52	5.37
C	**Mining and Quarrying**	-3.24	-1.71	-1.92	-1.02	4.14	-7.18	-4.09	-4.52	-1.71	-0.76	3.94	2.38	3.69	2.48	4.90
D	**Total Manufacturing**	5.44	1.51	1.78	4.72	2.71	-1.47	-0.97	-0.97	-0.55	-2.44	6.91	2.47	2.84	5.81	5.14
15	**Food and Beverages**	2.68	0.51	0.71	n.a.	-0.32	-1.7	-0.32	-0.26	-0.75	-0.73	4.38	0.83	1.35	n.a.	0.41
16	**Tobacco**	-1.97	-0.60	-0.77	n.a.	-6.73	-5.83	-4.07	-4.32	-3.88	-3.39	3.87	3.47	3.67	n.a.	-3.34
17	**Textiles**	2.07	-2.14	-1.78	-2.92	0.59	-5.88	-3.5	-3.46	-3.64	-6.83	7.95	1.35	2.29	1.51	7.42
18	**Wearing apparel (Clothing?), Dressing and dying of fur**	-1.25	-2.98	-2.75	-2.98	-3.43	-3.55	-4.48	-4.96	-4.59	-10.10	2.30	1.51	1.44	3.31	6.67
19	**Leather and Footwear**	-6.00	-3.50	-3.70	-2.45	-2.96	-8.03	-3.24	-3.44	-2.62	-9.58	2.03	-0.26	0.66	1.05	6.61
20	**Wood and products of Wood and Cork**	7.84	2.05	2.78	2.76	0.16	0.84	-1.15	-1.33	0.79	-0.98	7.01	3.20	3.34	4.12	1.14
21	**Pulp, paper and printing**	5.82	1.19	1.43	0.86	2.98	-1.94	-1.65	-1.6	-1.54	-3.29	7.76	2.83	3.12	4.18	6.27
22	**Printing, publishing and reproduction**	4.47	0.56	0.74	5.40	0.25	0.64	-0.94	-0.95	-0.92	-2.64	3.84	1.49	1.48	4.74	2.89
23	**Coke, refined petroleum and nuclear fuel**	-17.50	-2.53	-4.13	6.76	-40.24	-6.27	-1.54	-1.6	-0.90	-2.85	-11.23	-0.99	-1.49	8.66	-37.49
24	**Chemicals and chemical products**	2.03	2.91	2.86	8.94	2.35	-3.56	-1.14	-1.28	1.02	-1.45	5.58	4.04	4.38	7.96	3.8
244	**Pharmaceuticals**	3.80	5.47	5.4	n.a.	1.8	-2.43	1.27	1.23	2.33	-2.27	6.22	4.20	4.70	n.a.	4.07
25	**Rubber and Plastics**	12.06	2.94	3.72	2.80	3.25	3.34	0.04	0.06	-0.06	-1.86	8.72	2.91	3.11	1.66	5.11
26	**Other non-metallic mineral products**	10.02	1.05	2.03	2.77	2.91	-2.56	-0.81	-0.86	0.48	-0.73	12.59	1.86	3.21	2.53	3.64
27	**Basic metals**	-3.45	0.14	-0.10	1.16	1.01	-6.04	-2.01	-2.16	0.63	-3.91	2.60	2.15	2.83	4.16	4.92

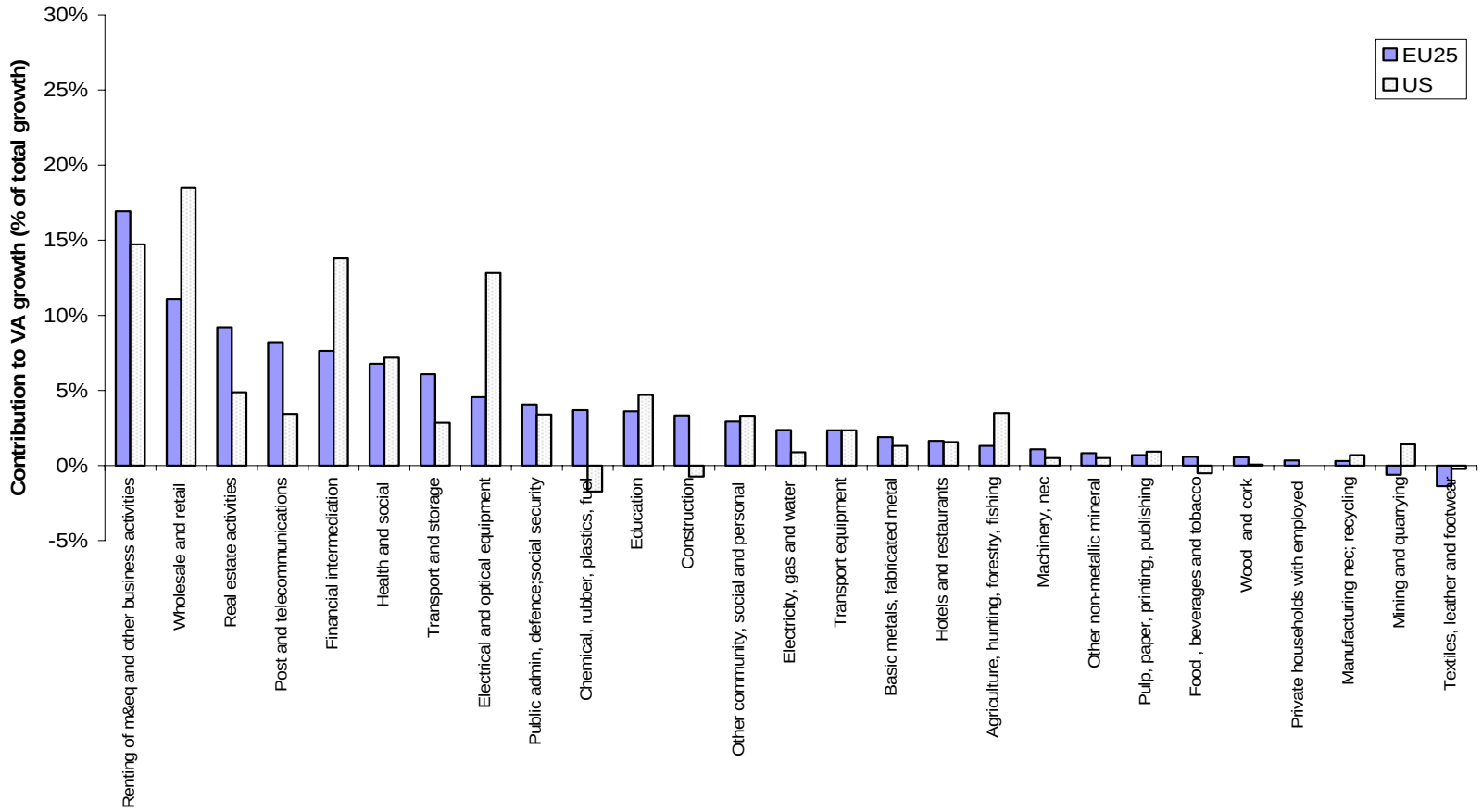
28	**Fabricated metals**	8.11	2.01	2.33	3.94	2.42	1.63	0.12	0.08	1.12	-1.43	6.47	1.89	1.96	0.96	3.84
29	**Machinery not elsewhere classified**	5.36	0.93	1.16	2.69	0.99	-4.25	-0.67	-0.72	0.13	-3.43	9.61	1.62	2.49	2.77	4.42
30	**Office, accounting, computing machinery**	33.31	5.66	6.83	-4.69	43.82	5.47	-3.14	-3.40	-2.87	-3.09	27.84	8.80	8.97	1.14	46.91
31	**Electrical machinery and apparatus**	13.27	0.73	1.61	6.61	9.67	2.02	-1.58	-1.58	-0.78	-3.24	11.24	2.31	2.45	4.36	12.91
32	**Radio, TV and communications equipment**	15.18	9.19	9.59	12.93	12.84	2.87	-1.65	-1.70	1.03	-2.91	12.31	10.85	10.36	n.a.	15.75
321	**Electronic valves and tubes**	13.87	13.86	13.89	n.a.	23.87	3.16	0.28	0.23	0.21	-2.27	10.71	13.58	12.99	n.a.	26.09
322	**Telecommunications equipment**	12.59	9.00	9.14	n.a.	1.63	-0.03	-1.5	-1.37	-5.30	-3.49	12.62	10.5	10.46	n.a.	5.12
323	**Radio and television receivers**	18.71	1.96	3.82	n.a.	-11.99	4.7	-5.05	-5.41	-7.95	-4.64	14.01	7.02	6.24	n.a.	-7.35
33	**Medical, precision and optical instruments**	5.98	4.59	4.64	7.58	1.80	-0.21	0.03	-0.12	2.56	-1.42	6.19	4.56	4.64	4.27	3.22
34	**Motor vehicles, trailers and semi-trailers**	15.35	2.82	3.34	5.15	5.61	2.54	0.43	0.41	0.72	-1.43	12.81	2.38	2.63	6.70	7.04
35	**Other transport equipment**	0.00	1.78	1.69	-0.08	1.94	-5.55	-0.79	-0.77	-1.99	-1.55	5.55	2.57	3.4	1.73	3.49
36 to 37	**Manufacturing n.e.c.; recycling**	6.04	0.44	0.77	2.01	3.3	1.14	-0.67	-0.73	-1.63	-1.31	4.91	1.11	1.07	2.67	4.61
E	**Electricity, gas and water supply**	0.7	2.51	2.31	0.55	1.3	-2.61	-2.31	-2.55	-0.17	-1.6	3.31	4.82	4.72	1.57	2.90
F	**Construction**	0.96	1.25	1.22	5.88	-0.42	-0.89	1.1	0.87	3.46	2.67	1.85	0.15	0.41	1.39	-3.09
G	**Wholesale and retail trade**	4.91	2.25	2.49	4.00	5.15	0.31	0.70	0.66	1.10	0.23	4.60	1.55	1.86	3.26	4.91
50	**Sale, repair of motor vehicles; retail fuel**	4.18	2.00	2.18	5.93	7.09	3.48	1.13	1.06	1.28	0.84	0.71	0.87	0.77	4.02	6.25
51	**Wholesale and commission trade, exc.50**	6.54	2.94	3.25	2.74	4.52	-0.02	0.70	0.68	0.87	-20.00	6.56	2.24	2.67	3.01	4.71
52	**Retail trade, exc.50; repair**	3.89	1.74	1.96	4.78	5.42	-0.12	0.57	0.53	1.16	0.33	4.01	1.17	1.51	3.07	5.09

H	**Hotels and restaurants**	1.00	1.78	1.74	5.66	2.19	1.12	1.97	1.98	1.56	0.95	-0.12	-0.19	-0.14	2.60	1.24
I	**Transport and communications**	3.23	4.66	4.55	5.56	3.65	-1.12	0.73	0.71	0.89	0.71	4.35	3.94	4.15	4.82	2.94
60	**Inland transport**	3.71	2.32	2.50	3.86	2.94	-1.38	0.12	0.07	0.78	1.09	5.09	2.19	2.7	1.32	1.85
61	**Water transport**	-7.14	9.55	8.80	13.84	-2.81	-6.52	-1.18	-1.42	0.06	1.37	-0.62	10.72	10.68	12.55	-4.18
62	**Air transport**	1.43	1.33	1.34	2.75	4.55	0.45	0.65	0.79	-0.35	-0.52	0.98	0.68	0.71	2.38	5.08
63	**Auxiliary transport; travel agencies**	0.07	3.15	2.86	5.14	4.92	2.00	3.21	3.36	1.43	1.01	-1.93	-0.06	-0.23	1.85	3.91
64	**Post and telecommunications**	8.39	8.17	8.17	4.90	4.44	-1.89	-0.39	-0.55	1.06	0.61	10.27	8.56	8.82	8.06	3.83
J	**Financial intermediation**	7.85	2.95	3.28	5.93	6.16	0.40	0.28	0.16	1.65	1.24	7.45	2.67	2.99	3.27	4.92
65	**Financial intermediation, exc. 66**	8.02	4.05	4.33	4.04	7.55	-0.06	0.09	-0.03	1.29	1.70	8.08	3.96	4.26	3.82	5.86
66	**Insurance and pension funds, exc. L**	7.49	-2.86	-2.22	7.63	1.66	-2.31	-0.4	-0.57	1.48	0.57	9.80	-2.46	-1.59	1.52	1.09
67	**Activities related to financial intermediation**	6.98	5.17	5.26	12.54	n.a.	8.72	1.37	1.25	3.56	n.a.	-1.74	3.81	3.49	4.42	n.a.
K	**Real estate, renting and business services**	1.96	2.94	2.86	4.13	3.36	4.28	4.08	4.05	4.45	2.67	-2.32	-1.15	-1.25	-1.31	0.69
70	**Real estate activities**	0.72	1.99	1.86	1.88	2.17	1.65	2.01	2.12	0.28	1.75	-0.93	-0.02	-0.09	-0.12	0.42
71	**Renting of machinery and equipment**	3.52	4.88	4.85	5.25	1.49	0.79	3.21	3.21	2.93	0.65	2.73	1.67	1.80	3.38	0.84
72	**Computer and related activities**	11.2	7.89	8.02	11.15	5.26	6.96	6.7	6.63	8.81	6.26	4.24	1.19	1.3	1.75	-1.00
73	**Research and development**	-4.17	1.33	0.79	9.86	6.3	-1.98	1.6	1.12	7.07	2.07	-2.2	-0.27	-0.18	0.77	4.23
74	**Other business activities**	5.02	3.17	3.28	6.15	4.22	5.42	4.06	4.03	4.26	2.46	-0.39	-0.89	-0.89	-0.72	1.75

Note: EU-4* comprises of Finland Greece, Ireland and Sweden, the best productivity performers of the 'Old' EU in the period 1995 to 2004.

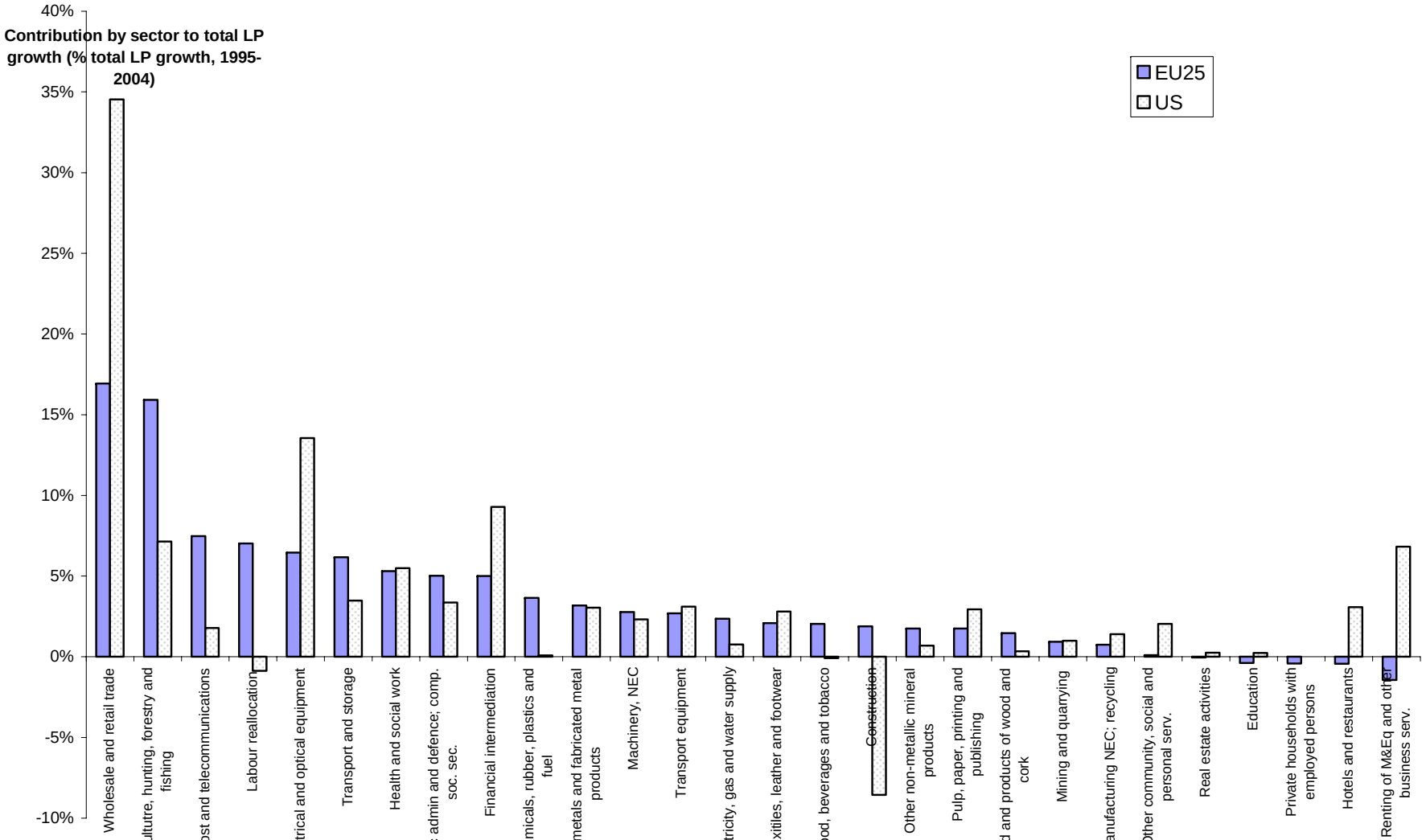
Source: EU KLEMS; NIESR calculation.

Graph 4.1: Contributions by sector to value added growth in the EU-25 and US, 1995 - 2004.



Source: EU KLEMS; NIESR calculations.

Graph 4.2: Contributions by sector to labour productivity growth in the EU-25 and US, 1995 - 2004.


Contribution by sector to total LP growth (% total LP growth, 1995-2004)
EU25
US
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
Wholesale and retail trade
Agriculture, hunting, forestry and fishing
Post and telecommunications
Labour reallocation
Electrical and optical equipment
Transport and storage
Health and social work
Public admin and defence; comp. soc. sec.
Financial intermediation
Chemicals, rubber, plastics and fuel
Basic metals and fabricated metal products
Machinery, NEC
Transport equipment
Electricity, gas and water supply
Textiles, leather and footwear
Food, beverages and tobacco
Construction
Other non-metallic mineral products
Pulp, paper, printing and publishing
Wood and products of wood and cork
Mining and quarrying
Manufacturing NEC; recycling
Other community, social and personal serv.
Real estate activities
Education
Private households with employed persons
Hotels and restaurants
Renting of M&Eq and other business serv.

Source: EU KLEMS; NIESR calculation.

Table 4.2 summarises the main components of the growth accounting decomposition for the period 1995-2004 by sectors for the aggregate of ten 'old' EU countries (with corresponding available data) and the US. The sectoral detail reveals a broad variation between industries. In general TFP represents a large part of the growth in some high technology sectors, such as electrical machinery and post and telecommunications but also in other declining industries such as traditional manufacturing and agriculture and mining. An interesting case is the textiles, leather and footwear sectors in the US, which show negative value added growth but an important positive contribution from TFP growth. In all sectors except some other production industries such as agriculture, electricity, gas & water, transport and storage and post and communications, the relative contribution of TFP is considerably higher in the US than in the EU. The sectors in which the differences are highest are wholesale and retail and financial intermediation. However, the difference between the relative contribution of TFP in the high-technology sector electrical and optical equipment is minimal between the EU and the US, where the value added growth is much higher.

Finally, Graph 4.3 depicts the growth of value added, labour- and Total Factor Productivity for selected broad sectors since 1995. Again, the graphs illustrate the substantial heterogeneity between industries. As mentioned before, the US shows the strongest lead in total manufacturing, wholesale and retail trade and financial intermediation. In the business services the US leads in terms of productivity performance, but the growth of value added is similar between the two areas. Conversely, the EU outperforms the US in the network industries of electricity, gas and water as well as transport and telecommunications. In most of the sectors, TFP appears to be a decisive and consistent source of labour productivity growth. One striking observation, however, is the minor role that TFP growth plays in the growth of financial intermediation and business services, both thought to use technology intensively. If measured correctly by national accounts[71], the data imply that the growth of output hardly matches the increased use of labour and capital inputs in these sectors. This suggests deficits in the adoption of new technologies, which depends on complementary investments (e.g., in labour skills, organisational innovation, or new products) before becoming effective through cost reductions or increased customer value.

In short, the comparison with the US demonstrates that the EU productivity slowdown is not due to exogenous forces, such as global business cycles, or a generally decelerated growth in high-income countries, but is instead due to a specific and current European experience.

Table 4.2: Growth decomposition, average p.a., 1995 - 2004

		EU*			US		
		VA	**K, L**	**MFP**	**VA**	**K, L**	**MFP**
		in %	**in percentage points**		**in%**	**in percentage points**	
TOT	**TOTAL INDUSTRIES**	**2.02**	**1.9**	**0.1**	**3.19**	**2.0**	**1.1**
A to B	**Agriculture, forestry, fishing**	1.57	-1.0	2.6	5.44	0.6	4.8

[71] One notable source of measurement problems are changes in the quality of output. If adjustments for quality improvements are too cautious, growth of output at constant prices will be underestimated.

C	**Mining and quarrying**	-1.80	-1.1	-0.7	4.14	0.7	3.4
D	**Total Manufacturing**	1.26	0.4	0.9	2.71	-0.2	2.9
15 to 16	**Food, beverages and tobacco**	0.30	0.6	-0.3	-0.96	0.4	-1.3
17 to 19	**Textiles, leather and footwear**	-2.81	-2.6	-0.3	-1.46	-6.1	4.6
20	**Wood, products of wood**	1.73	-0.1	1.8	0.16	-0.2	0.3
21 to 22	**Pulp, paper, print, publishing**	0.50	0.5	0.0	1.24	-0.8	2.1
23 to 25	**Chemical, rubber, plastics, fuel**	1.91	0.5	1.5	-1.86	0.3	-2.2
23	**Coke, ref. petrol., nuclear fuel**	-2.81	-0.4	-2.4	-40.24	-1.2	-39.1
24	**Chemicals, chemical products**	2.05	0.1	1.9	2.35	0.6	1.7
25	**Rubber and plastics**	2.96	1.3	1.6	3.25	0.1	3.2
26	**Other non-metallic min. prod.**	0.93	0.3	0.6	2.91	1.0	1.9
27 to 28	**Basic, fabricated metal prod.**	1.39	0.7	0.7	2.03	-0.7	2.7
29	**Machinery, NEC**	0.86	0.3	0.5	0.99	-1.2	2.1
30 to 33	**Electrical, optical equipment**	3.73	0.3	3.4	11.95	0.8	11.2
34 to 35	**Transport equipment**	2.36	1.4	1.0	3.71	0.0	3.7
36 to 37	**Misc. manufacturing, Recycling**	0.40	0.3	0.1	3.30	0.1	3.2
E	**Electricity, gas, water supply**	2.63	0.2	2.4	1.30	0.8	0.5
F	**Construction**	0.98	1.6	-0.6	-0.42	3.3	-3.7
G	**Wholesale and retail trade**	2.12	1.7	0.5	5.15	1.9	3.2
50	**Sale, repair motor vehicles; fuel**	1.70	2.2	-0.5	7.09	2.0	5.1
51	**Wholesale trade, except 50**	2.96	1.8	1.1	4.52	2.3	2.2
52	**Retail trade, except 50**	1.55	1.3	0.3	5.42	1.3	4.1

H	**Hotels and restaurants**	1.65	2.8	-1.1	2.19	2.1	0.1
I	**Transport and communications**	4.58	2.3	2.3	3.65	2.7	0.9
60 to 63	**Transport and storage**	2.81	2.4	0.4	3.04	1.7	1.3
64	**Post and telecommunications**	8.21	2.2	6.0	4.44	4.1	0.4
J to K	**Finance, real estate, business activities**	2.71	3.7	-1.0	4.14	3.6	0.5
J	**Financial intermediation**	2.59	1.8	0.8	6.16	2.7	3.5
K	**Real estate, renting, business activities**	2.73	4.2	-1.5	3.36	4.0	-0.6
70	**Real estate activities**	2.04	2.8	-0.7	2.17	2.7	-0.6
71 to 74	**Renting m&eq; other business activities**	3.51	5.8	-2.3	4.12	4.8	-0.7

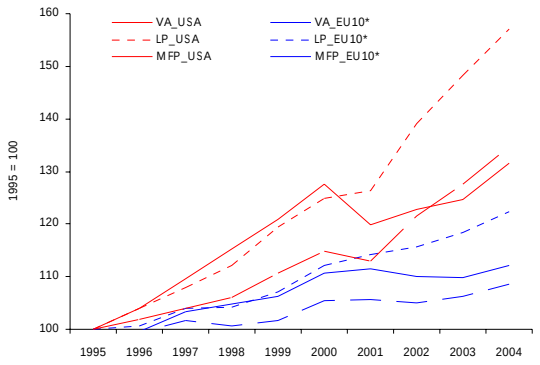
Note: * comprises all of the EU-15 countries, except Greece, Ireland, Luxembourg, Portugal and Sweden.

VA = value added growth, L = contribution of labour input growth, K=contribution of capital input growth, MFP= Contribution of multifactor productivity growth

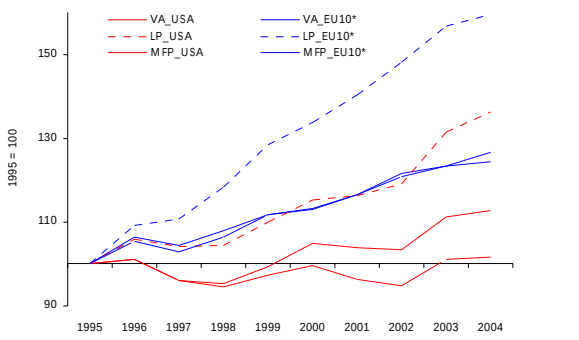
Source: EU KLEMS, NIESR calculations.

Graph 4.3: Growth of value added, labour productivity and TFP: EU* vs. US

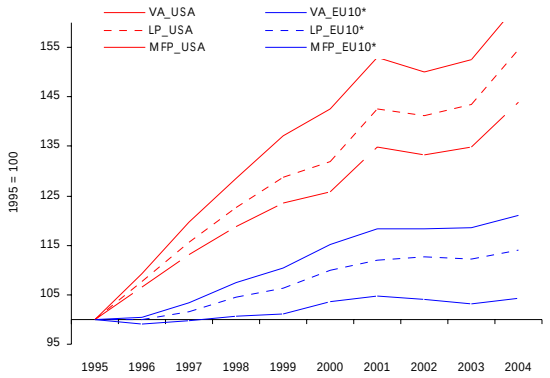
(a) Manufacturing



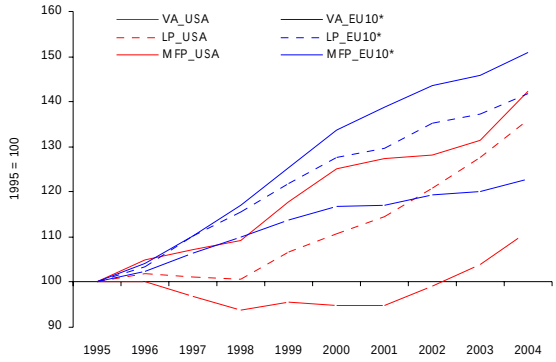
(b) Electricity, gas and water supply



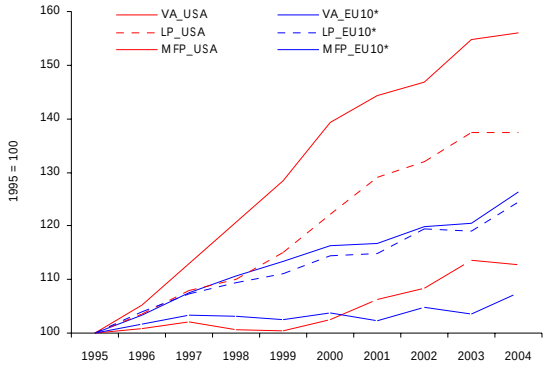
(c) Wholesale and retail trade



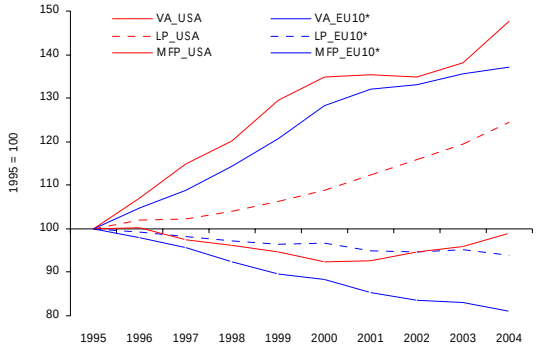
(d) Transport and communications



(e) Financial intermediation



(f) Business services (excl. real estate)



Source: EU KLEMS, WIFO calculations.

Note: * comprises all of the EU-15 countries, except Greece, Ireland, Luxembourg, Portugal and Sweden. VA = value added; LP = labour productivity; TFP = Total Factor Productivity.

4.3. Foreign trade

The aggregate trends in international trade are characterised by the fast growth of the world markets and rising competition from emerging economies, such as China, Mexico or India. Given these general tendencies, the European Union's trade performance is rather favourable when compared to that of the US, although the latter's faster growing domestic demand may absorb a greater part of its production and thereby explain its lessened profile on the export markets.

Taken together, in the year 2005 the European Union, the United States and Japan account for 48% of the world export market for *manufacturing* goods (see Annex Table 4.1)[72]. Taken separately, the EU-27 has the largest share (22%), followed by the United States (15%) and Japan (11%). Similarly, manufacturing export increases in the EU-27 are higher than those of the United States and Japan. The NMS12 in particular have recorded high export growth. As far as import growth is concerned, similar results have been reported by the EU-27 and the United States, while Japan has shown lower import growth due to sluggish domestic demand. While global market shares were generally redistributed in favour of the emerging economies, the EU-27 was relatively successful in maintaining its position. In absolute terms and relative to the year 1996, the EU-27 lost only 1.3 percentage points, the United States 3.9 and Japan 3.2. In relative terms, after 1996 the EU-27 lost fewer than 6% of its export shares, the United States more than 20% and Japan 23%.

Graph 4.4 presents the market shares for manufacturing industries in the EU-27, the NMS12 and the US on a disaggregated level[73]. Industries with a lower than average market share in 2005 are characterised as 'weak' and those above average as 'strong'; industries gaining or losing market shares since the year 2000 are depicted as either 'improving' or 'declining'. The main results[74] can be summarised as follows:

– In the EU-27, the pharmaceutical industry enjoys an outstanding strong position in international trade, followed at some distance by air and spacecraft, machinery, the broad sector of chemicals, and publishing and printing. As each of them was able to increase its market shares, albeit at relatively modest degrees, neither of them appears in danger of losing ground due to growing global competition in the short term. Most industries enjoying the highest growth of market shares are relatively close to the aggregate level of export shares. In particular, motor vehicles, pulp and paper, wood products and tobacco have substantially improved their market shares. Conversely, we find the weakest and further deteriorating performance in the manufacture of electronic components and audiovisual apparatus, as well as office machinery and computing.

– In the NMS12 all industries (except tobacco, electronic components) have increased their export market shares, with the greatest improvements taking place in communications

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72 The market shares are defined as the share in total exports of EU-27 (excluding intra-EU trade) plus Croatia, Macedonia, Turkey, Switzerland, Norway, Iceland, the United States, Australia, Canada, New Zealand, Japan, Mexico, South Korea, China, India, Israel, Brazil, Argentina, Chile, Hong Kong, Singapore, Malaysia, Thailand, the Philippines and Indonesia.

73 The results for the EU-15 are not displayed separately because the gains and losses in market shares have been very similar to those of the EU-27 (the only exception is transportation equipment and communication equipment, which both lost market shares in the EU-15 while gaining in the EU-27).

74 These results, taken in isolation, are prone to over-interpretation, i.e. losses of export market share could lead to the conclusion of a competitiveness decline where other factors (such as higher growth or domestic demand) might be in play.

equipment, isolated wire and cable, motor vehicles and publishing and printing. In terms of the actual market shares, the strongest positions are in ships and boats, the manufacture of wood, and that of non-metallic mineral products.

– In sharp contrast to the European Union, the US lost market shares in all of its manufacturing industries (except for refined petroleum and the manufacture of ships and boats). It enjoys its highest market shares in aircraft and spacecraft, which it has also been able to maintain. Other persisting strongholds are the publishing business and the paper industry. In contrast, the strong productivity performance of the US computer industry is not apparent from the trade data, where market shares are slightly below average and rapidly decreasing. The same applies to US producers of communication equipment. One possible explanation is the stronger domestic demand for information and communication technologies (ICT) in the US, absorbing a larger fraction of its ICT production.

– The trade data for manufactured goods provide more sectoral detail on a consistent basis than any other indicator in this chapter. Hence, they are especially useful for tracing the scope and direction of structural change and examining whether the European Union is falling behind or moving up the 'quality ladder' (in the sense of upgrading its industrial structure towards activities with a higher content of technology or skills and less exposure to pure cost competition).

– For that purpose, we apply three sectoral taxonomies to organise the numbers on the revealed comparative advantage (RCA) indicator. The taxonomies are based on data for 3-digit product groups (see Box 4.2 and Annex Table 4.2) and aim for essential characteristics of the respective competitive regimes. Taxonomy I focuses on the distinction between tangible and location-bound versus intangible and firm-specific factors of production, distinguishing labour and capital intensive sectors from marketing and technology driven industries while at the same time isolating a group of traditional industries with an average profile of factor inputs ('mainstream'). Taxonomy II is directed at the dimension of human resources and distinguishes industries according to educational intensity ('high skill' versus 'low skill') and occupation ('blue collar' versus 'white collar'). Finally, taxonomy III separates industries according to an indicator of 'revealed quality elasticity', which captures the response in trade volumes to changing trade prices (unit values)[75].

Box 4.2 – Industry taxonomies

We further condition the chosen trade indicators using three different taxonomies based on the 3-digit NACE classification of manufacturing industries. The taxonomies were specifically intended to facilitate inquiries into industrial performance with respect to the intangible sources of competitive advantage. Table 4.2 in the Annex provides a complete list of industries and their respective identification within the three taxonomies.

Taxonomy I focuses on the distinction between tangible and largely location-bound versus intangible and firm-specific factors of production. Statistical clustering is applied, using US sector and firm level data for wages and salaries, investments in physical capital, advertising outlays and R&D expenditures. These are assumed to span four independent dimensions of inputs for revenue generation. The classification identifies five types of industries that are

[75] See Peneder (2001) for a detailed documentation of taxonomies I and II; and Aiginger (2000) for taxonomy III.

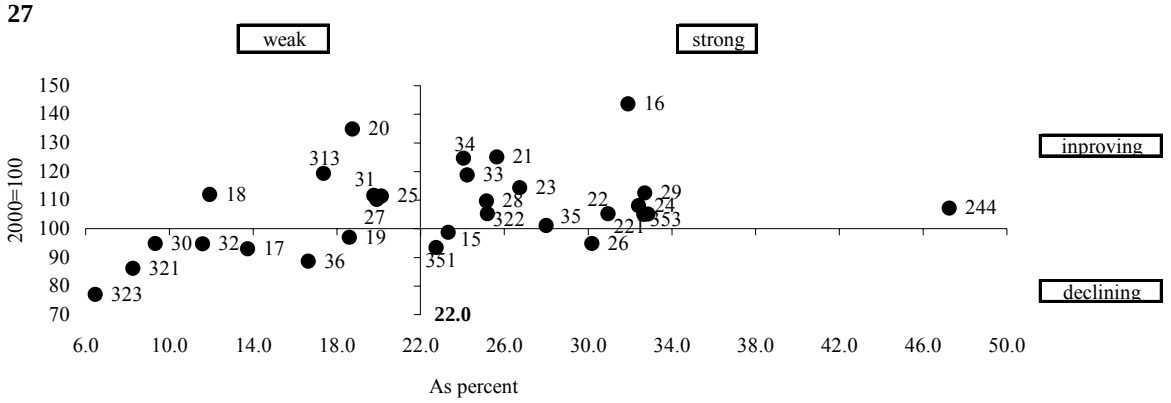
either particularly "labour intensive", "capital intensive", "marketing driven", "technology driven", or characterised by no pronounced deviation from the overall mean of factor input combinations ("mainstream manufacturing"). Peneder (2001) provides further details on the creation and validation of the taxonomy.

Taxonomy II is directed at the dimension of human resources and based on occupational data, that distinguish between two types of white collar and blue collar workers, as well as the shares of high and low skilled labour for each of these two types. The data originate from the OECD and cover employment shares for a sample of developed economies. The taxonomy is based on statistical clustering and classifies industries into "high skill", "medium skill white collar", "medium skill blue collar", or "low skill" industries. This taxonomy is also documented in Peneder (2001).

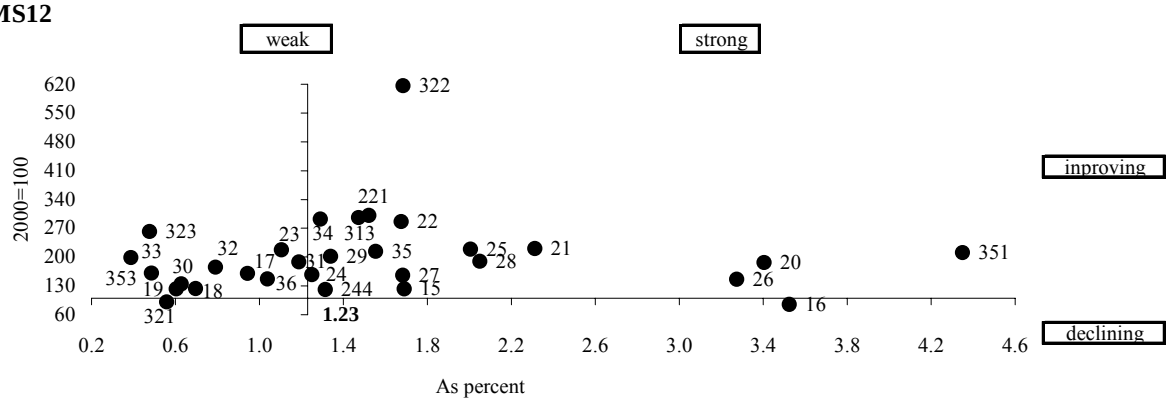
Taxonomy III separates the 3-digit NACE manufacturing industries into three classes, based on their revealed quality elasticity. For the calculation of the revealed quality elasticity, the industries of individual countries are divided into four segments depending on whether they are dominated by price competition or quality competition, and whether the country is successful in the prevailing type of competition. "Price competition industries" are defined as industries where low relative costs lead to high exports, whereas in quality competition dominated industries a higher unit value of exports (reflecting higher quality) leads to a trade surplus, thus revealing that quality is defining the competitive edge. A ranking of the industries based on the number of bilateral trade flows where price competition prevailed resulted in this revealed quality elasticity taxonomy by Aiginger (2000).

Graph 4.4: EU export market shares (excl. intra-EU-27 trade), 2005

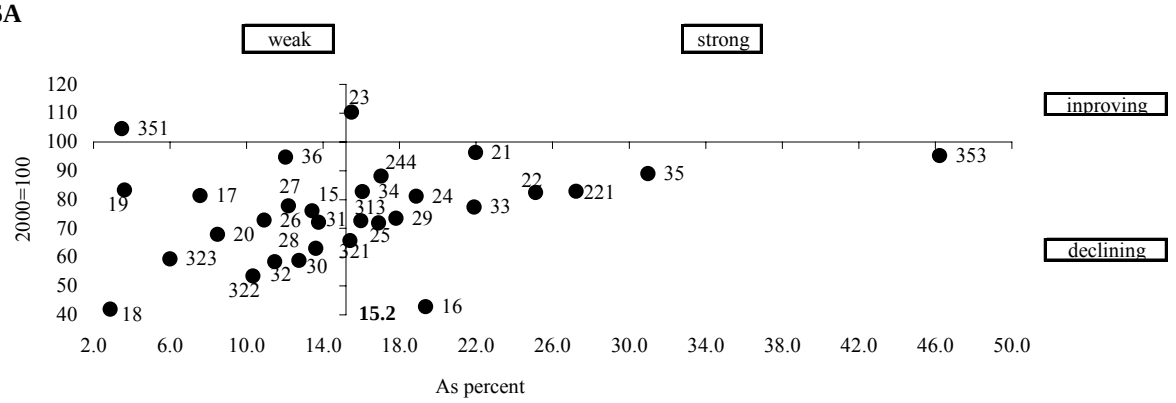
EU 27



NMS12



USA



15	Food, beverages	24	Chemicals	32	Radio, TV , communic.
16	Tobacco	244	Pharmaceuticals	321	Electr. valves and tubes, other electr. comp.
17	Textiles	25	Rubber, plastic	322	TV, radio transmitters, app. f. line teleph.
18	Clothing	26	Non-metallic min. prod.	323	TV, radio and recording apparatus
19	Leather, footwear	27	Basic metals	33	Scientific instruments
20	Wood, products, cork	28	Fabricated metal prod.	34	Motor vehicles
21	Pulp, paper	29	Machinery	35	Oth. transp. equipm.
22	Publishing, printing	30	Office machinery	351	Ships and boats
221	Publishing	31	Electrical mach.	353	Aircraft and spacecraft
23	Coke, refined petrol.	313	Isolated wire and cable	36	Furniture; manuf. n.e.c.

Note: The x-axis denotes export market shares for 2005 and the y-axis represents changes in export market shares between 2000 and 2005.

Source: UNO, EUROSTAT, WIFO calculations.

Table 4.3 summarises European and US trade performance for manufactured goods in terms of industrial specialisation by these taxonomies. In short, the EU-27 shows a comparative advantage in the groups of 'mainstream' manufacturing (which is comprised of traditional medium-tech industries such as the machinery sector or rubber and plastics), 'medium-skill/blue-collar' and 'high-skill' industries as well as those characterised by a 'high revealed quality elasticity'. In all other industry types the EU-27 is characterised by a comparative disadvantage. Remarkably, the European Union as a whole has not yet specialised in technology driven industries, even if individual countries (such as the UK, France, Denmark, Sweden, and Belgium) are already enjoying a comparative advantage in those. However, we find that specialisation in technology driven industries and those characterised by high-skills and a high revealed quality elasticity has increased in most of the EU-27[76], indicating a solid process of structural change which is moving the European economies further up the 'quality ladder' in international trade.

The NMS12 have a comparative advantage in all sectors of taxonomy I, except the technology driven industries. Similarly, they remain specialised in low-skill industries. However, the transition process is also accompanied by marked structural changes. The disadvantages in technology driven and high-skill industries and the comparative advantages in labour intensive and low-skill industries are decreasing, bringing the NMS12 closer to the patterns of industrial specialisation we observe in the old EU Member States.

The US patterns of specialisation show it to be the most advanced region on the 'quality ladder', with the strongest comparative advantages in high-skill, medium-skill/white-collar, capital intensive and technology driven industries as well as those characterised by a high and medium revealed quality elasticity. Accordingly, the negative specialisation in labour intensive and low-skill industries is nowhere as pronounced as in the US. Compared to the year 2000, the US improved its comparative advantages in the capital intensive, technology driven, medium skill and quality sensitive industries.

In conclusion, we see that, consistent with economic theory, industrial activity is shifting away from labour intensive and low-skill production to sectors characterised by innovation and product differentiation, which are thus largely technology driven and high skills intensive. In an influential report, Fontagné, Fouquin, Gaulier, Herzog and Zignano (2004) have stated that Europe has missed the 21st century technological boat. In a certain sense, the results presented here tell a different story. While it is true that historical evidence has shown unsatisfactory European performance in technology driven industries, we can observe that this trend is changing. Since 2000 the EU-27 has been increasing specialisation in technology driven industries, with several old Member States already enjoying a comparative advantage and the NMS12 having significantly improved their export structure in a relatively short time period. However, the total EU-27 does not yet have a comparative advantage in those sectors. It remains to be seen whether the observed structural changes are sufficient for 'catching the technological boat' and whether the European industries are 'moving-up', rather than "moving out" the international markets.

In addition to the observed structural changes between sectors, measures of intra-industry trade (IIT) provide an indication of quality upgrades within sectors. Recent analysis

[76] For example, with the exception of Bulgaria, the Czech Republic, Denmark, Estonia, Greece, Lithuania and the Netherlands (and hardly any change in Austria and Germany) all of them increased their RCAs in technology driven industries between 2000 and 2005.

performed on behalf of the Enterprise and Industry Directorate General reveals that the EU-27 share of vertical high quality IIT increased 13.7 percentage points between 1996 and 2005, while its share of vertical low quality IIT decreased 2.9 percentage points during the same period. Vertical high quality IIT was in 2005 the predominant type of intra-industry trade accounting for 58 percent of total intra-industry trade[77].

Table 4.3: Revealed comparative advantages (RCA) by taxonomies, 2005

	NMS12		EU-15		EU-27		US	
	RCA	RCA abs.	RCA	RCA abs.	RCA	RCA abs.	RCA	RCA abs.
	2005	change	2005	change	2005	change	2005	change
		2000/2005		2000/2005		2000/2005		2000/2005
Taxonomy 1								
Mainstream	0.292	-0.002	0.402	0.069	0.390	0.060	0.119	-0.093
Labour intensive	0.175	-0.355	-0.387	-0.175	-0.347	-0.167	-0.725	-0.058
Capital intensive	0.062	0.173	0.026	-0.027	0.028	-0.016	0.201	0.101
Marketing driven	0.161	-0.105	-0.179	-0.122	-0.156	-0.112	-0.271	-0.065
Technology driven	-0.357	0.077	-0.039	0.059	-0.055	0.053	0.117	0.040
Taxonomy 2								
Low skill industries	0.130	-0.145	-0.353	-0.112	-0.319	-0.102	-0.408	-0.063
Medium skill/blue c.w.	0.433	-0.061	0.213	-0.047	0.226	-0.044	-0.444	0.090
Medium skill/white c.w.	-0.279	0.036	-0.020	0.002	-0.040	-0.005	0.247	0.026
High skill industries	-0.142	0.068	0.176	0.110	0.167	0.107	0.378	0.000
Taxonomy 3								
High RQE	0.056	0.150	0.272	0.026	0.267	0.028	0.037	0.045
Medium RQE	-0.098	-0.075	-0.343	-0.063	-0.329	-0.058	0.042	-0.011
Low RQE	0.043	-0.097	-0.178	-0.060	-0.166	-0.057	-0.122	-0.061

Source: UNO, WIFO calculations.

NB: The RCA is defined as the logarithm of the export to import relation of one sector divided by the export to

[77] Vertical IIT measures intra industry trade with goods in different qualities, it can be divided further in high and low quality vertical IIT based on the export to import unit value relation.

import relation of all sectors. Positive RCA values indicate comparative advantages and negative values represent comparative disadvantages of a particular industry. Please note that this definition is different from the one given in the statistical Annex, which refers to RCA as measured by the normalised market shares.

In contrast to trade for manufactured goods, the relatively small but rapidly growing trade in services is only poorly documented. In the year 2005, services accounted for 30% of total exports in the EU-25. Within the Triad (excluding intra EU-15 trade), in the year 2004 more than 51% of all service exports originate from the EU-15, compared to 38% from the US and 11% from Japan (see Annex Table 4.1). The EU-15 more than doubled its export growth in services between 1996 and 2005, while its imports grew in a smaller proportion. As a result, over a nine year period the EU-15 almost quadrupled its services trade balance. In the same period the positive services trade balance of the United States diminished. In contrast to the positive trade balance of the EU-25 and the United States, Japan reported a services trade deficit of 30 bn € in 2003.

Table 4.4 summarises the available indicators on relative export shares in the Triad, measured as percent of total exports by the EU-25 (excluding intra-EU25 trade), Japan and the USA, and the revealed comparative advantages for broad sectors. With the exception of travel and personal services, the EU-25 has higher shares in the Triad's exports than the US in all the broad sectors. The differences are particularly pronounced in the sectors of construction and transportation as well as communications and computer services. With the exception of the travel, communication and personal services sectors, the EU has a positive revealed comparative advantage in all other sectors. In the US, the revealed comparative advantage is strongest in personal services, construction and computer services, but also positive in business services and travel.

Table 4.4: Trade in services sectors (excl. intra-EU-25 trade), 2004

	Export market share*		**RCA**	
	EU-25	**US**	**EU-25**	**US**
Construction	53.6	16.0	0.343	1.153
Business services	59.5	30.2	0.117	0.216
Travel	44.1	49.9	-0.332	0.140
Transportation	56.7	27.6	0.032	-0.486
Communication	60.8	35.7	-0.239	-0.238
Financial services	57.4	36.4	0.546	-0.231
Computer services	72.1	24.2	0.566	1.028
Personal services	46.9	52.6	-0.280	2.749

Note: * As% of total exports by EU-25, Japan and the US. Personal services include education, health and social work and recreational, cultural and sporting activities.

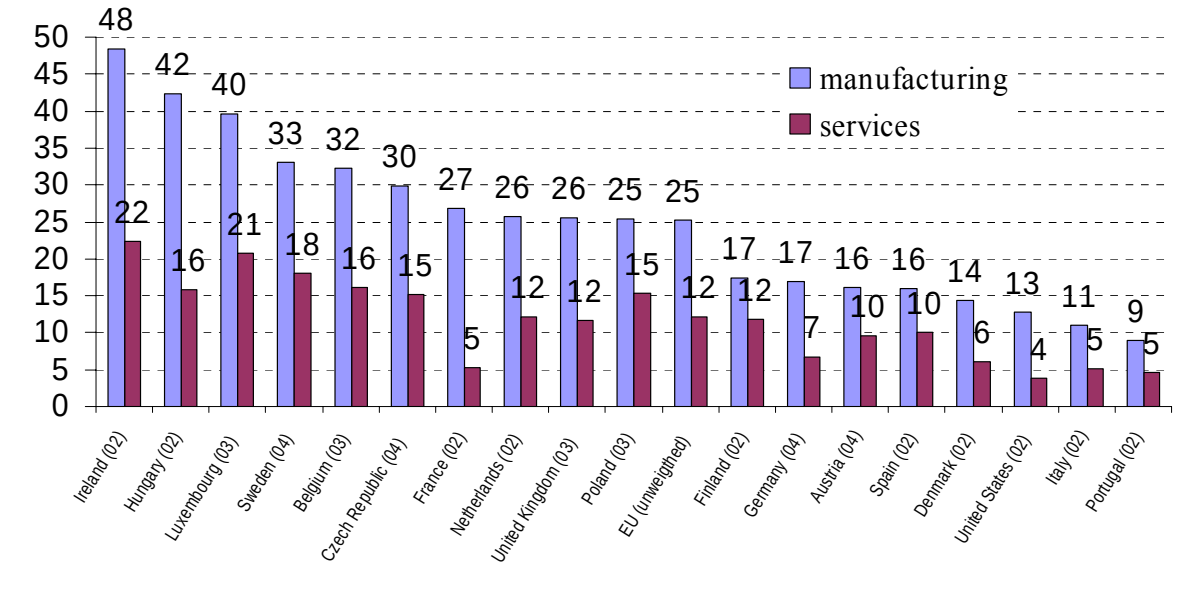
Source: Eurostat, WIFO calculations.

4.4. Foreign direct investment

Aside from international trade, the global integration of European industries has increased rapidly through increased foreign direct investments. This is confirmed by Graph 4.5, which exhibits the employment shares of affiliates under foreign control by country. In the manufacturing sector for all EU countries (with available data) the share of employment under foreign control is 25%. This compares to 13% in the United States. The service industries are generally less integrated in terms of foreign affiliate employment. Their share in total employment is 12% in the EU and 4% in the US. We also find wide differences between countries within the EU, where the employment share of foreign affiliates in the NMS is generally higher than that of the EU-15. Overall, the foreign affiliate data suggest that a significant proportion of domestic production is now accounted for by foreign owned firms.

Assessing their potential economic impact, inward FDI is generally thought to be beneficial for host countries in terms of generating positive effects for domestic growth[78]. In particular, they contribute to gross fixed capital formation, and thereby stimulate value added, employment, and the adoption of new technologies and business practices in the host market. Furthermore, the entry of foreign firms increases competition and forces domestic firms to use their resources more efficiently. Nearly all EU countries have thus established investment promotion agencies (IPA) in order to attract inward FDI. Most IPAs identify different 'target industries' with additional incentives.

Graph 4.5: Employment of affiliates under foreign control 2004 as a percentage of total employment



Note: Services do not include NACE 75-93.

Source: OECD, UNCTAD, German national bank, ITPS Sweden; WIFO calculations.

[78] See, e.g., Barrel and Holland (2000), Herrmann and Lipsey (2003), Lipsey and Sjöholm (2004).

Conversely, we find two contrary views on the potential impact of outward FDI. One view is that outgoing FDI reduces output, investment and employment at home. The other view is that FDI increases the level of domestic activity by making EU firms more competitive. In the latter case, outward FDI, whether for 'greenfield' investments or mergers & acquisitions, are perceived as an indication of corporate strength, signalling a company's ability to go after foreign markets and resources. In fact, both arguments can be valid, with the former likely to apply for direct effects in the short term, and the latter referring to indirect impacts that might only materialise in the longer run. What effect dominates will depend on the time scale of the assessment and on the initial motives for FDI, i.e. whether it is aimed at pure cost savings (offshoring of production), or at the opening of foreign markets and access to technology or a skilled workforce. As both effects are conflated in the available statistics, the empirical evidence tends to be ambiguous[79].

Despite the generally rapid increase of FDI, there remain large differences in the degree of internationalisation across industries. As the coverage of the New Member States by sectoral FDI statistics is still rather poor, Table 4.5 presents the main indicators on FDI stocks for the EU-15[80] and the US at the broad sector level. The major findings can be summarised as follows:

– For the total economy of the EU-15 the ratio of FDI stocks to value added in 2004 has been 18% for inward and 25% for outward FDI. Both ratios are steadily growing, but outward FDI is more dynamic. While the intensity of inward FDI is 11 percentage points above that of 1995, outward FDI intensity has even grown by 17 percentage points.

– Industries differ greatly in their degree of internationalisation measured as the FDI inward and outward stock. Financial services, mining and quarrying, chemicals and transport equipment have the highest stock of FDI as a percentage of value added in the EU-15. Financial services are characterised by a robust increase in both inward and outward activity, which indicate a positive impact of reduced regulatory barriers, decreased information and communication costs, the introduction of the Euro, and market-driven investments in the NMS, especially since the 2004 EU enlargement (Farouk, 2004).

– The ranking of industries from low to high FDI intensity tends to be very similar between the EU-15 and the US, even though the position of financial services is less exceptional in the latter. This indicates that sector specific factors may be more important than country specific factors in explaining outward FDI. With respect to the ratio of the inward FDI stock to value added, the US is ahead of the EU-15 in most manufacturing industries. However, the EU-15 have a higher inward FDI intensity in business services and financial service.

– With outward FDI stocks exceeding inward FDI stocks, the EU-15 is traditionally a net investor, which applies to all broad sectors except metal and mechanical products as well as real estate and business services. This net surplus is most pronounced in the food, trade, transport and communications sectors.

– The major part of direct investments takes place between EU-15 countries: 66% of the stock of inward FDI originates from the EU-15 member countries and 59% of the total

[79] See, e.g., Desai et al. (2005), or Pfaffermayr (2001).

[80] The data are for extra EU-15, i.e. not including FDI between the EU-15.

outward stock of the EU-15 is held in other EU-15 countries. From 1995-2005 intra EU-15 FDI stocks (not displayed in the table) also grew faster than Extra EU-15 stocks in all industries except transport equipment. This indicates that FDI has become a key element of the EU integration process.

– Again, the variation across industries is substantial. Food & beverages, textiles, and wood activities, transport equipment, and hotels & restaurants receive a larger than average share of inward FDI from non-EU-15 countries. Electricity, gas, and water; transport, storage & communication, and trade & repairs receive a low share of inward FDI from non-EU countries. With respect to outward FDI, food & beverages, petroleum, chemical, rubber, and plastic products, transport equipment, construction and energy, water and gas have a high share of extra-EU-15 FDI in per cent of the total outward EU-15 FDI stock.

– Finally, the Eurostat New Cronos FDI database provides additional information on inward and outward FDI stock by sector and destination (not displayed in the table). Activities in high-wage countries account for the bulk of the FDI outward stock of the EU-15. For instance, in manufacturing 88% of the FDI outward stock is held by other EU-15 countries or non-EU OECD countries. The New Member States account for only 4% of the outward FDI stock in manufacturing. This does not support the view that there is significant offshoring to low wage countries.

Table 4.5: Summary statistics on sectoral FDI stocks

	Ratio of FDI stocks to value added in%								**Ratio outward to inward FDI stocks**		**Share of Extra-EU-15 to total EU-15 FDI stocks in%**	
	Inward				**Outward**						**Inward**	
	EU-15		**US**		**EU-15**		**EU-15**		**US**		**EU-15**	
Total	18	+11	12	+4	25	+17	16	+6	1.4	1.3	34	41
Manufacturing	18	+7	30	+10	28	+11	25	+3	1.9	0.8	38	48
Food & beverages	19	+4	17	-4	29	-1	28	+6	4.0	1.6	43	52
Textiles and wood activities	15	+8	16	+6	13	+6	14	+6	1.5	0.9	44	26
Ref. petrol., chemical, plastics	39	+17	53	+2	57	+18	39	-6	1.5	0.7	36	52
Metal and mechanical products	8	+2	13	+6	13	+6	10	+4	0.8	0.7	33	46
Computers, R&TV, comm. equ.	9	-1	14	-5	13	+2	15	-19	1.5	1.1	31	49
Transport equipment	17	+8	31	+23	37	+27	24	-1	1.7	0.7	41	57
Electricity, gas and water	6	+3	16	+14	31	+27	6	+2	1.4	0.4	17	65

Construction	1	+1	1	+1	3	+2	1	+0	2.1	0.5	28	65
Total services	27	+20	13	+5	35	+27	22	+12	5.3	1.6	33	37
Trade and repairs	7	+0	15	+7	9	+4	11	+2	4.3	0.7	28	38
Hotels and restaurants	3	+1	7	+0	4	+1	7	+6	1.3	1.0	49	25
Transport and communication	5	+4	10	+6	20	+19	3	+0	4.3	0.3	16	29
Financial intermediation	144	+121	31	+8	192	+162	43	+15	1.3	1.4	36	41
Real estate, business activities	17	+11	3	-1	14	+9	27	+18	0.9	10.7	32	31
Total	18	+11	12	+4	25	+17	16	+6	1.4	1.3	34	41
Notes: Change is measured in percentage points. EU-15 is extra EU. Source: EUROSTAT (New Cronos), WIFO calculations.												

4.5. Mutual dependencies and the appropriate economic policies

– To establish a better understanding of the mechanisms that drive sectoral performance, this final section presents additional results which focus on mutual dependencies between the performance variables and the relative importance of differences between countries and sectors or the interaction of both[81]. For this purpose, in a first stage, the simple bivariate correlations among the chosen indicators are assessed and tested for their significance. These correlations provide an immediate indication of which variables tend to move together without any invocation of presumed causality. One remarkable set of observations from the bivariate analysis is a general catching-up tendency in labour productivity for the aggregate economy, not found at the sectoral level. In a second stage, are presented, in a summary fashion, results from a series of panel regressions that provide a deeper insight into the multivariate associations after controlling for fixed country and industry effects. These panel regressions offer an enriched understanding of the interdependencies between the variables. However, they are also more tentative in the sense that the results are sensitive to prior assumptions of causal relationships implied by the choice of variables for the estimations. Finally, an Analysis of Variance (ANOVA) is applied in order to decompose the total variation in the data panel into constant country and industry effects and the interaction between each pair of countries and industries. ANOVA is akin to fixed effects panel regressions and tells us whether the differences between countries, industries or their joint interactions predominantly affect the outcome in the performance variables. The source of variation can inform on which policies might be more appropriate for influencing the corresponding variables.

– Beginning with a brief examination of bivariate correlations among the performance variables (Annex Table 4.4), the first finding is an obvious and strong statistical association between the average growth of value added, employment, labour- and Total Factor Productivity (measured as value added per hour worked). This is not surprising, as the increase in value added can be mechanically decomposed into the contributions from

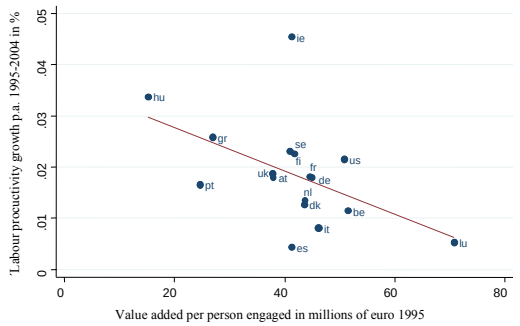
[81] As mentioned in the introduction, we study the actual determinants or 'drivers' of sectoral performance in more detail in the second part of the study.

labour inputs and labour productivity growth. Consequently, average growth of employment and labour productivity are positively related with value added growth, but negatively related among them. Similarly, we find a very high correlation between labour and Total Factor Productivity. More surprisingly, there are relatively few statistical associations among the other variables. Most notably, apart from the obvious relationships between the growth accounting variables, in the bivariate analysis TFP growth only relates significantly (and positively) to the change of inward FDI. This lack of direct statistical associations between the different indicators suggests that they span relatively independent dimensions of sectoral performance, which need explicit consideration in any comprehensive assessment.

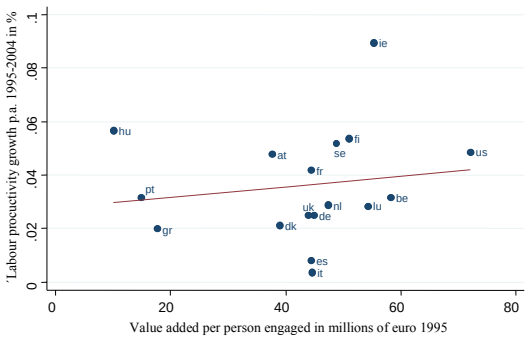
– The only exception is the initial level of labour productivity in 1995, for which there are significant coefficients with most of the other variables. In particular, the negative correlation with average growth of labour productivity indicates a tendency towards catching-up, implying that additional productivity growth becomes more difficult to achieve at higher levels. Graph 4.6 provides additional detail by separating the bivariate associations for the total economy and selected sectors. For the total economy, the first chart indeed shows a marked negative relationship between the initial level of productivity in 1995 and its average annual growth afterwards. The same catching-up tendency is observed, for instance, in the wholesale, retail trade and business services sectors. The implication is that countries at the top of their productivity performance find it difficult to defend their position in the longer run, as those countries lagging behind enjoy more opportunities to absorb productive knowledge and hence tend to more rapidly increase their labour productivity. This finding is of immediate relevance to economic policy. For countries lagging behind other nations in a sector, it demonstrates the particular need for the better diffusion of new technology and business practices and the need to ensure the openness of a country to foreign technology through the flow of goods, people and ideas (Guellec and Pottelsberghe de la Potterie, 2004). While this is also important for industrial leaders if they want to maintain their productivity advantage, a pronounced catching-up tendency will also raise their awareness of appropriability problems (Geroski, 1995). This may result, for instance, in the introduction of stricter intellectual property rights or attempts to speed up the innovation process, introducing new goods or practices at shorter intervals.

Graph 4.6: Catching-up versus dynamic specialisation

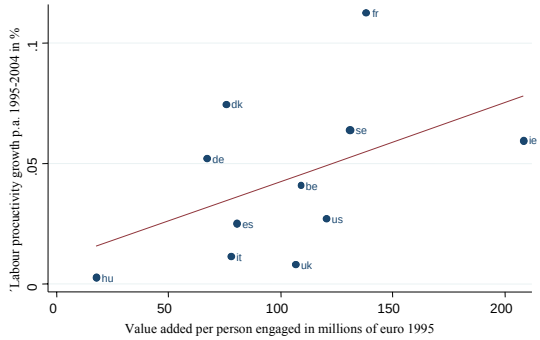
a) Total economy



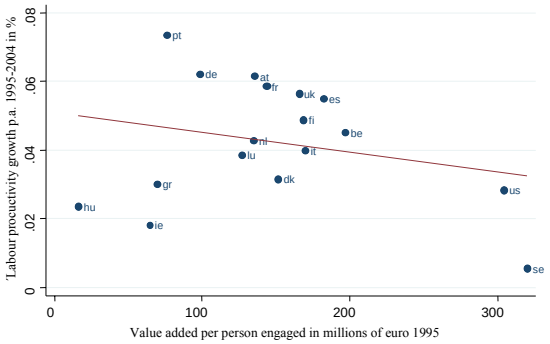
b) Total manufacturing



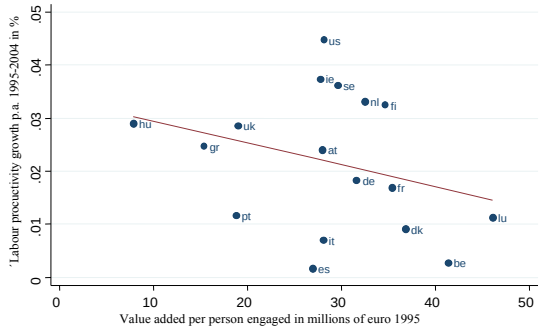
c) Pharmaceuticals



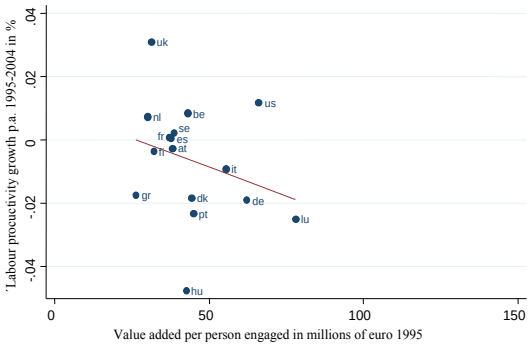
d) Electricity, gas and water



e) Wholesale and retail trade



f) Business services



Source: EU KLEMS, WIFO calculations.j

However, Graph 4.6 also reveals that convergence is not a universal force. It applies to some industries and not others. For example, in the broad sectors of total manufacturing or electricity, gas and water supply, we find no pronounced tendency, neither in favour of nor against catching up. Some industries even show a significant positive relationship between the initial level and subsequent growth of labour productivity. Graph 4.6 picks the example of the

pharmaceutical industry, where those countries with the highest labour productivity in 1995, e.g., France, Sweden or Ireland, also enjoyed the fastest productivity increases in the subsequent period. Again, the finding of a tendency towards 'dynamic specialisation' has an immediate bearing on economic policy. In general, it calls for measures to raise the capacity for own innovation in the respective technology field. However, countries that lag far behind are warned that attempts to catch up are costly and unlikely to succeed (unless they focus on very specific niches of yet uncharted opportunities). In keeping with the principle of comparative advantage, the general policy prescription will be to enable the free and competitive flow of goods and services and thus maintain consumer welfare.

To conclude, the data show that the relative importance of the dynamic forces of catching-up versus self-reinforced strengths depend on the technological nature of the industry. While catching-up is more frequently observed, we also find instances of dynamic specialisation, especially in high-tech industries with a strongly cumulative knowledge base.

The results of the multivariate analysis can be found in Annex Table 4.3.A which summarises the coefficients of selected panel regressions. For the standard growth-accounting variables (i.e. the growth of value added, employment, and productivity) the general relationships in the correlation table also determine most of the outcomes of the panel regressions. For example, any change in growth of employment or labour productivity affects value added growth by almost the same magnitude. Conversely, for both employment and labour productivity, own increases negatively affect the growth of the respective other variable, while a rise in Total Factor Productivity has a positive effect on both. This illustrates a fundamental trade-off in common policy choices. While activities directed at raising the growth of value added (e.g., public investments in infrastructure) have a positive impact on productivity and employment, other policies either focus more on generating employment (for instance, by lowering labour cost) or on increasing productivity (for instance, by means of structural reforms raising competition).

Structural reforms that take a long-term view tend to favour productivity increases, despite the likely negative effects on employment in the short-term (i.e. for a given rate of value added growth). Such policies are nevertheless based on the expectation of a positive relationship between the growth of employment and long-run labour productivity (i.e. when the growth of value added is not given). The small but positive relationship between the level of labour productivity in 1995 and the average growth of employment between 1995 and 2004 is consistent with this view. Further supportive evidence is provided by the positive coefficient on Total Factor Productivity in the estimation of employment growth. The bivariate correlation between the two variables was negative. However after separating the impact via increased labour productivity in the multivariate regression, Total Factor Productivity captures additional efficiency gains which appear to have a positive effect on employment growth. The consistent positive contribution of Total Factor Productivity growth has proved to be the most remarkable observation from the additional panel regressions on the other dimensions of sectoral performance, i.e. on the intensity of inward FDI, the change in RCA and the export market shares (Annex Table 4.3.B). This was not to be expected after an investigation of the correlation matrix, where none of the coefficients on the bivariate relationship with MFP growth is significant (Annex Table 4.4). From the multivariate regressions, however, Total Factor Productivity comes out as the most robust determinant with a positive influence on sectoral performance in each of the chosen dimensions. This would make Total Factor Productivity a central driver that could be identified among the various measures of performance.

Finally, the following paragraphs review the impact of differences between countries, industries, and the respective pairs of particular industries in a country on sectoral performance. Again, this bears relevance for economic policy, as, for example, large shares of explained variation from fixed country effects point at the relevance of differences in the macroeconomic business environment, which is the same for all industries in a country. Conversely, a higher explanatory power of fixed industry effects hints at the importance of different intrinsic characteristics of the sectors, which are hardly affected by economic policies (particularly at the national level). However, if certain industries exhibit desirable characteristics, such as a sustained tendency toward increased growth dynamics, fixed industry effects may still help define the targets of policies directed at enabling favourable structural changes. Finally, the importance of interaction effects from specific pairs of countries and industries (Annex Table 4.5) may indicate the need for a refined approach to competitiveness policy, where the simultaneous pursuit of horizontal activities directed at the general business environment, combined with an awareness of the particular needs of the individual industries, is the most promising approach.

At this point, one must of course emphasise that differences in sectoral performance need not primarily relate to economic policy but could be mainly caused by other factors. For instance, fixed country effects may be due to different endowments of natural resources, geographic location, etc. Similarly, interaction effects are largely driven by idiosyncratic events, such as individual bursts of technological breakthroughs and entrepreneurialism or dynamic spillovers due to increasing returns and other instances of self-organised processes (such as the formation of regional industrial clusters).

An analysis of variance (ANOVA, see Annex Table 4.5 for results and methodological notice) on the data found that, on average, the differences between countries explained fewer than 12% of the total variation in sectoral performance. Thus fixed country characteristics, such as general differences in the business environment (tax rates, labour market regulation, etc.) or macroeconomic conditions explain some of the performance of European industries, while leaving a much larger portion unexplained. The fixed country effects are most powerful in explaining the FDI intensities while are particularly small for employment growth. To avoid misinterpretation, however, one must emphasise that this finding does not mean that the general business environment or horizontal policy measures have little impact on performance as such. Nevertheless, it confirms that industries differ in their sensitivity to these factors and that much of their impact must be sought in the interaction term of particular country and industry pairs.

Employment growth is the variable with the highest share of explained variation by fixed industry effects. While on average these account for about 33% of total variation, in the case of employment growth the constant differences between industries explain more than 56%.

In all other cases, the joint interaction of country and industry effects is the most powerful factor. On average it explains more than 55% of the total variation. This is to be expected, as the interaction term adds one dummy for each industry and country pair. Indeed, it is surprising that the fixed country and industry effects do not leave more for the interaction term to explain. Its share is highest for the change in revealed comparative advantage and export market shares, and lowest for employment growth.

4.6. Conclusions

This chapter investigates European sectoral competitiveness, assessing the relative strengths and weaknesses of European industries with respect to the various dimensions of performance, such as the growth of value added, employment, labour and Total Factor Productivity, international trade, and foreign direct investments.

Overall, we find that the competitive performance of European industries is highly variable, both across countries and between sectors. This large heterogeneity accentuates the need for sectoral analysis of two different kinds. On the one hand, industrial policy requires detailed sector studies which investigate competitive performance and its determinants at the level of individual industries. Second, we need systematic analyses across sectors, as pursued here, in order to set the general frame of reference for a coherent understanding of individual developments.

More specifically, the empirical findings lead to the following conclusions:

– The general profile of European competitiveness differs greatly depending on which dimension of performance is observed. For the period since 1995, the EU exhibits low performance in terms of the growth of value added, labour and Total Factor Productivity, while appearing quite healthy in terms of sectoral profitability and trade performance. Foreign direct investments expand rapidly in each direction, with outward FDI growing stronger. Even though the current upswing of the European economies (which is not yet captured in the sectoral data) will improve the general outlook, the comparatively poor performance in the growth of labour and Total Factor Productivity is likely to become the major concern of European policies in coming years.

– Assessing the relative strengths and weaknesses by sector, the sectors of mining and among manufacturing industries the production of leather & footwear, clothing, textiles, nuclear fuel and tobacco show a persistent decline in value added and employment. Conversely, apart from water transport, all industries with the highest rates of value added growth in the European Union relate to the new information and communication technologies, i.e. communication equipment, office machinery and computers, as well as telecommunications and computer related services.

– Compared to the US, the biggest gap in sectoral performance can be found in the manufacturing of office machinery and computers, wholesale and retail trade, air transport, and the financial services. The latter three services sectors all appear to be rather sensitive to economies of scale and are likely to benefit from the larger integrated markets in the US. Conversely, the EU shows pockets of higher growth in selected areas of high-tech manufacturing, particularly pharmaceuticals, and the network industries, such as the sectors of electricity, gas and water supply, water transport, and telecommunications, which are apparently undergoing substantial restructuring processes.

– Addressing the dynamics of labour productivity growth, the data confirm a general catching-up tendency for the total economy, including many service sectors. This implies that countries with lower initial levels of labour productivity have since on average achieved higher growth, whereas countries initially ranking at the top of productivity performance found it more difficult to maintain high growth rates. However, a general tendency does not establish universal rules, as some technology driven manufacturing industries demonstrate. For instance, pharmaceuticals and the computer industry are

characterised by the opposite process of dynamic specialisation, where given competitive strengths not only persist but tend to be reinforced. Consequently, in these industries certain countries with an initially high level also enjoyed higher rates of labour productivity growth.

– An analysis of structural relationships among the different performance indicators highlights the trade-off between the growth of employment and labour productivity, which in the short run affects the choice of priorities among policies that are primarily directed at raising the labour intensity of growth, or those aiming to raise productivity growth. Overall, among the variables investigated, Total Factor Productivity growth appears to be the central driver of sectoral performance. It exerts a positive impact on the growth of value added and labour productivity, inward FDI, and gains in international comparative advantage.

– Decomposing the entire variation in average sectoral performance between countries and industries, an analysis of variance shows that a relatively small portion of about 12% is accounted for by fixed country effects. This is the share of performance, which results from differences in purely macro-economic conditions and the general business environment with equal impact on all industries. Conversely, fixed industry effects explain almost one third of the total variation in performance. These refer to intrinsic differences between industries and as such are not likely to respond to different policies. However, they point toward the importance of structural change and the policies that enable it (such as raising the power of labour and capital markets to reallocate resources).

– Finally, the majority of variation is explained by country-industry interaction effects, i.e. by the particular performance of country and industry. This is testimony to the heterogeneity in performance and variety of causative factors. It calls for an integrative policy approach, where horizontal and vertical perspectives are combined in order to adjust the business environment to the particular characteristics of the respective industries (e.g., in terms of regulation, innovation and education policies). This confirms the validity of the integrated approach to industrial policy put forward by the European Commission over these last years[82], based on a concrete work programme of horizontal and sectoral initiatives.

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[82] See European Commission Communications COM(2005)474 "Implementing the Community Lisbon Programme: A Policy Framework to Strengthening the Policy " of 5 October 2005 and COM(2007) 374, "Mid-term review of industrial policy: A contribution to the EU's Growth and Jobs Strategy" of 4 July 2007.

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Annex: Supplementary tables and figures

Annex Table 4.1: Summary indictors on aggregate trade performance

	Trade in goods (manuf. excl. intra-EU-27 trade), 2005				Trade in services (excl. intra-EU-15 trade), 2004			
	Coverage ratio		Export market* share		Coverage ratio		Export market* share	
		1996=100	*in%*	*1996=100*		*1996=100*	*in%*	*1996=100*
Austria	1.40	119.38	0.58	124.2	1.01	97.78	1.81	100.85
Belgium-Luxembourg	0.93	86.70	1.17	117.1	1.26	132.26	2.51	132.53
Bulgaria	0.68	45.92	0.05	70.9	-	-	-	-
Cyprus	0.28	68.17	0.01	27.6	-	-	-	-
Czech Republic	0.70	98.34	0.20	165.5	-	-	-	-
Denmark	1.56	104.88	0.48	100.5	1.18	-	2.16	-
Estonia	0.58	60.35	0.03	117.3	-	-	-	-
Finland	1.67	91.48	0.50	92.0	1.59	184.59	0.89	166.45
France	1.07	87.90	2.59	82.1	1.20	92.21	6.41	80.65
Germany	1.38	105.17	6.41	102.8	0.83	111.98	7.98	106.40
Greece	0.35	63.55	0.08	73.3	2.19	72.75	2.00	212.03
Hungary	0.80	83.03	0.22	223.0	-	-	-	-
Ireland	1.50	148.35	0.72	163.3	0.54	-	1.94	-
Italy	1.45	74.78	2.53	78.4	1.01	92.82	3.75	60.07
Latvia	0.87	60.92	0.02	106.5	-	-	-	-
Lithuania	1.21	85.45	0.06	120.8	-	-	-	-
Malta	1.20	118.94	0.02	87.6	-	-	-	-
Netherlands	0.66	81.26	1.26	95.7	1.26	108.10	4.16	109.80
Poland	0.79	99.76	0.35	175.1	-	-	-	-
Portugal	0.95	109.08	0.12	84.9	1.32	114.32	0.37	93.94
Romania	0.57	52.99	0.09	113.0	-	-	-	-
Slovak Rep.	0.47	61.01	0.07	197.7	-	-	-	-
Slovenia	1.78	147.80	0.11	138.3	-	-	-	-

Spain	0.67	66.69	0.87	98.3	0.99	85.10	2.32	120.61
Sweden	2.05	95.16	0.90	86.1	1.39	-	2.15	-
UK	0.86	95.39	2.52	72.9	1.56	109.93	13.25	133.68
Japan	1.60	105.46	10.52	76.8	-	-	10.75	88.73
US	0.60	75.88	15.19	79.3	1.20	76.16	37.54	88.57
EU-15	1.12	92.51	20.75	92.1	1.13	105.38	51.71	113.65
NMS-12	0.76	84.23	1.24	148.1	-	-	-	-
EU-27	1.09	91.22	21.98	94.14	-	-	-	-

Source: * Defined as share in total exports of EU-27 plus Croatia, Macedonia, Turkey, Switzerland, Norway, Iceland, the United States, Australia, Canada, New Zealand, Japan, Mexico, South Korea, China, India, Israel, Brazil, Argentina, Chile, Hong Kong, Singapore, Malaysia, Thailand, the Philippines and Indonesia, ** Defined as share in total exports of EU-15 plus US and Japan.

Source: UN COMTRADE, EUROSTAT, WIFO calculations.

Annex Table 4.2: List of 3-digit industries and the respective identification within the three taxonomies				
NACE 3-digit industries		**Taxonomy I***	**Taxonomy II***	**Taxonomy III****
		Factor inputs	**Skills**	**Quality**
151	**Meat products**	4	1	2
152	**Fish and fish products**	4	1	2
153	**Fruits and vegetables**	4	1	3
154	**Vegetable and animal oils and fats**	4	1	3
155	**Dairy products; ice cream**	4	1	1
156	**Grain mill products and starches**	4	1	2
157	**Prepared animal feeds**	4	1	2
158	**Other food products**	4	1	2
159	**Beverages**	4	1	1
160	**Tobacco products**	4	1	1
171	**Textile fibres**	3	1	2
172	**Textile weaving**	2	1	1
174	**Made-up textile articles**	2	1	3
175	**Other textiles**	1	1	2
176	**Knitted and crocheted fabrics**	1	1	1
177	**Knitted and crocheted articles**	1	1	2
181	**Leather clothes**	2	1	2
182	**Other wearing apparel and accessories**	2	1	1
183	**Dressing and dyeing of fur; articles of fur**	2	1	2
191	**Tanning and dressing of leather**	4	1	1
192	**Luggage, handbags, saddlery and harness**	4	1	1
193	**Footwear**	4	1	1
201	**Sawmilling, planing and impregnation of wood**	2	2	3
202	**Panels and boards of wood**	2	2	3
203	**Builders' carpentry and joinery**	2	2	2
204	**Wooden containers**	2	2	3
205	**Other products of wood; articles of cork, etc.**	2	2	3

211	**Pulp, paper and paperboard**	3	3	3
212	**Articles of paper and paperboard**	1	3	3
221	**Publishing**	4	3	3
222	**Printing**	4	3	2
23	**Refined petroleum and nuclear fuel**	3	3	2
241	**Basic chemicals**	3	3	3
242	**Pesticides, other agro-chemical products**	5	3	1
243	**Paints, coatings, printing ink**	1	3	1
244	**Pharmaceuticals**	5	4	1
245	**Detergents, cleaning and polishing, perfumes**	4	3	2
246	**Other chemical products**	5	3	1
247	**Man-made fibres**	3	3	2
251	**Rubber products**	1	1	3
252	**Plastic products**	1	1	2
261	**Glass and glass products**	1	1	3
262	**Ceramic goods**	2	1	2
263	**Ceramic tiles and flags**	3	1	2
264	**Bricks, tiles and construction products**	2	1	3
265	**Cement, lime and plaster**	3	1	3
266	**Articles of concret, plaster and cement**	1	1	3
267	**Cutting, shaping, finishing of stone**	2	1	3
268	**Other non-metallic mineral products**	1	1	3
271	**Basic iron and steel, ferro-alloys (ECSC)**	3	1	3
272	**Tubes**	1	1	3
273	**Other first processing of iron and steel**	3	1	2
274	**Basic precious and non-ferrous metals**	3	1	3
281	**Structural metal products**	2	2	2
282	**Tanks, reservoirs, central heating radiators, boilers**	4	2	1
283	**Steam generators**	2	2	3
286	**Cutlery, tools and general hardware**	4	2	2

287	**Other fabricated metal products**	1	2	3
291	**Machinery for production, use of mech. power**	1	4	2
292	**Other general purpose machinery**	1	4	1
293	**Agricultural and forestry machinery**	1	4	1
294	**Machine-tools**	2	4	1
295	**Other special purpose machinery**	1	4	1
296	**Weapons and ammunition**	1	4	3
297	**Domestic appliances n. e. c.**	1	3	3
300	**Office machinery and computers**	5	4	2
311	**Electric motors, generators and transformers**	1	3	3
312	**Electricity distribution and control apparatus**	5	3	1
313	**Isolated wire and cable**	1	3	3
314	**Accumulators, primary cells and primary batteries**	1	3	3
315	**Lighting equipment and electric lamps**	1	3	2
316	**Electrical equipment n. e. c.**	2	3	2
321	**Electronic valves and tubes, other electronic comp.**	5	3	2
322	**TV, and radio transmitters, app. for line telephony**	5	3	1
323	**TV, radio and recording apparatus**	5	3	3
331	**Medical equipment**	5	3	1
332	**Instr. for measuring, checking, testing, navigating**	5	3	1
334	**Optical instruments and photographic equipment**	5	3	1
335	**Watches and clocks**	4	3	1
341	**Motor vehicles**	5	2	1
342	**Bodies for motor vehicles, trailers**	2	2	1
343	**Parts and accessories for motor vehicles**	3	2	1
351	**Ships and boats**	2	2	2
352	**Railway locomotives and rolling stock**	2	2	1
353	**Aircraft and spacecraft**	5	4	1
354	**Motorcycles and bicycles**	1	2	3
355	**Other transport equipment n. e. c.**	1	2	2
361	**Furniture**	2	2	2
362	**Jewellery and related articles**	2	2	1
363	**Musical instruments**	4	2	2
364	**Sports goods**	4	2	2
365	**Games and toys**	4	2	1
366	**Miscellaneous manufacturing n. e. c.**	4	2	3

		1. Mainstream	1. Low skill industries	1. High RQE (revealed quality elasticity)
		2. Labour intensive industries	2. Medium skill/blue collar workers	2. Medium RQE (revealed quality elasticity)
		3. Capital intensive industries	3. Medium skill/white collar workers	3. Low RQE (revealed quality elasticity)
		4. Marketing driven industries	4. High skill industries	
		5. Technology driven industries		

Source: * Peneder, M., Entrepreneurial Competition and Industrial Location, Edward Elgar, Cheltenham, UK, 2001. - ** Aiginger, K., Europe's Position in Quality Competition, European Commission Enterprise Directorate General, 2000.

Annex Table 4.3.A: Fixed effects panel regressions on growth performance

Dependent variables / Independent variables	**Value added growth**	**Employment growth**	**Labour productivity growth**
Labour productivity 1995	-	0.00001	5.46e-06
Employment growth	0.97079***	-	-0.20651***
Labour productivity growth	0.98424***	-0.34171***	-
Total Factor Productivity growth	-	0.30727***	0.88036***
Fixed country effects	yes	yes	yes
Fixed industry effects	yes	yes	yes
No. of observations	*1,289*	*404*	*404*
R^2 (adjusted)	*0.992*	*0.727*	*0.878*

Note: Labour productivity is value added per hour worked; growth is measured as annual average rates from 1995 to 2004. Fixed effects control for constant differences between countries and industries.

Level of significance: *** 1%; ** 5%; * 10% level.

Source: EU KLEMS, WIFO calculations.

Annex Table 4.3.B: Fixed effects panel regressions on FDI and trade

Dependent variables / Independent variables	**Average inward FDI ratio**	**Growth RCA**	**Growth export market share**

Labour productivity 1995	-	0.00718*	0.03140***
RCA 1995	-	-0.28420***	-
Export market share 1995	-	-	-0.08166**
TFP growth	14.78684**	3.82420**	10.07829**
Fixed country effects	yes	yes	yes
Fixed industry effects	yes	yes	yes
No. of observations	*17*	*48*	*39*
R^2 (adjusted)	*0.934*	*0.226*	*0.537*

Note: labour productivity is value added per hour worked; growth is measured as annual average rates from 1995 to 2004.

Level of significance: *** 1%; ** 5%; * 10% level.

Source: BACH, EU KLEMS, EUROSTAT, OECD, UNO; WIFO calculations.

Annex Table 4.4: Bivariate correlations between performance variables

	lpi1995	agva	agemp	aglpi	agmfp	anpm	aroa	arca	drca	aexs	dexs	aifdir	difdir	aofdir
lpi1995	1.000													
agva	-0.010	1.000												
agemp	0.085 ***	0.498 ***	1.000											
aglpi	-0.067 **	0.715 ***	-0.231 ***	1.000										
agmfp	-0.105 **	0.659 ***	-0.228 ***	0.902 ***	1.000									
anpm	0.160 ***	0.058	-0.021	0.076	0.069	1.000								
aroa	**	-0.012	-0.103 *	0.092	-0.038	0.725 ***	1.000							
arca	0.182 ***	0.045	0.195 ***	-0.078	-0.024	0.246 ***	0.205 **	1.000						
drca	-0.039	0.109 **	0.194 ***	0.100 **	-0.015	0.076	0.078	-0.113 ***	1.000					
aexs	***	-0.039	0.006	-0.023	0.046	0.075	0.031	0.163 ***	-0.036	1.000				
dexs	***	0.185 ***	0.244 ***	0.121 **	-0.074	0.187 **	0.163 *	-0.076 **	0.597 ***	-0.105 ***	1.000			
aifdir	0.108	-0.020	-0.031	-0.010	0.081	0.311	0.220	-0.159	0.132	-0.349 *	0.059	1.000		
difdir	-0.020	-0.045	-0.002	-0.036	0.229 **	0.130	0.102	-0.052	0.136	-0.247	-0.037	0.670 ***	1.000	
aofdir	0.179 **	-0.071	-0.096	-0.008	0.136	0.687 ***	0.406 **	-0.067	0.060	-0.340 *	-0.134	0.698 ***	0.381 ***	1.000
dofdir	0.206 **	-0.046	-0.020	-0.018	0.122	0.516 ***	0.390 **	0.037	0.108	-0.169	-0.147	0.497 ***	0.344 ***	0.752

Note: lpi1995 = labour productivity in 1995; agva = average growth of labour productivity; agemp = average growth of employment; aglpi = average growth of labour productivity; agmfp = average growth of multifactor productivity; anpm = average net profit margin; aroa = average return on assets; arca = average revealed comparative advantage; drca = change of RCA value; aexs = average export share; dexs = change of export share; aifdir = average ratio of inward FDI to value added; difdir = change of ifdir; aofdir = average ratio of outward FDI to value added; dofdir = change of ofdir; depending on data availability all averages are for the years 1995 (1996) to 2004 (2005). The changes are measured as differences between the average of periods 2000 – 2004 (2005) and 1995 (1996) – 2000.

Source: BACH, EUROSTAT, EU KLEMS, OECD, UNO, WIFO calculations.

Annex Table 4.5: Summary Analysis of Variance (ANOVA)				
	Share of total variation in% explained by			
	Country effects	Industry effects	Country*Industry effects	No. of obs.
Labour productivity 2004	10.11	32.72	57.17	2035
Employment growth	5.95	56.61	37.44	1440
Value added growth	7.67	33.68	58.66	1295
Labour productivity growth	8.87	27.29	63.84	1294
MFP growth	11.62	27.95	60.43	436
Change of RCA	4.12	12.61	83.27	828
Change of export shares	11.73	8.06	80.21	714
Inward FDI	27.01	34.40	38.59	153
Change inward FDI	18.22	23.53	58.25	171
Outward FDI	14.57	40.71	44.72	160
Change of outward FDI	12.03	34.23	53.74	167
Mean of explained variance	*11.81*	*32.66*	*55.53*	

Note: In this exercise, ANOVA was performed after removing the time dimension, through calculation of mean values or by using the values for a particular year. Thus, the overall variance has been dramatically reduced when compared to the same analysis with all variables in the respective years appearing as independent observations. However, in the latter case all fixed time effects were entirely negligible and remained below 1%, leaving the major part of explanation to the noisy time dependent interaction effects.

Source: BACH, COMTRADE, EU KLEMS, Eurostat (New Cronos), WIFO calculations.

5. THE FUTURE OF MANUFACTURING IN EUROPE - A SURVEY OF THE LITERATURE AND A MODELLING APROACH

5.1. Introduction

The current wave of globalisation has led to a renewed discussion of how the manufacturing landscape, in terms of location, production, distribution of labour and physical appearance will manifest itself in the near and longer-term future. Will the world be an even 'flatter', 'spikier' or 'smaller' place by 2030? (Friedman, 2005; Florida, 2005; Leamer, 2006). And if so, what would this imply for manufacturing activity in Europe? What about future employment? Can Europe's future prosperity be ensured without a thriving manufacturing sector? What would a further retreat of manufacturing - a 'gravity centre' for R&D and innovation - from European soil mean for future innovation capacity?

While structural adjustment and relocation have been linked to manufacturing for decades, the character and speed of adjustment and its potential longer-term consequences appear to have recently taken on new dimensions recently. This review aims to highlight the most significant trends and issues for European manufacturing in the next 25 to 30 years[83]. It does so in the form of an extensive literature survey of existing foresight and futures studies. It includes the findings of a wide range of different studies, some of which are directly concerned with the future of manufacturing. Others only deal with particular issues such as (the impact of) climate change, future technologies, organisational innovation or new business models. The backbone of this literature survey is formed by three recent EU-wide foresight projects on the future of manufacturing in Europe FutMan, ManVis and Manufuture (see Annex Boxes 1 and 2 for a short background on the key futures and foresight studies).

Across the studies surveyed, a considerable degree of consensus appeared to exist on what the most important drivers are that shape the future of manufacturing. These include:

– *Increasing international competition* involving the emergence of new competitors and the further integration of global markets.

– *Increasing pace of technological change* leading to shorter product cycles forcing firms to continuously innovate but also enabling new organisational forms and processes.

– *Socio-demographic drivers* including the 'greying' of most of the industrialized world (except for the US) and some emerging economies (e.g. China, Russia), but also further growth of the emerging economies offering new market opportunities.

– *Environmental drivers* such as climate change, the depletion of natural resources and pollution caused by industrial activity impacting how and what will be manufactured in the future.

– Additionally, some – but not all – studies outlined the importance of the *regulatory environment* and the *values of the public* as important driving factors determining future developments.

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[83] A more detailed presentation of the literature review can be found in *Manufacturing futures for Europe – a survey of the literature*; F. Van der Zee and F. Brandes, TNO, 2007.

These drivers are quite broad and give rise to new challenges. Understanding future challenges is therefore as important as understanding the nature and background of the drivers to shed light on future development in manufacturing. This chapter will hence take the classification into five major categories of drivers as a point of departure. Section 2 discusses the key international developments expected to shape global manufacturing. Section 3 outlines new key (enabling) technologies as well as knowledge skills and competencies essential to the firm of the future. Section 4 presents emerging manufacturing paradigms that have received considerable attention with the advent of the knowledge society and Section 5 explores societal and consumer aspects likely to shape the future of manufacturing, as well as key environmental factors (Section 6). Section 7 uses a modelling and scenarios approach so as to obtain more differentiated outcomes at sector level and to explore the effect of policies. Section 8 concludes.

5.2. Globalisation and international competition

5.2.1. Introduction

The current wave of globalisation has led to renewed discussion of how the manufacturing landscape, in terms of location, production, distribution of labour and physical appearance will look like in the near and longer-term future. Are we witnessing a new industrial revolution? In most developed countries the potential loss of jobs associated with relocation of manufacturing and other production has become a major topic of both popular and academic debate (e.g. Blinder, 2005; Kirkegaard, 2005; OECD, 2005 and 2006). Calculations show that the number of jobs potentially affected by offshoring is substantial. According to recent OECD (2006) estimates, 18% of total employment in the US and 19% in the EU-15 *could* be affected (upper limit). Many if not most of these potentially affected jobs are professional or high-skilled jobs[84].

The current wave of globalisation is unprecedented in terms of scale and speed. Whereas openness to trade, investment and talent are important preconditions for globalisation, international competition is one of its major drivers. Much of the current discussion focuses on the integration of the 'new' emerging economies in the world economy, in particular the BRICs (Brazil, Russia, India and China; see Box 5.3). While sometimes perceived as an important threat to Western economies, the emergence of the BRICs and other developing countries on the world stage also offers new opportunities with new attractive and large(r) markets and with even more scope for specialisation for individual companies. Of course, global competition is not confined to goods and services (trade), but applies also to capital (FDI; relocation) and labour (talent and skills), thereby adding a further dimension to globalisation.

Improving competitiveness and revitalising manufacturing production already feature prominently on the policy agendas of the US, Europe and Japan (ManVis, 2005C; see also UNCTAD, 2005). For developing economies, in particular the new emerging economies, the high growth era not only increases expectations about future income and wealth, it also raises questions as to its sustainability in the medium and longer run. One major challenge for the BRICs and other rapidly growing developing countries is for instance to balance high growth

[84] However, evidence to date suggests that offshoring has played a minor role so far for labour market developments.

sectors and regions with the other less thriving parts of the economy (ManVis, 2005C; OECD, 2005).

5.2.2. Expected macro-developments: productivity, income and wealth

In a long-term scenario to 2030, the WorldBank (2007) foresees a near doubling of GDP in high-income countries and more than a tripling of GDP in developing countries. An important driver behind this process is the expansion of China and India, home to half of the population in developing countries. This world-wide rise in GDP will go hand in hand with increasing exports and energy use, with Asian levels approaching those of Europe and the US. Evidently, all kinds shocks may occur along the way. The longer the timeframe, the larger uncertainty will be.

Anchored in trends already evident and based on a number of assumptions, GoldmanSachs (2003) and PriceWaterhouseCoopers (2006) estimate that by 2050 China will be the world's biggest economy, followed by the US and India. PriceWaterhouseCoopers (2006) projects that by 2050 the 'E7' economies (BRICs plus Indonesia, Mexico and Turkey) will be around 25% larger than the current G7, and in Purchasing Power Parity (PPP) terms even 75% larger. Currently the size of the E7 is only around 20% of that of the G7 (75% in PPP terms). With three of the four largest economies in 2050 potentially residing in Asia, important geopolitical shifts towards Asia are to be expected too. One crucial assumption behind these projections is that the BRICs maintain their growth-supportive policy settings. Not all experts share this optimism about future growth, however. Some even refer to the BRIC growth optimism as a 'marketing ploy' (Amicus, 2006). However, what holds for developed high-income economies also applies to the new emerging economies: ensuring the right conditions for growth now and in the future is vital. These conditions include macro stability (sound macroeconomic policies and a stable macro environment), strong and stable institutions (CEPII-CERIM, 2004)[85], openness to trade, and investment in new technologies, R&D and talent, and education (secondary schooling and beyond).

Both GoldmanSachs (2003) and PriceWaterhouseCoopers (2006) illustrate that – driven by demographic trends[86] – notable shifts in relative growth rates within the E7 can be expected. China and Russia are expected to face significant declines in their working age populations between now and 2050, in contrast to younger countries like India, Indonesia, Brazil, Turkey and Mexico. As a result, India is projected to have the highest growth potential, with a GDP similar to the US in PPP terms by 2050. China, even with a marked growth slowdown, would be around 40% larger than the US economy in PPP terms. Note that as a result of demographic change, most established OECD economies are projected to lose some ground relative to the US economy by 2050. This holds for all bigger EU-15 economies as well as Japan, with Canada and Australia being notable exceptions.

PriceWaterhouseCoopers (2006) and ManVis (2005C) point out that while the BRIC might represent some of the largest markets by 2050, GDP per capita in that area will still be lower than in the G7. By 2050 PriceWaterhouseCoopers (2006) projects India and Indonesia to be on a par with Spain and Korea today, and China, Turkey and Brazil on a par with the leading G7 in per capita GDP terms (PPP based, see Graph 5.1). In a similar study, with growth

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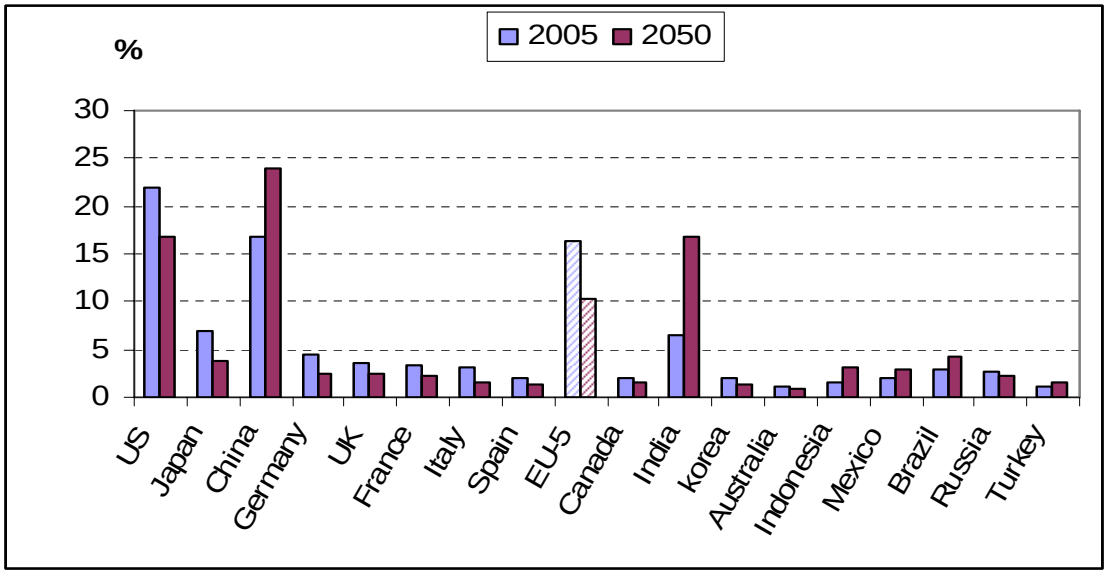
85 In the broadest sense, including the legal system, functioning markets, financial institutions, health and education systems and government bureaucracy.

86 GDP projections of the E7 appear to be particularly sensitive to assumptions on trends in education levels, net investment rates and catch-up speeds.

stemming from labour force growth, capital accumulation and total factor productivity growth, Poncet (2006) estimates that the US does *not* lose the first rank in the world GDP hierarchy in 2050, even if China and India are expected to experience a 13-fold and 10-fold increase in GDP at current real exchange rates, respectively. Of the current G7, only the US, Japan, Germany and the UK may be among the seven largest economies in 2050 according to Poncet (2006).

Graph 5.1: Projected relative size of economies in 2005 and 2050



Note: relative sizes expressed as percentage of their sum in 2005 and 2050, respectively. GDPs are expressed in PPP terms. EU-5: sum of Germany, UK, France, Italy and Spain.

Source: calculation using projection results by PriceWaterhouseCoopers (2006) "The World in 2050. How big will the major emerging market economies get and how can the OECD compete?" March 2006.

In all projections discussed above Total Factor Productivity (TFP) expected to be a major factor for GDP growth. In the past productivity growth in manufacturing was unrivalled by other sectors in the economy. This trend is likely to continue, although productivity in parts of the services industry, especially tradable services, could rise significantly due to the pervasive and continuing impact of ICTs.

By 2030 the per capita income gap between East Asia and other emerging economies on the one hand and the high-income countries on the other will still be considerable (WorldBank, 2007). The same will still be true in 2050 (PriceWaterhouseCoopers, 2006). Nevertheless, steep rises in income, like in East Asia, will clearly have implications for the types of the goods and services that consumers will demand, with patterns of demand looking much more like those in the leading OECD economies today, notwithstanding cultural differences. With rises in income, income inequality is likely to rise as well, posing considerable social and public policy challenges.

Larger and wealthier economies are not per se important lead markets. Much depends on individual purchasing power and the willingness to buy leading-edge products and services (ManVis, 2005C). For OECD consumers, the trend of the last decade in which low cost imports from China and other emerging economies were much to their benefit is set to continue and to even broaden to a wider range of products over time, leaving consumers with more money to spend on services (PriceWaterhouseCoopers, 2006).

5.2.3. Relocation and international sourcing

One of the manifestations of globalisation is the growing trend in international sourcing. The term sourcing applies to firms that contract out (parts of their) production to other firms (i.e. outsourcing) or other production locations within the firm itself (i.e. insourcing), either domestically or abroad. In the latter case we speak of offshoring. International sourcing in manufacturing is not new, with original equipment manufacturing (OEM) in electronics and ICTs in East Asia in the 1970s being the prime example of offshore outsourcing *avant la lettre*. Yet the scale and the pace at which relocation of production has occurred over the last decade appear to have increased.

Relatively new phenomena are the take-off of international sourcing in services (including R&D) and the emergence of global production networks. A crucial enabling factor behind both developments is the increased ability of firms to fragment or divide production processes into increasingly smaller components, which can in turn be traded (Krugman, 1995; OECD, 2005A; Evans et al., 2006). Thus recent technological developments, which have resulted in important decreases in communication, computing and transport costs and an increased ability to monitor, manage and control have enabled firms to fragment and spatially separate various stages of production at different locations. According to BoozAllenHamilton (2004) a new wave of (international) sourcing is occurring now also including white collar work and business services. At the same time, the quality of sourced services has reached unprecedented levels while costs have decreased significantly (ditto).

One major argument for the relocation of production to other parts of the world, mostly emerging economies, is low labour cost (KPMG, 2004) or – more general - lower production costs. Key are total landed (i.e. integral) costs, including energy, transport and other costs. With important changes in relative prices, and with falling levels of labour content in total production, the relative importance of labour costs may well shift in the longer run. While China may be a low cost labour location now, its future landed cost may appear to be relatively similar to countries in the EU or the US (see Box 5.1 below) especially if exchange rates adjust accordingly. In some sectors, cost differentials can be substantial, however. To take the example of IT-enabled services, the reported cost savings of offshoring amount up to 40%. Yet the evidence is not all-conclusive. Other surveys give a more mixed picture, with some companies even losing from offshore outsourcing (OECD, 2006). Increasingly other arguments for offshoring are voiced, including the search for new markets and customers and the availability of a talented and skilled labour force (PricewaterhouseCoopers[87]).

While accessing a highly skilled pool of talent is not yet among the most important drivers for business presence in emerging economies, the longer-term future will most certainly look very different. FutMan (2003E) emphasises that the recruitment of skilled workers and the training of the workforce will become a major competitive factor for manufacturing companies in the post-industrial area.

Globalisation and the increased use of sourcing by manufacturing and services firms can also have important effects on productivity. However, the direction and extent of these effects has not been studied in depth (Olsen, 2006) and the empirical evidence remains far from conclusive. If any, the effect on productivity of outsourcing seems to be conditional on the industrial sector (Olsen, 2006).

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[87] 9th Annual Global CEO Survey based on interviews with 1,410 CEOs between September and December 2005.

5.2.4. The emergence of regional and global production networks

The increasing ability of firms to decompose and 'slice up' the value chain into a number of self-contained parts (activities/production processes as well as products) has, together with the search for cost reduction and new markets, led to the emergence of global production networks and – associated with these - an increase of trade in parts and components. The emergence of global production networks has also significantly stimulated the use of services, ranging from third-party logistics (3PL) services such as customs clearance and freight forwarding, quality assessment services through communication, transport, distribution and financial services, to R&D and engineering (OECD, 2005A; UNCTAD, 2005)[88].

The complex, transnational character inherent in *global value networks* necessarily implies a growing importance of organisation and coordination. Of particular interest is the role of leading firms that govern the chain and enforce the governing rules by which local producers - often micro-enterprises and SMEs - in the chain operate. Multinational companies (MNCs) are the classic example of chain governors and continue to play this role, particularly in so-called *producer-driven* value chains (OECD, 2005A). These producer-driven chains often manufacture complex goods such as semiconductor chips or automobiles, and in order to do so chain governors have significant control over both backward (raw materials, components) and forward linkages (distribution and retailing). *Buyer-driven* value chains on the other hand operate in competitive global and regional *production networks* typically situated in various locations around the world, the role of leading firm being performed by a large manufacturer with a well-known brand name, a large marketing firm or a large retailer. Buyer-driven value chains are usually labour-intensive industries, ranging from apparel, footwear, toys to wood furniture.

5.2.5. Globalisation vis-à-vis further regionalisation and regionalism

China and India play an important and increasingly eminent role in internationalisation and globalisation. At the same time, a trend of increasing intra-regional *Asian* trade and rising intra-Asian investment can be observed (regionalisation), along with a strong rise in Preferential Trade Agreements (PTAs) and other forms of intra-regional cooperation (regionalism). China and the other East and South-East Asian nations, including Japan, have developed a strong intra-regional trade and investment focus, while actively striving for further trade integration through the forming of PTAs at the same time (Evans et al., 2006). India is less pro-active in concluding bilateral trade agreements and lags behind China in opening up to global trade, although there are indications of acceleration lately (The Economist, 2006A; ADB, 2006). Whether Asian regionalism is to the benefit of the world in the medium and longer term is not yet clear; what the proliferation of PTAs in Asia means for unilateralism and the future of multilateral organisations, most importantly the WTO, neither. In China and India, and indeed throughout Asia, a strong preference for technological independence and an increasing ability to set technical rules and standards can be observed (Suttmeier, 2005; Schmitz, 2006; Kang and Segal, 2006).

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[88] Manufacturing and services have become increasingly intertwined, and it is increasingly difficult to categorize firms as strictly manufacturers or service providers, especially where digital goods (e.g. software) are concerned.

Box 5.1: BRICs and Future Competitiveness

Globalisation and the concomitant intensification of international competition is the single most important driver shaping the future of manufacturing. While countries like Japan and South Korea have already made the transition to competing on equal terms with the West, similar expectations hold at least for China. The current discussion on future competitors focuses on the BRIC countries although large differences exist between these countries.

China being the world's manufacturing powerhouse is perceived as the biggest potential competitor of the BRICs. If current trends continue GoldmanSachs (2003) estimates that China will become the largest economy by 2050, although not the richest in terms of GDP per capita. Furthermore, China's large number of R&D employees, which is only second to the US, makes it not just an attractive low cost manufacturing location but increasingly competitive in high-technology and R&D (Amicus, 2006). While wage inflation is starting to affect highly skilled jobs in China, the large reservoir of unskilled labour means that wage inflation for low skilled manufacturing activities is less of an issue. In view of these advantages the challenges China is likely to face and which determine its competitiveness receive less attention. For example even China has lost manufacturing jobs since the mid-1990s due to high productivity gains (ManVis, 2005C). Furthermore, energy and a lack of infrastructure are key constraints to future growth in China. The uneven growth within the country is hampering development as some areas such as Shanghai already lose their labour cost advantage, whereas other parts of the country lack the infrastructure to be attractive for manufacturing (ManVis, 2005). Due to the one child policy China is one of the most rapidly ageing societies posing similar challenges as in the West. Lastly, the industrial catching up process of China has come at huge environmental costs, which seem unsustainable as the country is already suffering from heavy environmental pollution and shrinking water supplies (Amicus, 2006).

Despite not experiencing the same growth rates as China, **India** is perceived as one of the most prospective economies of the coming decades. Among its advantages is its use of special economic zones (SEZ) and having one of the best legal frameworks in Asia which reduces investment risks. Although having well educated workers, labour costs in India are at the lower end of emerging economies (KPMG, 2005). Also India's population is the only one expected to grow until 2050. However, insufficient infrastructure making transport expensive as well as unstable energy supplies could hamper future development (KPMG, 2005). Overall, India is expected to play an important role in the second wave of outsourcing, where white collar work is outsourced and off-shored (Deloitte, 2006).

Although the economies of **Brazil and Russia** are expected to grow significantly, the future of manufacturing is much less rosy than in China or India. Brazil is perceived as far from being competitive on foreign markets and much less open to trade than China. Furthermore, its investment and saving rates are lower, whereas public and foreign debt is higher (Amicus, 2006). Also, to achieve the projected growth rates Brazil's performance would have to increase considerably (GoldmanSachs, 2003). Russia's growth is largely driven by recent increases in energy and commodity prices, whereas the economy is not diversified and at the mercy of cyclical movements of the world economy. Russia's biggest challenge though is its weak institutions and the expected population decrease. Overall, although Russia and Brazil are expected to grow, their role in the international division of labour in global manufacturing is uncertain given the challenges they are presumed to face.

5.2.6. Financial globalisation and financialisation

One of the most salient features of the current wave of globalisation is the surge in capital flows between industrial countries and, even more notably, between industrial and developing countries. While in the early 1970s the ratio of foreign exchange trading to world trade was around 2:1, this had risen to 50:1 by the early 1990s and to 70:1 by the end of the 1990s, with the majority of foreign exchange positions held for less than a week (Eatwell and Taylor, 2000). The daily volume of global foreign exchange transactions amounted to more than 1.9 trillion US$ each day in 2004, in contrast to 570 billion per day in 1989[89]). FDI flows which accounted for US$22 billion only in 1990 have nowadays reached levels of some US$600 billion each year (after peaking at over US$1,300 bn in 2000 at the end of the dot-com boom) (WorldBank, 2007). Capital markets have become more integrated so that global and international industry-specific factors appear to have become more important compared to national factors in stock markets movements (Brooks and Catao, 2000).

While theoretical models have established a number of channels through which financial globalisation can promote economic growth, systematic examination of existing empirical evidence reveals that it is difficult to establish a strong causal relationship. The same goes for the ability of international financial integration to help countries to reduce macroeconomic volatility.

5.2.7. Relocation and the future: possible consequences for European manufacturing

There is little doubt among experts that relocation will have affect significantly European manufacturing in the next years (ManVis, 2005D). However, there are strong mitigating factors which can be summarised as follows. For manufacturing production where the quality of the product as well as the quality of the supplier is of high importance, Europe remains competitive as certain levels of quality can not be achieved cost effectively overseas (KPMG, 2004). Furthermore, close user-producer relationships require a presence in the European market while the available pool of talent in Europe is still a factor in location decisions according to the KPMG survey. Lastly, lower labour productivity and higher risks, often associated with weak institutions, in any emerging economies also militate in favour of European location (KPMG, 2004). Thus when considering the total cost of relocation and outsourcing the picture becomes less bleak for Europe (and other industrialised nations) (ManVis, 2005C).

While R&D and other business services are increasingly outsourced, the question whether R&D will follow manufacturing production is hotly debated among experts. While a close user-producer interaction is increasingly important for innovative processes, this mechanism works both ways. European firms relocate R&D facilities to emerging economies to build the necessary user relationships. However, ManVis experts see no 'automatism' of R&D following manufacturing production. One out of five ManVis experts do not believe that R&D will be performed close to manufacturing. While this does not imply that R&D will remain in its current locations, there does not seem to be a natural co-location pressure. What is clear though is that competition in R&D and R&D location will intensify in the coming years (ManVis, 2005C).

[89] Bank of International Settlements, see www.bis.org/press/p040928.htm; www.bis.org/publ/rpfx02t.pdf

In conclusion, the longer-term impact of continued globalisation and the recent integration of new competitors in the global economy will be pervasive, even if the exact consequences in terms of productivity, income and wealth, employment and industry location are difficult to predict. Who will win and who will lose from globalisation is therefore far from clear-cut. However, based on 'educated guesses', the following tentative list illustrates the possible effects of further globalisation (see Table 5.1).

Important parts of the low- and medium-skilled labour segment are expected to come under considerable stress as manufacturing across the OECD will account for a diminishing proportion of GDP. This trend is well known: while productivity in manufacturing is generally higher than in services, thus compressing the relative prices of manufactured goods in comparison to services, the higher income elasticity for the latter leads to their ever increasing share in consumption.

Table 5.1: Potential winners and losers in OECD economies over the next 10 years

	Potential winners	**Potential losers**
Companies	• Retailers • Leading global brand owners • Business services • Media companies • Niche high value added manufacturers • Health care and education providers • Financial services companies able to penetrate E7 markets • Energy and utilities companies	• Mass market manufacturers (both low tech and hi tech) • Financial services companies not able to penetrate E7 markets who may become vulnerable in their home markets • Companies that over-commit to key emerging markets without the right local partners and business strategies
Individuals	• Global 'star performers'* • Consumers of low cost imports • Providers of high value personal services with cultural barriers to migrant labour • Individuals with strong cross-cultural skills	• Low and medium-skilled workers in tradable sectors (including those open to offshoring) • Low and medium- skilled workers in non-tradable sectors open to migrant labour

Source: PriceWaterhouseCoopers, 2006. * Ranging from chief executives and financial market traders to footballers and film stars.

5.3. Technological progress and innovation

5.3.1. Introduction

New technologies not only enable firms to reorganise and optimize business processes, but also enable the production of new and better quality goods and services. A key message signalled by a majority of futures studies is that the rapid pace of technological change and the need of staying competitive in a globalising and increasingly ICT-based world nowadays requires firms to focus even more on science, technology and innovation. Firms seem to be caught in a race in which rapid advances in science and technology exert almost constant pressure to adapt and exploit new technological possibilities. Over the last decades the ICT

revolution has had a profound impact across manufacturing industries. For the future the convergence of nano-tech, bio-tech, cognitive and neuroscience with ICTs is expected to cause similar disruptive changes, although no one exactly knows how and what these might look like (RAND, 2001; SRI, 2004B).

Technological progress is dealt with in different ways in the surveyed futures studies. Some studies attempt to outline the expected major technological developments over the coming decades (e.g. FutMan, 2003; IMTI, 2000; ManVis, 2005; ManuFuture, 20006; Nistep, 2005). Other studies make instead inferences about future productivity changes based on *assumed* technological progress, the latter remaining largely or entirely a black box (e.g. GoldmanSachs, 2003; PriceWaterhouseCoopers, 2005; WorldBank, 2007). Again other studies present a rudimentary outline of expected technological advances and combine these with trends in R&D expenditure and R&D capabilities to draw conclusions regarding the future technological competitiveness of countries or sectors (e.g. Amicus, 2006; CME, 2004; HM Treasury, 2004; US DoC, 2004). These various perspectives all highlight different aspects for the future of European manufacturing.

5.3.2. R&D and innovative capacity

Technological progress and innovative capacity are usually assessed on the basis of variables such as R&D expenditures, patents and patent applications or the number of R&D workers. While these measures are indicators of technological and innovative capacity, it should be stressed that technological and innovative capacity is as much about how R&D money is spent and how results are commercially exploited as it is about how much R&D is spent or how many patents are granted.

Still countries with high R&D expenditures such as Germany, Sweden and Denmark are perceived to have a viable long term future in manufacturing, whereas in countries with low R&D expenditure such as Spain and Portugal, the prevailing manufacturing structure is perceived to be problematic (KPMG, 2004). Implicit here is the belief that high R&D expenditure is associated with high-technology and highly innovative firms that can compete internationally by focusing on knowledge intensive activities. By contrast, low R&D expenditures are associated with low skill manufacturing activities that are expected to be relocated to low cost countries over time.

Some studies highlight the large (absolute) number of R&D workers in China – second only to the US - emphasising a potential future threat of China becoming a high technology competitor rather than just a location for manufacturing production (Amicus, 2006). Others, however, point out that the relationship between R&D workers and technological leadership is far more complex than mere numbers suggest. For example, during the Cold War Russia employed more R&D workers than the US, nevertheless failing to achieve technological leadership in the long-run (WorldBank, 2007).

The importance of strong institutions in relation to commercial exploitation of technological advances is stated as the main reason for the superior US innovative performance (WorldBank, 2007). For emerging economies like China, which currently are a magnet for manufacturing production, key in closing the technological gap to industrialised economies in the future will be the development of efficient institutions (CEPII-CIREM, 2004).

5.3.3. Future key technologies

Future key technologies are expected to enable new products and processes and create new market opportunities (ManVis, 2005A; Manufuture, 2006). However, many of these new technologies are literally in the making with expected impacts coming to us only in the longer term.

Enabling technologies will play a crucial role in keeping a technological leadership role for Europe in the future. Key is their pervasive diffusing capacity, which potentially affects future competitiveness across sectors. The four key enabling technologies outlined by major foresight studies are Information and Communication Technologies (ICTs, most developed), micro-systems, advanced materials, and bio-technologies and nano-technologies (least developed) (FutMan, 2003; ManVis, 2005A; SRI, 2004).

Most futures studies expect ICTs to play a decisive role in short-term *manufacturing operations* (CME, 2004; IMTI, 2000; ManVis, 2005; Nistep, 2005). ICTs allow for productivity increases through *automation* as well as through reorganising *business processes*. In combination with technologies such as Radio Frequency Identification (RFID), this will cause supply chains and value networks to be dramatically transformed. It will also enable the emergence of new business models. Although this will no doubt lead to productivity increases, high uncertainty precludes any firm quantitative predictions. Several studies outline the importance of ICTs in 'virtual design', which makes it possible to reduce both production costs and development times (CME, 2004; IMTI, 2000; Manufuture, 2006; Nistep, 2005). Virtual manufacturing defined as the use of information technology and computer simulation to model real world manufacturing for the purpose of analyzing, evaluating and designing, is increasingly used to engineer the real manufacturing environment (Offodile and Abdel-Mayek, 2002). In some instances, actual simulation can be carried on concurrently as the manufacturing facility is being built.

Furthermore, ICTs are important for the *customisation* of products as they enable producers and customers to communicate in different and new ways, such communication being a new and important ingredient for the creation of new business models (see Section 5.4). ICTs also enable the delivery of product/services combinations, whose development is pursued by firms in order to generate new niches and a high(er) value added (ManuFuture, 2006A; Manufuture, 2003). However, in the long run, better human-machine interfaces need to be developed to exploit further productivity increase from more flexible automation technologies based on ICT and complementary technologies in controls and sensors (ManVis, 2005D). Interestingly, futurists remain sceptical about long-term automation visions such as the manless factory (ManVis, 2005).

Most of the applications above are already in use. At the same time though it is clear that developments in ICTs can be expected to continue playing a major role in shaping future manufacturing operations.

Micro-systems – particularly electromechanical micro-systems – such as actuators and integrated sensors and microprocessors are expected to be used across production systems in the mid-term to make machines more intelligent and efficient. This will allow using machines more flexibly and will enable firms to tailor production to individual customers' demand more easily (ManVis, 2005). Other studies speak of *micro-machining,* meaning essentially the same as micro-systems (CME, 2004B). In the long run experts expect micro-systems to enable *plug-and-produce productions systems*, which allow combining different components to

production systems according to the required task, thus allowing for even more flexible production in the future (ManVis, 2005A). However, this vision is still a long way off.

Advanced & smart materials are expected to enable the production of high performance products that fulfil the demands of customers better than current product technologies. While advanced materials focus on improving product and process performance, smart materials change material attributes such as colour or shape to external stimuli (CME, 2004B). Smart materials attempt to serve customer needs better. The challenge faced by manufacturing is to make the processing and manipulation of new materials feasible(ManVis, 2005A).

Nano-technologies and bio-technologies allow the manipulation of inorganic and organic materials for manufacturing products and components. Firms are already exploiting scientific advances in this field using genetically modified products and nano-materials for some applications (CME, 2005B). However, over the coming decades huge advances are expected from developments in bio- and nano-technologies which will drastically change the way in which products are manufactured. In a long term – 20 to 50 year – vision, products may be manufactured from the molecular or 'bottom-up' level. However, scientific developments in this area are just starting and future developments are still highly uncertain (ManVis, 2005A; Manufuture, 2006B).

What is regarded as highly important for the future of European manufacturing is the development of complementary manufacturing technologies that will allow for the integration of new technologies in products and processes that can be brought to the market, and hence will create future commercial opportunities as well as strengthen competitiveness. The development of these complementary technologies is a challenge for European manufacturing that needs to be addressed through a continuous updating of research and innovation policies.

5.3.4. Non-technological innovation

Non-technological innovation, particularly organisational innovation, plays an important role in maintaining and improving competitiveness and growth, both as an enabler and facilitator of technological innovation and in its own right. The organisational changes manufacturing firms are expected to go through in the future are discussed in most of the surveyed studies, including the large European foresight studies (FutMan, 2003; ManVis, 2005; Manufuture, 2006), US (IMTI, 2000; SRI, 2004;) and Japanese reports (METI) as well as accounts by the large management consultancies (KPMG, BoozAllenHamilton, Deloitte). Organisational innovation is particularly important for knowledge development in companies (ISI, 2006) and for better management of business processes. Examples of organisational innovations over the last decades include the widespread implementation of team work, Just-In-Time (JIT) production, Total-Quality-Management (TQM), Continuous Improvement Processes (CIP), Supply Chain Management (SCM), outsourcing/relocation and performance-based pay, to mention only a few. Over time numerous organisational innovations have been introduced, with varying relevance and impact on the various manufacturing sectors (ISI, 2006; ETEPS, 2006). However, the exact impact of organisational innovation on industrial performance is *very difficult to quantify*.

All studies agree that the future firm should network and collaborate to exploit knowledge that is *beyond its organisational boundaries* in order to remain competitive (CME, 2004; FutMan, 2003; ManVis, 2005; ManuFuture, 2006; SRI, 2004). The reason is that technologies become increasingly complex and interdisciplinary in nature. The rapid pace of technological change means that firms cannot build all competencies within the firm. Consequently, firms

will have to learn how to exploit knowledge through collaborations with suppliers, customers, competitors, but also with research organisations and universities. Accessing external knowledge from networks and collaborations is broadly known as *open innovation*. Open innovation will be a source of competitive advantage as it determines how cost effective firms manage to exploit knowledge commercially. An important observation is that companies prefer to limit these collaborations to pre-competitive research as they are afraid of losing their competitive advantage (FutMan, 2003D). The challenge is to find the right balance between 'openness' while defending competitive advantage.

Closely linked to open innovation is *user-centred innovation*, a concept that refers to learning processes through close producer-user interaction. Learning is important to improve products and processes and hence is a major source of competitive advantage. If a firm knows what its customers want, it has already a competitive advantage over potential competitors that lack that knowledge. The special importance for Europe is that such close interaction can 'localise' production as it ties producers to users (ManuFuture, 2006). Whether such localisation actually occurs remains to be seen. Firm evidence here is (still) lacking. In order to seriously implement user-centred innovation, European firms are also required to build up R&D facilities in large overseas markets such as the US and more importantly Asia to serve overseas users (KMPG, 2004).

5.3.5. Knowledge, skills & competencies

The transformation from a resource-based to a knowledge-based manufacturing paradigm leads experts to rate knowledge and skills as absolutely crucial to future growth and competitiveness. This is one of the key messages found across most futures studies (CME, 2004; FutMan, 2003; HM Treasury, 2004; KPMG, 2004; Manufuture, 2006; ManVis, 2005; Nistep, 2005). Such a transformation does not only require firms to develop and manage a *skilled and educated workforce*, it also requires organisational competences in *knowledge* and *innovation management*.

One of the key challenges for manufacturing is warranting a continued supply of skilled labour. Future labour supplies are under threat, not only as a result of demographic change (ageing), but also as a result of underinvestment in education and training. These are not particular European problems, but also apply to the US and Japan (FutMan, 2003D, IIPS, 2005, ManVis, 2005, ManuFuture, 2006, US DoC, 2004). The aforementioned studies specifically call for educating more *graduates* in areas relevant to manufacturing as well as *attracting* graduates to enter the manufacturing sector after graduation instead of seemingly more attractive sectors of the economy. Also more women need to be integrated into the labour market to prevent future skills shortages (FutMan, 2003; CEFIC, 2004).

The number of skilled workers in other parts of the world is assumed to increase, even though the skill premium (defined as the ratio of skilled wages relative to unskilled wages) is set to increase as well, and mostly so in countries with a high investment rate (WorldBank, 2007: 58). Currently, the share of skilled workers is 32% in developed countries and less than 10% in developing countries (ibidem).

To work in knowledge-based manufacturing employees increasingly need new *soft-skills*. These become more important as organisations are increasingly globally networked and flexible. Teamwork, networking, intercultural literacy, interdisciplinary thinking, high worker autonomy and mobility/flexibility are therefore crucial skills required in knowledge based businesses (FutMan, 2003D, FutMan, 2003E). Soft-skills are generally associated with

university education. An OECD study revealed that one-fourth to one-third of workers do not possess the required soft-skills (FutMan, 2003E). Firms therefore need to develop their workforce to adapt to the new challenges. While life-long employment in the same firm is expected to be a thing of the past, workers will need to engage in *life-long learning* (FutMan, 2003, UK Foresight, 2000). The pace of technological change makes this especially important for highly innovative rapidly changing sectors. New learning strategies and technologies need to be adopted by companies in order to build the necessary human capital and keep it competitive (FutMan, 2003D, see also Chapter 3 for a discussion of trade offs associated with skills acquisition).

5.4. Transforming the manufacturing landscape: new manufacturing paradigms and future business models

5.4.1. Introduction

European manufacturing businesses will need to adapt to new realities in which continuing globalisation, international competition and innovation will play a pervasive role. Increasing international competition has already led firms in developed countries to move away from pure *cost competition* to higher *added value* activities and to relocate (parts of their) production to the new emerging economies with their substantially lower labour costs. Manufacturing firms face more competition but also collaborate more and are increasingly part of global *value networks* (FutMan, 2003E; IMTI, 2000; ManVis, 2005; ManuFuture, 2006A; Meti, 2005; SRI, 2004A). Moving into *high value added* manufacturing segments and niches calls for *customisation* and *high performance products,* with the latter increasingly including a *service* component. New requirements in terms of service, 'new' human capital and knowledge alter the manufacturing landscape as much as technological change.

Manufacturing firms will actively have to identify, promote and apply new business models, new methods and information tools, in order to sustain global competitiveness. If taken up well, this could allow existing industries to continue to operate from a base within Europe and allow new businesses to arise (ManuFuture, 2006B). Recent transformations in business models observed in industrialised countries are rather similar, as most firms are exposed to the same pressures of international competition and operate in similar environments with an increasing pace of technological change and innovation.

The search for new ways to adapt and transform to new realities also includes 'new' *grand visions* or *designs* at the higher, overarching 'supra-sector' level. New manufacturing paradigms have emerged, not only in Europe but also in Japan, on how manufacturing can transform and reinvent itself and face the future in a sustainable manner. This section starts with a concise discussion of new manufacturing paradigms (Section 5.4.2), followed by a more extensive discussion of new trends and developments in manufacturing in relation to future business models (Section 5.4.3).

5.4.2. New manufacturing paradigms

New *manufacturing paradigms* have been defined both in Europe (the '*Manufuture'* paradigm*)* and Japan (the '*Monodzukuri'* paradigm). While US studies refrain from coining a new manufacturing paradigm, it is certainly acknowledged that similar challenges call for solutions similar to those proposed in Europe (e.g. CME, 2004; SRI, 2004). This includes the adoption of mass customisation, more and better quality services, more networking and collaboration, and embracing globalisation. Both '*Manufuture'* and '*Monodzukuri'* endorse

fundamentally different ways of production in view of increasing scarcity of non-renewable energy and natural resources (water, minerals, metals) as well as climate change (global warming). In the US sustainability seems to be less prominent an issue still. New impetuses and signals, both from the global warming and climate change debate (Stern, 2006; IPCC, 2007 and 2007A; Al Gore's film *An Inconvenient Truth*), but also discussion on and increasing concern about the effects of offshoring (e.g. Blinder, 2006) could quickly change the position and views in the US though.

Manufuture is described as a powerful vision linking human and societal needs (demand) to both industrial and education systems (supply) (ManuFuture, 2004). The paradigm shift is proclaimed to be a transition from competing on 'cost' to competing on added value, which requires 'high performances', 'customisation', 'new business models', 'new human capital' and a 'service dimension' in manufacturing (Manufuture, 2006A). Important to note is that this is a future vision and not yet reality, although the trends are visible.

While traditional manufacturing is based on land, labour, and capital, *'manufuture'* is founded on knowledge and capital. The transition therefore depends on the successful adoption of new attitudes towards the continuous acquisition, deployment, protection and funding of new knowledge as a source of competitive advantage (ManuFuture, 2004). *This requires a high degree of collaboration and networking with suppliers, customers, competitors and other sources of external knowledge* as firms will have to cooperate across whole manufacturing systems instead of competing individually in view of more complex technologies. This paradigm also requires *complex organisational approaches* as dispersed organisations are collaborating in networks (ManuFuture, 2006).

The trend of linking future developments of manufacturing to societal needs can also be observed in Japan where foresight is used as extensively as in Europe. The Monodzukuri paradigm also seems similar to the *Manufuture* paradigm in that the transformation is described as involving a move from 'manufacturing objects' to 'producing value' (JMA, 2003) but puts more emphasis on environmental constraints. It is not clear though how 'monodzukuri' is put into practice and how it is expected to affect Japanese manufacturing competitiveness in the future.

5.4.3. New business models: importance and possible ingredients

Whereas *manufacturing paradigms* can be compared with grand visions at the supra-sector level, *business models* represent the set of (multidimensional) opportunities and choices that individual firms – the micro-level – make vis-à-vis the future. These range from value propositions to customers, financial models, value networks to functional architecture[90]. Business models are crucial for future competitiveness as they determine revenue generation by integrating production system, workforce and organisational competencies (Manufuture, 2006B). Recent changes in business models reflect four major trends identified across futures studies (e.g. FutMan, 2003; KPMG, 2004; ManVis, 2005; Manufuture, 2006; SRI, 2004). Firstly, large businesses become *less vertically integrated* as they *increasingly manage global networks*. Secondly, a *transition from products to services* is observed, with manufacturing firms increasingly providing add-on services to their traditional products as well as relocating

[90] A business model can be defined as "a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams" (Osterwalder et al., 2005). Business model analysis is widely applied in the context of strategic, financial and operational decisions by private firms.

and outsourcing production. Thirdly, firms increasingly diffuse intellectual property (IP) beyond company and even country boundaries, as *firms innovate more openly*. Lastly, small businesses have to *compete in manufacturing networks* and collaborate openly to address market challenges.

That business models and manufacturing paradigms will play an important role in the future of manufacturing is beyond doubt. *Future business models* will need to reflect 'new ways of working' based on the rapid formation of open networks in both traditional and emerging sectors, which will improve capabilities and increase productivity. At the same time, future business models will also need to take account of other factors, issues and trends. The following sub-sections discuss some of the more prominent trends in organising business operations.

5.4.3.1. Managing global networks, firms becoming 'orchestrators'

In the past big manufacturing firms owned large parts of the supply chain. However, today many of the most successful manufacturers rely on outside suppliers for major portions of their supply system. This trend is acknowledged without exception across all studies surveyed. An extreme example is Dell (see Box 6.2) that sources all components from outside vendors. The core competence here changes from producing to managing the production, which requires well managed global networks (SRI, 2004). This trend also offers new opportunities for smaller manufacturers that are capable of participating in the global networks of large manufacturers.

An extreme case of orchestration would be the *virtual factory* where linkages between the firm and its suppliers and customers are purely electronic. This business model has been experimented with by global firms operating in global industries. Nevertheless, even these large firms so far struggle implementing the concept (FutMan, 2003D: 61). A reason could be that the virtual factory model impedes closer linkages between producers and their suppliers / customers. Furthermore, technology does not yet replace personal contacts that are important to the management of networks.

Box 5.2: Successful Business Models of Large Firms

While technologies and competencies are crucial to the firm its business model determines success or failure. Current trends in outsourcing, collaborating, networking and the provision of services are clear, although differences between sectors exist. On the other hand new developments in internet-based business models such as the virtual world 'Second Life' or the 'Long Tail' comparative advantage of internet retailers presently receive much media attention while it is yet unclear if and how these developments impact manufacturing.

In manufacturing **Dell** represents an example of a business model innovator that has become a manufacturing '*orchestrator'*. Although a manufacturer, Dell assembles and markets products using system designs and architectures developed in-house but *sources* most product technologies and components from a *global network of suppliers*. Furthermore, Dell sells directly to end consumers specified to order mainly over the internet. Production only starts with product payment. Large parts of its business focuses on the provision of *services*, which range from maintenance contracts, technology consulting, technical support, training of system administrators as well as financial services (SRI, 2004A). Dell's business model today is already widely emulated indicating its potential beyond electronics and textiles. Nevertheless, many firms still have to make the transition of stringently exploiting

opportunities from ICT technologies to reorganise their supply chain and adapt their business model.

Another example is **GE** which generates most of its sales growth from the provision of *services* rather than products allowing it to outperform its competitors (SRI, 2004A; 2004d). These examples emphasise the general trend across manufacturing sectors of traditional firms adapting their business models to become service providers.

While the orchestrating of global value chains is a prevalent aspect of changing business models for large firms, outsourcing seems to be limited to *non-critical* products / technologies. Pharmaceutical companies like **GSK** represent a special case as they exploit global scales in production through sourcing, but keep the majority of production of strategic drugs and active ingredients in-house. In fact GSK chooses to produce its active ingredients in only five countries, namely Australia, Ireland, Singapore, the U.K. and the US. Consequently, its supply chain has two components: primary sites produce active ingredients which are then mixed and packaged into final products at secondary sites. (SRI, 2004d). Furthermore, the pharmaceutical sector provides fewer opportunities to provide services competitive advantages could be jeopardized by collaborating or outsourcing critical products. Thus sectors vary in terms of outsourcing, collaboration and networking.

The examples also show that there is no 'one size fits all' business model. Instead, even within sectors different business models can co-evolve. Structural differences between sectors, such as high R&D expenditure and negligible variable production costs in the pharmaceutical sector, lead to limited sourcing and R&D collaboration.

Especially for small and medium sized enterprises, operating in manufacturing networks and collaborating openly to grab new market opportunities and face new challenges is of crucial importance. This applies in particular to the acquisition of external knowledge from suppliers, customers, competitors and universities (see Section 5.3.4: 'open innovation'). However, apart from collaborating, firms need strong competition to their advantage (ManuFuture, 2004). The fruitful combination of collaboration and competition has been termed co-opetition[91]. But experts participating in ManVis remain sceptical about the economic viability of external cooperation as it is cost intensive (ManVis, 2005A). Furthermore, firms fear losing competitive advantage through collaborating with competitors (FutMan, 2003D). Nevertheless, the need of, and current trend towards, collaborating and networking in value chains and knowledge networks is given high importance across studies (inter alia: FutMan, ManVis, Manufuture, SRI, KPMG, Deloitte).

5.4.3.2. (Mass) Customisation

All studies point at an increasing future demand for customised products, yet with short delivery times. Firms therefore adjust their organisational structure to provide mass customised goods. Mass customisation requires close user-producer interaction and allows charging higher prices than for commoditized products. This also implies that firms produce according to demand-pull production systems to take into account customer specifications. Demand-pull production reduces working capital, increases flexibility, satisfies customer demand and tightens user-producer linkages. These advantages are all sources of competitive

[91] The purpose of co-opetition is not to limit competition but, usually, to share pre-market development costs (for instance, among software producers or among carmakers).

advantage, and also offer the opportunity to attach add-on services to the product. According to industry experts surveyed in FutMan, the demand for this type of production is, however, still lower than expected (FutMan, 2003D: 51).

5.4.3.3. Services and servation

Servation i.e. the need to incorporate a greater service element into the product, both during design and during after-sales, has emerged as a major trend across the studies surveyed. The addition by manufacturers of services to their core manufacturing activities in a search for further differentiation and increased performance implies a whole new business model which no longer emphasises the maximisation of output and unit sales, but instead revenue generation via long-term customer relationships (FutMan, 2003E). A recent US study even identified the services and servation trend as the main driver for the growth of sales in manufacturing (SRI, 2004A) and hence as a key source of growth for the manufacturing sector overall. It is expected to continue as services allow manufacturers to diversify, create new revenue opportunities and gain competitive advantages. Furthermore, the close user-producer interactions necessary for the provision of services provide customer feedback into the design and manufacturing process, which is important for innovative competitiveness. Services and servation require high skilled labour, however. In an era in which ageing and increasing labour and skill shortages are expected, the provision of labour may pose a major challenge to manufacturing firms (see Section 5.5).

While manufacturing firms increasingly offer services to their customers, they also outsource many business functions to external service providers. This has important implications for the labour market, as the number of people directly employed by manufacturing firms is decreasing. In statistical terms, however, this is largely a problem of sector classification rather than of job losses. An expected decrease in employment in manufacturing therefore is not *per se* an undesirable development. The question is where the outsourced business functions are located, and whether the job losses in the manufacturing sector can be compensated by new jobs in the services sector.

5.5. Society at large: demographics and ageing

Future societal developments and consumer behaviour will to a large extent determine the beacons for industries and firms and are key in any analysis of the future of manufacturing. Population growth associated with rising consumption levels, increasing incomes, but also changing consumption patterns driven by many different factors will all affect the future demand for manufactured products.

Key drivers are future developments in economic growth, income and wealth, demographic changes and the impact of an *ageing society*, developments in *education and skill* levels as well as *changes in social values* of European consumers impacting future consumption patterns. A*geing society* in industrialised economies and, related, overall expected *skill shortages* are two major factors that are found across almost all studies (inter alia: CME, 2004; CEFIC, 2004; FutMan, 2003; ManVis, 2005; Manufuture, 2006; WorldBank, 2007; US DoC, 2004; SRI, 2004).

Between 2005 and 2030 the world population is projected to grow from 6.5 billion to 8 billion persons. According to WorldBank (2007) calculations, roughly 12% of the world population will be living in high-income countries, down significantly from 18% in 1980 and 14.5% in 2005. The population growth rate, however, will gradually slow to 1% in 2015 and 0.7%

toward 2030. High-income countries will observe population declines – Japan after 2010 and the EU soon thereafter. Under current projections Japan will fall from 128 million in 2005 to 117 million in 2030. The EU-15 population will fall likewise from 412 to 402 million persons (WorldBank, 2007: 38)[92]. In the EU accession countries, population declines will average about 0.2 to 0.3% annually up to 2030. The US population, with much higher fertility rates than in other high-income countries, is projected to grow by 45 million to 345 million in 2030. Elsewhere, population growth patterns are more highly varied, with declining populations in Central Asia and Russia, but steep increases in India (up by 320 million), Sub-Saharan Africa (up by 320 million), and less so but still significantly, China (up by 170 million).

The 'greying' of society in the Western world as a result of huge declines in fertility on the one hand and longer life expectancy on the other is regarded as an important driver of future change (FutMan, Montalvo *et al.*, Manufuture, WorldBank, HM Treasury, ManVis, US DoC). While ageing is not limited to developed economies, the developed economies are expected to age faster than the rest (HM Treasury, 2004).

The ageing of society has three major implications for the future of manufacturing. Firstly, manufacturing will have to *adapt to the demands of an ageing society*. More health care products, pharmaceuticals, medical equipment but also medical services will be demanded. Furthermore, future products need to be designed in more user-specific ways for older and disabled people (FutMan, 2003E). This change offers a chance for Europe to become a lead market for such products as ageing is a global trend.

Secondly, as a result of ageing the *labour force* is declining as the baby boomer generation retires, particularly in Europe and Japan (FutMan, 2003E; HM Treasury, 2004; Montalvo *et al.*, 2006; WorldBank, 2007). In Europe this decline is expected shortly after 2010. If aggregate growth of 2-3% on an annual basis is to be sustained over the next decades, this will necessarily imply that both capital accumulation and productivity will have to accelerate in order to compensate for the effect of a declining labour force and the resulting negative employment growth (Poncet, 2006; WorldBank, 2007). At the same time, important skill shortages across industries can be expected, as the combined effect of a declining labour force and an increasing need for skills in tomorrow's knowledge-based economy. What is clear, however, is that manufacturing sectors need to make workplaces more attractive for potential high-skilled employees. This refers especially to the female workforce, the elderly as well as to the young (Cefic, 2004; EMCC, 2005; FutMan, 2003E; ManVis, 2005).

Thirdly, an ageing society not only faces a reduced share of workers, but also an increased share of dependents consuming out of existing production. Increasing *dis-savings* would lower the rate of overall savings in developed economies, including Europe. Yet, evidence for this effect is mixed since other factors may affect savings and investment patterns as well. Lower labour supply could lessen investment needs in sectors where labour and capital are close complements while increasing investments in labour-saving technology may counteract this effect in sectors where the capital and labour are substitutes (WorldBank, 2007). The exact implications for industry and competitiveness are, therefore, less clear (FutMan, 2003E).

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[92] EPC and European Commission projections to the year 2050 indicate a relative stability of EU-15 (+1%) and a 12% fall for EU-10 population (Economic Policy Committee and European Commission, 2006).

The issue of education and skills is of course connected to demographic developments as a better educated and, thus more productive workforce is seen as an antidote to a shrinking one. Chapter 3 of this report explored the relationship between skills and competitiveness and the prevailing trends of skills upgrading which in all foresight studies is expected to continue.

In addition to demographic developments, other important factors such as *changes in social values* determining future consumption patterns are relevant. Although their importance can hardly be downplayed – consider for instance how the debates on genetically modified organisms and stem cell research affect the development of the corresponding technologies – are discussed in more detail by only a few studies (Futman, 2003E, 2003A; Montalvo *et al.*, 2006).

5.6. Environmental and natural resource concerns

Our environment not only provides the raw materials and natural resources that form the very basis of manufacturing, but it also determines the physical context in which manufacturing production takes place. In the following we will discuss three key drivers that will shape the future of manufacturing: (i) the availability of natural resources focusing on the supply of energy and energy efficiency, (ii) the impact of climate change, and (iii) the impact of environmental regulation. The key studies dealing with environmental aspects most comprehensively are Futman (2003), ManVis (2005), Montalvo et al. (2006) and WorldBank (2007). These are complemented by studies such as Stern Review (2006) and IPCC Summary (2007) focusing on climate change, analyses on the availability of mineral resources (BMWi, 2007) and projections on energy resources (IAE, 2005).

Climate change is a major issue on current global and national policy agendas. In particular the Stern Review and the Intergovernmental Panel on Climate Change (IPCC) have outlined the potential impacts of global warming for humanity. Both address the necessary actions for governments and industries. Waste and pollution as by-products of 'normal' manufacturing processes also have potentially serious negative impacts on the environment and humanity. In a response to counteract the negative impact of waste and pollution new laws and regulations are being introduced (e.g. REACH the new chemicals legislation in the European Union).

The costs of environmental protection for the manufacturing sector increased by 3% in absolute terms between 1995 and 2002 but their share relative to Gross Value Added decreased from 2.1% to 1.8%. Some of these costs will of course have been offset by increases in efficiency associated with new processes. There is no evidence that this trend is changing, so any structural adjustment and changes in the future composition of European manufacturing due to environmental policy is likely to be negligible.

5.6.1. Availability of resources

The availability of natural resources is usually discussed along two distinctive lines: energy and *other* natural resources. The reason is that energy makes up a considerable part of production costs *across* sectors. As a result some studies focus on energy and do not deal with other natural resources. This holds for example for US DoC (2004). Experts appear to have contradicting opinions regarding the future availability of 'other resources'. While some experts only expect 'other natural resources' to become scarce in 50 years time (FutMan, 2003D), others see scarcity already now as an important driver for manufacturing (Montalvo *et al.*, 2006).

Important to note here is the recently published study by the German Ministry of Economics and Technology (BMWi, 2007) that sees no critical shortages of long term supplies of mineral resources for industry and expects shortages for specific minerals to be eased through technological change creating substitutes and exploring new reserves. The SRI (2004C) study is the only surveyed study that makes quantitative long-term projections of future prices (see section below).

5.6.1.1. Energy and energy efficiency

Past trends make it very clear that energy consumption is broadly rising in line with GDP growth (Montalvo *et al.*, 2006). As studies expect global growth to continue over the long-term, global energy demands are also expected to rise (HM Treasury, 2004), even if at a lower rate.. However, this rise in energy demand can have an adverse effect on energy prices, possibly slowing down growth rates as high energy prices continue. Furthermore, globalisation thrives on cheap transport costs, which could increase in case of higher energy costs in the future thereby impacting global trade. However, recent high oil prices do not seem to affect global economic growth as adversely as might expected. Energy use is also one of the main sources for green house gases emissions. In this context energy efficiency represents an important driver of climate change mitigation,

As energy prices rise energy efficiency becomes an increasingly important topic. However, FutMan (2003D) argues that energy efficiency is only an important topic in *product markets* for example in automotive and lighting sectors. Energy efficiency is less important for mechanical manufacturing processes, as energy cost are only one cost factor and need to be balanced against cost savings. This is, however, not true for process manufacturing such as the chemicals industry where energy is a considerable cost factor in production (FutMan, 2003D). Here energy efficiency measures are taken up by industry without specific legislation for cost reasons but are limited for technological reasons where process energy is needed. Furthermore, recent increases in energy costs make it increasingly attractive to save energy, changing the underlying assumptions of the FutMan assessment for mechanical manufacturing processes. The subject of energy efficiency nevertheless seems to be of varying importance across manufacturing sectors, receiving attention wherever representing a considerable cost factor. This fits the observation of experts stating that increasingly alternative sources of energy are used across manufacturing industries (FutMan, 2003D). The recent energy price hikes, as well as the more acute sense of urgency regarding climate change have renewed interest in energy saving at political level (see, for instance, the European Council Decision of 9 March 2007 backing the 20% energy efficiency objective or the G8 Declaration of 7 June 2007, in Heiligendamm).

5.6.1.2. Other resources

As indicated above the scarcity of resources other than fuels is controversially debated among experts. While experts participating in the FutMan study indicated that the availability of natural resources is not relevant to the future of manufacturing over the coming 50 years (FutMan, 2003D), others perceive this as far more problematic. While this discussion has been going on for several decades starting with the 'limits to growth' debate, it remains unconcluded (Montalvo *et al.*, 2006). A recently published study by the German Ministry of Economics and Technology BMWi (2007) analysing past trends of mineral resources provides strong evidence that there are no critical future absolute shortages to be expected in the future, thus contradicting other experts proclaiming scarce resources. The study expects technological change stimulating substitutes and new reserves to prevent any absolute

shortages. From 1995 to 2002 world commodity prices have declined structurally to around 75% of 1995 levels and were expected to do so in the future (SRI, 2004C). However, commodity prices have increased considerably since then due to increasing global demand, particularly from China. According to the WorldBank (2007), mineral prices have increased by around 200% from their low in 2001 until 2006. Again, similar to the predictions of long-term oil prices a couple of years ago this only highlights how difficult quantitative predictions are. Consequently, the BMWi (2007) study does not make any price forecasts as past data shows that mineral prices follow a 'random-walk' making the last price the best forecast available.

5.6.1.3. Recycling

In terms of resource availability BMWi (2007) points at the increasing importance of recycling levels as more and more materials – especially metals – are recycled, making predictions about future supply levels even more complex. The increasing importance of recycling is also confirmed by the results of the Japanese Delphi (2005) that outlines the future importance of recycling oriented manufacturing technology in the manufacturing sector (Nistep, 2005). According to FutMan (2003D), recycling of other materials is largely regulation driven creating a trend to more environmentally friendly production. However, as products comprise multi-materials, recycling becomes increasingly difficult and needs to be considered in product development (FutMan, 2003D).

5.6.2. Global warming and climate change

The Stern Review, consecutive IPCC reports and other studies have led to a wide consensus that climate change will be one of the main drivers affecting the future of the globe over the coming centuries. More extreme weather events and rising sea levels will have wide economic and social impacts as agricultural and human settlement patterns will have to adapt (HM Treasury, 2004). The main message of Stern was the costs of climate change far outweigh the costs of action, Climate change will pose challenges to many economic sectors and will magnify regional differences in Europe's natural resources and assets (IPCC, 2007A). However, the studies cannot tell us *how* exactly climate change will affect European manufacturing sectors.

Much depends also on clear policy responses as well as individual actors (business and consumers) following the latest climate change reports. Policy-makers and others are urged to take steps to reduce green house emissions in an attempt to stabilize climate change (Stern, 2006; IPCC, 2007). The key message of the Stern Review for example is to introduce a global carbon-price that reflects the real cost of fossil energy to reduce global consumption of fossil energy, while making substitutes more attractive (Stern, 2006: 324). Such policy actions will have implications for all sectors of the economy but particularly for energy-intensive sectors, as energy cost will be rising. However, so far no global concerted binding actions have been implemented that could cause major structural changes.

5.6.2.1. Impact of climate change on manufacturing

Even if the proposed policy actions raised in the Stern Review or IPCC reports (part of which is still forthcoming) are not implemented, manufacturing will be impacted by climate change in one way or the other. Either directly through environmental changes or indirectly through legislation passed to stabilise global warming. The Stern Review estimates future costs caused by climate change if no actions are taken at 5%-20% of GDP annually over the next century

or two (Stern, 2006). Comprehensive estimates of costs of climate change for manufacturing are nevertheless to be developed, This compares to an estimated mitigation cost of 1% GDP annually by 2050 for policy measures expected to stabilise global warming (Stern, 2006). The WorldBank (2007) acknowledges that if the worst climate change scenarios materialise, the development prospects of whole regions and or countries can be undermined through the potential effects on agriculture, water supplies and ecosystems.

The Green Paper on adaptation to climate change (European Commission, 2007) focuses more particularly on Europe and presents climate change impact scenarios for 2071-2100. The most immediate effects would be felt by agriculture, forestry, fisheries, and tourism, as well is in the construction materials industry.

5.6.2.2. Environmental rules and regulations

Legislation influence industry structures as companies adapt to regulatory changes. Firms generally have two options: they can either adapt to regulatory changes or relocate to areas where legislation is – still – less strict.

Adapting to regulatory changes, particularly the measures proposed by the Stern Review, will come at a cost (Stern, 2006). This mitigating cost is estimated to be around 1% of GDP by 2050 if actions are taken now while the cost of no action is predicted to be several times bigger. However, experts also point out that the proposed changes create new business opportunities in markets for low-carbon, high-efficiency goods and services (ibid). The impact on competitiveness also depends on whether carbon reduction policies are implemented simultaneously around the globe, preventing relocation of the worst affected sectors (Stern, 2006:253). However, it is argued that very few of the most affected sectors have internationally mobile plants and processes limiting expected impacts (ibid).

It also has to be realised that the costs of environmental regulation are not significant for the vast majority of sectors and factories. In practice, relocation is more likely to take place due to other factors that are much more financially significant: proximity to market, labour costs, exchange rates etc. Indeed, it is often the case that firms who relocate maintain the same environmental standards in their new locations as they do in their previous – suggesting that they see environmental performance as synonymous with good process management and corporate social responsibility,

On its March 2007 summit the European Council agreed to embark on an ambitious policy for energy and climate change. The aims of this policy are the following: the EU will reduce greenhouse gas emissions by at least 20% compared to 1990, will ensure that 20% of total energy use comes from renewable sources and will accomplish a 20% decrease in energy intensity over and above business as usual developments. Part of the target for renewable energy will be covered by increasing the share of biofuels up to 10% of total transport fuel use in 2020.

Important environmental legislations discussed in the studies surveyed are the European chemicals legislation REACH and the CO^2 trading scheme (CEFIC, 2004; FutMan, 2003; IEA, 2005; ManVis, 2005). While the current impact of CO^2 emission trading is perceived as modest for the most energy intensive industries, it is expected to increase energy prices in the long-run (IEA, 2005). The largest emitters of the European industry are included in the system, which will significantly contribute to the EU's Kyoto objectives in the period from

2008-2012. It is currently being revised, in order to fully exploit its potential in the period after 2012, i.e. to achieve effective emissions reductions at least cost,

The implications of REACH are negligible for the competitiveness or make-up of the chemicals sector. The costs over the entire central 11 year period are estimated to be equivalent to less than 1,5% of the sector's annual turnover. Firms outside Europe have complained that it will be harder to comply, and that it will unfairly boost the competitive advantage of-European markets (CEFIC 2004; FutMan, 2003). It also provides European chemical firms new incentives and opportunities to develop innovative products based on less hazardous substitutes that ensure competitiveness tomorrow (EMCC, 2005; FutMan, 2003h).

Other environmental measures that will have a direct impact on European manufacturing are those related to the quality of the air, which include specific targets for acidifying gazes (SO_2, NO_x and NH_3) by 2010 and 2020. Large combustion plants are more particularly addressed in this context. Specific to the car industry are the targets of reducing CO_2 emissions by 2012. Measures regarding water quality (targets by 2015) will affect more particularly the industries in the metals and chemical sectors.

While experts see relocation of global sectors as a possible consequence of environmental legislation, no unanimous view appears to exist on its importance; it remains unclear and case-specific of how this may affect future industry structures.

In general, environment protection can be expected to be a more significant policy constraint in Europe than in other regions. While this entails costs, it is also a major driver towards the development and early adoption of technologies that can give European manufacturing first mover and lead market advantages. The global market for eco-industries is worth about €600 billion a year, and the EU holds about one third of it.

5.7. Two scenarios for European manufacturing

5.7.1. Introduction

The literature reviewed in the previous pages indicates that globalisation, technological progress, business models, ageing and the availability of energy and sustainability of the environment are the main drivers for the future of manufacturing in Europe. The future trends of these drivers are uncertain. In order to obtain a more clear and systematic view of what Europe's future in manufacturing might be, two alternative scenarios with varying trends in globalisation, technological progress, business models and energy efficiency have been developed. It must be stressed that those scenarios are purely indicative; their value lies in permitting illustrate the effects of different assumptions at sectoral level over long term.

The two scenarios presented here differ across all the drivers of change discussed above; to summarise them, in scenario II globalisation and technological progress thrive, production grows quickly, but the geographical centre of global manufacturing production shifts to Asia. In scenario I, with less globalisation and technological progress, manufacturing production grows more slowly and the European share in global production is relatively larger[93].

[93] For details of the scenarios see Lejour, A.M., and G. Verweij, 2007, "The future of manufacturing in Europe: background report". In the background report, scenario I is code-named *Cosy at Home* and scenario II Adventuring the World.

This section provides a numerical illustration of the two scenarios through using CPB's applied general equilibrium model WorldScan (See Box 5.3, Lejour et al., 2006). Lejour and Verweij (2007) explain in detail the translation from the qualitative scenarios to the quantitative ones and they also provide more detailed results. Because a large part of the scenarios can not be quantified, this section gives not a complete overview of the scenarios. It only illustrates scenario trends which are related to economic growth and economic integration which are at the heart of the WorldScan model.

Box 5.3: WorldScan model

WorldScan is a multi-sector, multi-region Applied General Equilibrium (AGE) model. The model builds upon neoclassical theory, and solves for the equilibrium that maximizes welfare across the entire economy, subject to technological constraints, greenhouse gas limitations, etc.). Producers maximise their profits and consumers maximise their utility. Production technologies relate output to inputs, so a potential increase in the output of a sector leads to extra demand for inputs. This links output to input markets. Moreover, trade flows between countries, and in particular two-way intra-industry trade, are well modelled. The integration of national goods and services markets and of capital markets creates the possibility to analyse spillovers between countries. Another advantage is that these models distinguish several sectors in the economy. This model version inhibits endogenous R&D decisions and spillovers and imperfect competition. It distinguishes 15 regions and 20 sectors. Seven large EU countries are modelled separately, and two aggregates for the other old and new Member States. Also United States, Japan, China, India South-East Asia and the rest of the world are distinguished. The sectors are agriculture, energy, ten manufacturing sectors and seven services sectors. The last sector is the R&D sector.

The scenario-specific trends determine the variation between the scenarios in two ways: directly, because the exogenous trends differ between the scenarios; and indirectly, because these differences imply also the variation in the model outcomes. Table 5.2 reviews the variation in exogenous input. Lejour and Verweij (2007) discuss these inputs and the results in greater detail.

Table 5.2: Variation in exogenous inputs

Trend	**Scenario I**	**Scenario II**
Unemployment rate	constant over time	declining
Labour productivity EU	low	high
Energy efficiency	low	high
Savings policy	no	yes
Capital mobility	low	high
Global trade barriers	high	low

Note: the terms low and high are used to describe the development of a trend in one scenario compared with the development in the other scenario. It is not meant to characterise differences between various trends in one scenario.

Source: WorldScan.

Scenario II is built on a smooth functioning of national and international goods and services markets, with barriers to trade reduced through successive liberalisation rounds. In addition, this scenario assumes that the costs of international trade are gradually reduced. Innovation and fierce competition spur labour productivity all over the world. The twelve new EU members and Asia catch-up fast with the EU-15 and the rest of the OECD. The growth in labour productivity in the Rest of the World is much lower than in these catching-up regions. Economic growth is high in this scenario because of more technology spillovers and a more rapid catching up of the developing countries (represented in higher TFP growth). In scenario I labour productivity growth is lower than in scenario II, by about 1%, and no important innovations spur economic growth. This is the case for all regions.

5.7.2. The macroeconomic variables in the two scenarios

Table 5.3 presents the annual average growth rates in labour productivity and GDP for the period 2006-2025. The growth in labour productivity is heavily based on the growth in TFP and the capital-labour ratio.

Table 5.3: Labour productivity and GDP growth, annual averages 2006-2025 by region

	Scenario I		**Scenario II**	
	Labour productivity growth	**GDP growth**	**Labour productivity growth**	**GDP growth**
EU-27	1.5	1.3	2.5	2.5
EU-15	1.3	1.2	2.4	2.4
EU-12	3.1	2.6	4.7	4.4
Rest OECD	1.3	1.5	2.0	2.3
Asia	3.3	4.6	4.6	6.1
Rest of World	1.9	3.3	2.9	4.5

Source: WorldScan.

Table 5.3 shows that the spread for the EU-27 between labour productivity growth rates is 1.5%. That explains a large part of the variation in GDP growth. In general, Both GDP and labour productivity growth display similar patterns. Table 5.4 also illustrates the process of catching up. Labour productivity growth in the EU-12 members and the non-OECD, exceeds that in the EU-15, the United States and Japan. This process will, in time, narrow the gap in GDP per capita between regions.

The variation in regional and global trade policies leads to a diverse picture of openness in the scenarios. In scenario I openness is about constant over time for the EU-15 and the rest OECD, but decreases for the other regions. This drop is explained mainly by the shift to services in the latter regions which are less open for cross border trade. This is completely different in scenario II which is based on liberalised global trade. The degree of openness increases every where and even more so in Asia.

Changes in the openness of regions and differences in regional growth patterns affect also the size and direction of trade flows. Asia, but also, to a lesser degree, the Rest of the World, will become a more important trading partner for Europe during the coming decades in both scenarios but more so in scenario II. This is triggered by high economic growth in Asia. In general, the redirection of trade is stronger in scenario II, with its higher GDP per capita growth and trade liberalisation, than in scenario I.

5.7.3. The two scenarios at sectoral level

In both scenarios, the trend towards a services economy is likely to continue, albeit at a lower speed. Employment shifts away from manufacturing towards services and manufacturing contributes less to the European economy in terms of its value added share. In terms of production manufacturing will grow and will remain important for trade.

Within manufacturing various developments take place. For the purposes of this exercise ten broad manufacturing sectors have been explored: food products, textiles and wearing apparel, wood and other manufacturing, pulp, paper and publishing, chemicals, rubber and plastics, basic metals, non-metallic minerals, electronic equipment, transport equipment and other machinery and equipment. Existing futures and foresight studies as identified in the literature survey underlying the scenarios (see Sections 5.2 - 5.6) do not give much guidance on specifying possible future sectoral developments in the scenarios. Moreover, based on historical productivity growth paths of these sectors, their trade openness, R&D intensity, energy efficiency, and skill intensity, it is highly likely that these sectors will develop differently over time. It has to be noted also that the developments may also differ *within* the ten sectors identified. In most of these aggregate sectors one can distinguish between basic and specialized manufacturing. Basic manufacturing will on average be more affected by international competition than specialized manufacturing. Possible intra-sector shifts from basic to specialized manufacturing are not analysed here, but are certainly relevant.

Economic growth in Europe and the world is higher in scenario II (see Table 5.3 above). This is also reflected in production growth by sector. Production grows faster in scenario II than in scenario I for nearly all sectors in Europe, except textiles and wearing apparel and electronic equipment. These are also sectors in which Europe has a comparative disadvantage. It seems that increasing globalisation and a faster technological change reinforces existing specialization patterns. For most other sectors production growth is about 1% per year higher in scenario II. For wood and other manufacturing, transport equipment, construction and non-metallic minerals it is about 2% higher per year and for chemicals, rubbers and plastics and transport services about 1.5%.

The increase in production seen in almost all sectors does not imply that manufacturing in Europe keeps up with other regions. High economic growth in Asia expands manufacturing production there faster. The Asian share at the world markets increase measured in production and trade. For instance, in scenario II, Europe's share in World production decreases by about 5.4% points, on average. For electronic equipment the decline is dramatic from 22% to less than 8% (see Table 5.4), but also in other machinery and equipment and textiles and wearing apparel the decline is substantial, about 10% of global production. In chemicals, rubber and plastics and basic metals the loss in production share is also substantial, but in wood and other manufacturing we see a small increase in the share of global production. The pattern of changes in production shares differs in both scenarios. The average decrease is equal, but the changes per sector over time are more pronounced in scenario II.

Table 5.4: EU production as share of world production by sector, 2025			
Sector		**Scenario I**	**Scenario II**
	2005	2025	2025
Agriculture, oil and minerals	14.3	11.6	11.8
Energy carriers	19.2	16.5	18.4
Food products	26.9	22.7	23.0
Textiles and wearing apparel	19.3	13.9	9.7
Wood and other	25.6	21.8	25.9
Pulp, paper and publishing	27.8	23.4	24.6
Chemicals, rubber and plastics	27.7	20.7	21.1
Non-metallic minerals	28.6	21.5	24.9
Basic metals	26.2	19.0	18.6
Electronic equipment	22.1	12.9	7.7
Transport equipment	29.3	23.5	24.8
Other machinery and	28.5	19.0	17.7
Research and development	22.5	18.9	18.6
Transport services	25.5	22.0	23.5
Construction	24.8	19.3	21.0
Trade services	23.4	20.0	20.6
Communication	24.8	20.6	20.7
Financial services	21.7	18.7	19.1
Other business services	29.1	26.2	27.5
Other services	28.1	23.8	24.2
Source: WorldScan			

5.7.4. The impact of policies

The use of a general equilibrium model to build the scenarios assures that those are internally consistent. More importantly, this approach permits to evaluate the impact of policies that aim at improving the general framework conditions for competitiveness and their relative importance.

The policies considered are:

– Upgrading skills - the policy modelled is the achievement of the 2010 targets adopted by Council on May 2003 (10% maximum of early school leavers, at least 85% of 2 years olds with upper secondary education, 20% reduction of 15 years olds with low reading literacy achieving, at least 12.5% participation in Lifelong Learning and 15% increase of S&T graduates). The transmission channel is increased labour efficiency. Some of the costs

(notably opportunity costs) involved in reaching the targets - but not all, such as policy costs- are taken into account.

– Better regulation and less administrative burdens for firms - the simulation assumes the achievement of the 25% reduction in administrative costs target. Here too, the transmission channel is increased labour efficiency, i.e. fewer workers are needed for the same production level.

– R&D and innovation policies – here the model assumes that the share of R&D expenditure in GDP reaches 2.7% by 2010. The transmission mechanism is increased TFP growth due to R&D spillovers (sectoral, domestic from other sectors and international) which have been estimated empirically. The model takes into account the policy costs of increasing R&D expenditure.

– A strong competitive Single Market – modelled by reducing the non trade barriers applying to cross border trade of services and energy (by 20%) and to goods and agriculture (by 10%), thus resulting in higher trade flows.

– Environmental policies – reflected by an increase of energy efficiency of 1% per year in all sectors (except energy production itself). This translates into reduced production costs and higher production, especially in energy-intensive sectors. However, the costs of developing more energy efficient technologies are not taken into account.

The individual impact of achieving the targets of these policies on GDP by 2025 is in the range of 0.5-0.6% (skills[94]) to3.0-3.5% (R&D), with the other structural policies in-between (Table 5.5). Their cumulative impact amounts to around 8% (scenario I) to 9% (scenario II).

Table 5.5: Macro effects of framework policies in EU-27

EU	Skills	R&D	Admin. burden	Internal market	Energy efficiency	Total
Scenario I						
GDP	0.5	3.0	1.5	1.7	0.9	7.7
Consumption	0.5	1.6	1.4	5.5	0.9	9.8
Exports	0.5	4.8	1.4	40.6	1.8	49.0
Scenario II						
GDP	0.6	3.5	1.6	2.3	0.8	8.8
Consumption	0.5	1.6	1.4	5.2	0.8	9.4
Exports	0.6	5.9	1.6	29.0	1.5	38.5

Source: WorldScan simulations. The results are % changes from the baseline in 2025.

[94] The economic effect of improved skills increases very gradually, as successive, better educated cohorts enter the work force. In addition, the costs of extra schooling in terms of working time lost are relatively high.

If the differences between the two scenarios in the macro effects of the individual structural policies are minor, the same cannot be said for their at sector level impact (Table 5.6). Globalisation is an important driver that affects particular industries in different ways. The sectors which are already most open for international trade are also the ones mostly affected. These include textiles and wearing apparel, wood and other manufacturing, chemicals, rubber and plastics, electronic equipment, transport equipment and other machinery and equipment. Overall, the sectors food products and pulp, paper and publishing are less influenced. These are sectors which are more domestically oriented, less R&D intensive and face less technological progress. Europe has no comparative advantages in textiles and wearing apparel, electronic equipment and basic metals. Chemicals, rubber and plastics, transport equipment and other transport and equipment will be the important manufacturing sectors in Europe.

Table 5.6: Production volume changes per sector due to framework policies in the two

	Scenario I	**Scenario II**
Agriculture, oil and minerals	0.0	0.5
Energy carriers	2.4	3.6
Food products	3.1	4.2
Textiles and wearing apparel	17.3	20.4
Wood and other manufacturing	10.8	13.4
Pulp, paper and publishing	3.5	4.1
Chemicals, rubber and plastics	18.9	31.7
Non-metallic minerals	5.9	6.5
Basic metals	11.1	15.3
Electronic equipment	53.2	85.8
Transport equipment	25.0	32.4
Other machinery and	18.8	24.0
Research and development	63.6	73.7
Transport services	7.2	7.3
Construction	7.7	6.9
Trade services	3.5	4.1
Communication	1.5	2.4
Financial services	0.3	0.8
Other business services	2.3	3.1
Other services	4.4	3.7

Source: WorldScan.

The increase in R&D benefits the most R&D intensive industries, like electronic and transport equipment, other machinery and equipment and chemicals. Also non-metallic minerals and basic metals benefit more than the R&D-extensive service sectors. R&D does not only affect

the sectors directly but also indirectly by the spillovers between domestic sectors and the international spillovers.

More energy efficiency seems to increase production in most sectors. In particular, the energy-intensive sectors as the chemical industry and transport services benefit the most. For the energy sector itself it has a negative impact due to reduced energy demand. Non-metallic minerals benefits because it is energy-intensive, and manufacturing sectors like transport equipment benefit because equipment is more demanded by the increase in transport services.

Of the structural policies fed into the model, improving skills, reducing the administrative burden and increasing energy efficiency, have the least impact on manufacturing. R&D and innovation policies and strengthening the internal market on the other hand have the strongest and most positive impact. In the coming decades Europe's decreasing share in global manufacturing production and trade will slow down. The structural policies decelerate further the relative decline trend of manufacturing in Europe, such that in some manufacturing sectors such as chemicals, rubber and plastics, and combined machinery and equipment sectors the trend is almost cancelled out. In terms of the EU share in world production (Table 5.7), in the absence of structural policies there is no sector where EU maintains its relative importance by 2025, under either scenario. In the presence of policies (i.e. achievement of targets) sectors such as transport equipment, wood and other manufacturing, energy carriers, Research and development services, chemicals, rubber and plastics; transport services and other business services maintain or almost maintain, their global share (Table 5.7).

Table 5.7: EU production as share of world production by sector in the two

		Scenario I		Scenario II	
Sector		**No framework policies**	**With framework policies**	**No framework policies**	**With framework policies**
	2005	**2025**	**2025**	**2025**	**2025**
Agriculture, oil and minerals	14.3	11.6	11.9	11.8	12.0
Energy carriers	19.2	16.5	17.8	18.4	19.8
Food products	26.9	22.7	23.5	23.0	23.9
Textiles and wearing apparel	19.3	13.9	16.2	9.7	11.5
Wood and other	25.6	21.8	23.8	25.9	28.7
Pulp, paper and publishing	27.8	23.4	24.4	24.6	25.6
Chemicals, rubber and	27.7	20.7	23.5	21.1	26.3
Non-metallic minerals	28.6	21.5	22.7	24.9	26.2
Basic metals	26.2	19.0	20.8	18.6	21.0
Electronic equipment	22.1	12.9	19.0	7.7	13.7
Transport equipment	29.3	23.5	27.6	24.8	31.0
Other machinery and	28.5	19.0	22.1	17.7	21.4
Research and development	22.5	18.9	29.8	18.6	30.8

Transport services	25.5	22.0	23.1	23.5	24.7
Construction	24.8	19.3	20.9	21.0	22.5
Trade services	23.4	20.0	21.5	20.6	22.0
Communication	24.8	20.6	21.8	20.7	21.8
Financial services	21.7	18.7	19.7	19.1	20.0
Other business services	29.1	26.2	27.7	27.5	28.9
Other services	28.1	23.8	25.8	24.2	26.0
Source: WorldScan.					

5.8. General conclusions

Taking the long view only reinforces the conclusions already reached in the previous chapter. From the literature survey of existing foresight and futures studies, the backbone of which is formed by three recent EU-wide foresight projects on the future of manufacturing in Europe FutMan, ManVis and Manufuture, there emerge some clear dynamics, summarised below.

Manufacturing will employ directly far less persons (even in China manufacturing employment shrunk over the last years) than today and will represent a smaller part of the whole economy. European manufacturing firms will employ more people and will produce more outside Europe than today. Also, their ownership, at least for the larger among them, will be much more international than today. The most successful of these firms will act as component integrators, leading global value networks.

It needs to be stressed that the continuation of the two negative trends, on employment and relative share in the total economy, must not be confounded with stagnation or decline. European industry can still contribute directly to welfare and productivity growth, in addition to its other positive "externalities", such as superior research intensity and demand for high skilled services, while losing jobs and relative size. To a certain extent, these trends result from normal demand size developments and reflect the effect of different income elasticities of demand for goods and services. Of real concern, over the longer term, would be a growing differential in productivity growth with its main competitors.

It is not clear which of the emerging technologies (electromechanical microsystems, advanced materials, bio and nanotechnologies) will be in everyday use. What is certain is that managing knowledge will be as important, if not more, as managing the other production factors and the successful business models of the future will be those that perform better in this respect. This will probably lead to ever more complex organisational approaches, with a high degree of collaboration and networking with suppliers, customers, competitors and external sources of knowledge, such as research institutions and universities.

It is also certain that the service content of manufacturing, but also of the package sold with the final product, will further increase. The latter creates new revenue opportunities and valuable long lasting relationships with customers; however, they are also prone to outsourcing.

These developments will put the skill basis under stress. Soft skills, such as team working, learning, sharing and communicating, providing a service as well as a good and the ability to think interdisciplinary will become crucial, especially for SMEs wanting to participate in the

global networks, something which may become necessary even for serving a local market. In return, work places will have to become more attractive and accommodative for potential high-skill employees, especially older ones and women.

Dynamic specialisation will result in Europe maintaining strong positions in many medium-high and high technology sectors (chemicals, including pharmaceuticals, mechanical engineering, cars, aerospace). This will necessitate important R&D efforts to continuously expand the technological frontier in these industries so as to keep the competitive edge. Another stronghold is represented by sectors with high income elasticity (high end products in traditional sectors) where, together with technological innovation, design and marketing play an important role.

Much will also depend on European firms' ability to capitalise on the opportunities that global challenges, such as ageing and climate change, represent. As Europe seems to face them earlier than most of its competitors, with the exception of Japan, there is a real opportunity for establishing lead market positions in products linked to health care, convenience, leisure and entertainment. While the global response to climate change remains uncertain, energy efficiency and recycling potential will be important value attributes. More generally, technologies that permit to operate within much stringer environmental constraints than today will offer lead market opportunities.

The use of scenarios permits to draw a number of interesting conclusions on the future of manufacturing in Europe. The increase in trade and, more generally, globalisation appears to be one of the most important drivers. The sectors which are already most open for international trade are also the ones mostly affected by this trend. These include textiles and wearing apparel, wood and other manufacturing, chemicals, rubber and plastics, electronic equipment, transport equipment and other machinery and equipment. Overall, the sectors food products and pulp, paper and publishing are less influenced. These are sectors which are more domestically oriented, less R&D intensive and face less technological progress. Europe has no comparative advantages in textiles and wearing apparel, electronic equipment and basic metals. These disadvantages will further manifest themselves in the oncoming twenty years. In particular this applies to electronic equipment which – while in the past a relative big sector - will decline even further. Textiles and wearing apparel is an already small sector in terms of value added and employment, which means that an even less prosperous future for this sector will also have less overall impact. Chemicals, rubber and plastics, transport equipment and other transport and equipment will be the important manufacturing sectors in Europe, although the comparative advantages in the other machinery and equipment sector will slide away. These sectors are important in the composition of Europe's exports and produce about a quarter of global production and global trade in these sectors the coming decades.

Of the framework policies analysed in this study, improving skills, reducing the administrative burden and increasing energy efficiency, have a positive but relatively modest impact on manufacturing while R&D and innovation policies and strengthening the internal market will have a much stronger, and positive, effects. These are also the most ambitious in terms of policy formulation and implementation, but potentially very effective in supporting manufacturing because of their R&D intensive and reinforcing competition nature. In the coming decades Europe's decreasing share in global manufacturing production and trade will slow down. The framework policies further decelerate this slowing down of the relative decline of manufacturing in Europe, such that in some manufacturing sectors, as chemicals, rubber and plastics, and combined machinery and equipment, the declining trend nearly stops.

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Annex Box 5.1: Overview of Key Futures Studies

An obvious source for identifying trends and drivers affecting the future of European manufacturing are foresight or future studies on the subject conducted in Europe. However, as Europe's future depends on developments of its main competitors, it is essential to take into account similar projects in America, and Asia to avoid a too Europe-centric view of the future.

The key European manufacturing foresight projects conducted in the past 5 years are FutMan (2003), ManVis (2005) and Manufuture. FutMan, short for 'Future of Manufacturing', was conducted in 2003 addressing the question of how Europe can be competitive in 2015-2020 exploiting new scientific and technological developments, while responding to the needs and challenges of sustainable development (CEC, 2003). Based on a large Delphi survey involving more than 3000 manufacturing experts across Europe as well as the research results of FutMan, ManVis (2005) – short for Manufacturing Visions –developed future visions of EU manufacturing 2020. Questions also addressed how emerging economies such as China, India and Brazil impact on the location of global manufacturing production and resulting impacts for European manufacturing. These results have been fed into long-term planning for research funding in 2006 as part of the 'ManuFuture' Strategic Research Agenda. Manufuture is a European Technology Platform whose mission is to develop a strategy based on research and innovation to secure high added value employment as well as a major share of world manufacturing in Europe by speeding up industrial transformation towards a knowledge driven economy (Manufuture, no date). All three projects were financed by European Commission (DG Research) and feed into policy making at European but also national level.

The main American studies are the 1998 'Integrated Manufacturing Technology Roadmapping Initiative' (IMTI), which was created to identify and evaluate the key technology goals that would enable a competitive and capable US manufacturing base in the future, while creating pathways for achieving these goals in practice (Merrell, 1999). Furthermore, in 2004 SRI – a non-profit research institute formerly part of Stanford University – conducted a series of analyses for the Manufacturing Extension Partnership (MEP) of the National Institute of Standards and Technology (NIST) to provide America's small manufacturers with reports to better understand the major shifts arising from deepening globalisation, the emergence of south-east Asian competitors and rapid advances in technology (SRI, 2007).

Asian studies on the future of manufacturing available in English language are sparse. While Japan is the country with the longest tradition of technology foresight conducting quinquennial large scale foresight exercises since the late 1970s (Cuhls, 2001), the only relevant study found was the 2005 Delphi survey (Nistep, 2005) focusing on future technologies. As broader visions of future manufacturing cannot be found in this report, government policy documents were instead the main source on future manufacturing paradigms and strategic developments in Japan. Other countries like China (NRCSTD China, 2005) and India (PC India, 2002) have just started conducting national foresight or future studies, meaning that perspectives on future manufacturing in these countries rely on mostly Western assessments found in the large European and American projects.

Additionally, key global future studies with a primarily economic focus were included as macro-economic future projections were missing from the Foresight projects presented above.

These are the *Global Economic Prospects* study by the World Bank (2007) as well as the GoldmanSachs (2003) and PwC (2006) studies on emerging economies in 2050.

Annex Box 5.2: Emergence of Foresight in Europe

While the desire to foresee the future is as old as mankind, in the 1940s serious attempts emerged in the US to forecast future technological developments known as 'technological forecasting' (Jantsch, 1967). Disappointments with methods and results of these forecasts – particularly the failure to foresee the 'oil crisis' – meant that during the 70s and 80s interest was waning. The only nation consistently engaging in long-term forecasts were the Japanese, producing quinquennial large scale national Delphi surveys since 1971 (Cuhls, 2001). Europe experienced a renewed interest in forecasting in the early 1990's, primarily to focus public resource allocation. Germany was the first to emulate the Japanese survey in 1991 soon followed by France (Grupp & Linstone, 1999). The UK started exploring new methods using expert panels for the different UK industry sectors, informed by a national Delphi survey, scenarios, expert presentations and regional workshops to identify future science and technology areas, which could be exploited for wealth creation and improvements in quality of life (Georghiou, 1996). This formed the UK Technology Foresight Programme from 1996.

These developments marked a new approach commonly termed as 'technology foresight'. However, as these projects do not only focus on future technologies but as much on social and economic developments the term 'technology foresight' is misleading. Instead, it is nowadays plainly referred to as 'foresight' (Unido, 2005). Foresight is commonly described as "a systematic means of assessing those scientific and technological developments which could have strong impact on industrial competitiveness, wealth creation and quality of life" (Unido, 2005). It should not be confused with other approaches such as forecasting, future studies or strategic planning. In contrast to the previous forecasting attempts, the emphasis has changed from predicting to creating the future through shared visions and plans to put these into practice. Furthermore, with the rise of the 'Systems of Innovation' concept, the importance of linking the various actors became a key aspect of national foresight exercises. Consequently, the emphasis changed to creating networks and shared visions among dispersed expert groups to create possible self-fulfilling prophecies linking social-demands with technological and economic developments.

While the early phase of foresight in Europe led to a number of large scale national programmes, the focus has changed to small scale, topic related exercises in the countries that conducted the first national programmes in the early 1990s. Examples are the 2nd and 3rd round of foresight exercises in the UK. However, the interest in national foresight exercises has spread to the New EU Member States and countries overseas, such as Romania and Hungary but also Thailand, India and China.

This spreading of foresight has led to a number of European exercises, also on the subject of manufacturing. In 2003 FutMan "The Future of Manufacturing in Europe 2015-2020 – The Challenge for Sustainability" was the first project focusing on manufacturing. It differed to the foresight exercises described above in the respect that it was research groups producing the reports based on expert surveys and desk research. However, it also included the construction of four scenarios. FutMan formed the basis for the large scale European foresight exercise ManVis – Manufacturing Visions 2020 – concluded in 2005. Backbone of the ManVis exercise was a large scale European Delphi survey involving more than 3000 manufacturing experts across Europe. The results of this survey were used to augment the scenarios developed in the FutMan project to create visions of European manufacturing in 2020. Furthermore, the FutMan and ManVis results also fed into the 'Strategic Research Agenda' of the European Manufacturing platform 'Manufuture' presented in 2006. All three

projects represent important sources in this survey. In addition, the European Commission (DG for Research) established in 2000 the European Foresight Monitoring Network (EFMN)[95].

[95] http://www.efmn.info/

D. STATISTICAL ANNEX

6. SECTORAL COMPETITIVENESS INDICATORS

Explanatory notes

Geographical coverage: all indicators refer to EU-27

Production index: The production index is actually an index of final production in volume terms.

Labour productivity: this indicator is calculated by combining the indexes of production and number of persons employed. Therefore, this indicator measures **final production** per person.

Unit Labour Cost: it is calculated from the production index and the index of wages and salaries and measures labour cost per unit of production. "Wages and salaries" is defined (Eurostat) as *"the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period, regardless of whether it is paid on the basis of working time, output or piecework and whether it is paid regularly … wages and salaries do not include social contributions payable by the employer"*.

Relative Trade Balance: it is calculated, for sector "i", as $(X_i-M_i)/(X_i+M_i)$, where X_i and M_i are EU-27 exports and imports of products of sector "i" to and from the rest of the World.

Revealed Comparative Advantage (RCA): For sector "i" it is defined as follows:

$$RCA_i = \frac{\frac{X_{EU,i}}{\sum_i X_{EU,i}}}{\frac{X_{W,i}}{\sum_i X_{W,i}}}$$

where:

X = exports

i = sector

W = World

Table 7.1: EU-27 production index annual growth rate (%)													
NACE	**Sector**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Average 2001-2006**
C	**Mining and quarrying**	1.2	-2.2	-1.6	1.7	-3.0	-3.7	1.2	-2.9	-3.1	-4.1	-4.1	0.0
D	**Manufacturing**	0.2	4.4	3.6	1.7	5.4	0.2	-0.6	0.6	2.6	1.4	4.5	1.4
DA15	**Food products and beverages**	1.3	3.1	0.9	1.8	1.2	1.6	2.4	1.0	1.4	2.0	1.7	1.7
DA16	**Tobacco products**	9.4	-1.7	1.9	-5.2	-5.9	-2.4	-0.4	-5.7	-6.1	-4.5	-6.2	-4.2
DB17	**Textiles**	-3.6	3.7	-1.9	-4.7	1.3	-3.7	-4.5	-2.8	-4.5	-4.8	-1.9	-3.7
DB18	**Wearing apparel; dressing; dyeing of fur**	-5.1	-3.4	-3.0	-9.5	-5.1	-2.7	-11.3	-5.3	-5.5	-9.8	-0.8	-6.0
DC19	**Tanning, dressing of leather; manufacture of luggage**	-3.4	1.1	-5.5	-3.9	-3.1	-3.9	-7.6	-7.5	-11.1	-8.4	-1.5	-6.7
DD20	**Wood and products of wood and cork**	-3.3	4.2	3.0	2.6	5.5	-3.0	0.2	1.3	3.5	1.1	3.8	1.1
DE21	**Pulp, paper and paper products**	-2.0	5.1	0.6	2.4	3.3	-2.2	3.3	2.1	3.5	-0.8	3.1	1.5
DE22	**Publishing, printing, reproduction of recorded media**	-0.1	3.7	4.7	3.4	2.0	-1.5	-0.5	-0.7	2.2	-0.2	0.3	-0.1
DF23	**Coke, refined petroleum products and nuclear fuel**	-0.4	-1.6	2.3	-5.7	3.8	-0.2	-1.3	1.4	4.0	1.0	-0.3	0.8
DG24	**Chemicals and chemical products**	2.8	6.1	3.1	4.7	5.1	3.2	5.3	2.1	1.6	2.0	3.9	3.0
DH25	**Rubber and plastic products**	-0.9	5.6	4.4	2.5	4.8	-0.7	0.2	1.9	1.9	0.5	4.0	1.3
DI26	**Other non-metallic mineral products**	-2.6	2.8	2.2	2.2	3.8	-1.0	-1.9	0.7	2.1	0.2	4.0	0.7

DJ27	**Basic metals**	-2.2	6.3	0.9	-3.6	6.8	-1.5	-0.3	-0.2	4.3	-1.7	5.1	0.9
DJ28	**Fabricated metal products**	-1.1	4.0	4.6	0.6	5.9	0.7	-0.2	0.4	3.0	1.6	5.3	1.8
DK29	**Machinery and equipment n.e.c.**	0.4	2.9	2.5	-2.7	5.9	1.4	-1.3	-0.7	3.9	3.6	7.4	2.3
DL30	**Office machinery and computers**	8.2	5.5	13.2	8.9	17.5	-2.1	-16.8	-0.4	-0.4	2.8	6.6	-2.0
DL31	**Electrical machinery and apparatus n.e.c.**	-0.4	4.9	5.0	3.3	7.8	1.4	-3.8	-0.7	3.9	2.0	8.1	1.8
DL32	**Radio, television and communication equipment and apparatus**	3.9	7.0	9.0	12.0	25.9	-10.9	-9.8	1.3	12.4	5.3	13.9	1.6
DL33	**Medical, precision and optical instruments, watches and clocks**	0.4	2.2	3.9	1.5	10.3	4.6	-0.2	1.5	2.5	1.9	7.4	2.9
DM34	**Motor vehicles, trailers and semi-trailers**	2.9	8.0	11.3	3.8	7.7	2.0	1.0	2.3	5.1	1.9	2.6	2.5
DM35	**Other transport equipment**	1.2	8.6	4.1	5.8	0.4	3.0	-6.1	3.0	2.9	3.0	10.2	2.6
DN36	**Furniture; manufacturing n.e.c.**	-1.1	1.5	4.5	2.7	2.7	-0.4	-4.7	-2.4	0.7	-0.2	2.5	-0.8
DN37	**Recycling**	n.a.	n.a.	n.a.	n.a.	n.a.	3.5	6.6	-0.2	6.8	2.7	13.0	5.3
E	**Electricity, gas and water supply**	3.3	0.4	1.8	2.4	3.8	2.5	0.8	3.0	1.9	1.6	0.9	1.8
Source: calculated with Eurostat data.													

Table 7.2: EU-27 number of persons employed annual growth rate (%)													
NACE	**Sector**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Average 2001-2006**
C	**Mining and quarrying**	n.a.	-5.7	-6.7	-9.8	-9.1	-4.0	-4.0	-4.4	-5.1	-3.6	-5.2	0.0
D	**Manufacturing**	-1.4	-0.7	0.7	-1.9	-1.1	-0.2	-2.1	-1.9	-1.9	-1.3	-0.6	-1.3
DA15	**Food products and beverages**	0.0	-0.3	0.8	-1.3	-1.6	-0.7	-0.3	-0.3	-1.3	0.2	-0.2	-0.4
DA16	**Tobacco products**	n.a.	-4.3	-3.0	-9.3	-5.1	-2.9	-2.3	-6.0	-6.4	-2.8	-1.1	-3.6
DB17	**Textiles**	n.a.	-2.8	-2.1	-6.8	-4.9	-3.0	-4.7	-6.9	-5.9	-4.4	-6.1	-5.2
DB18	**Wearing apparel; dressing; dyeing of fur**	n.a.	-3.5	-2.2	-3.2	-4.3	-2.7	-3.8	-4.0	-5.8	-8.3	-5.8	-5.1
DC19	**Tanning, dressing of leather; manufacture of luggage**	n.a.	-2.4	-4.2	-7.5	-4.1	-1.5	-1.1	-4.9	-7.9	-6.1	-3.4	-4.2
DD20	**Wood and products of wood and cork**	n.a.	-0.3	1.1	0.3	-0.4	-0.8	-1.5	-1.8	-1.1	-0.2	-0.9	-1.1
DE21	**Pulp, paper and paper products**	-2.1	-1.3	0.8	-3.3	-1.5	-1.7	-1.2	-1.8	-1.2	-2.5	-2.0	-1.8
DE22	**Publishing, printing, reproduction of recorded media**	0.2	0.3	1.6	0.3	0.4	0.3	-1.8	-2.9	-1.0	-2.6	-1.1	-1.5
DF23	**Coke, refined petroleum products and nuclear fuel**	n.a.	-4.4	-6.6	-1.1	-3.2	-2.4	-3.0	-3.1	-1.6	-2.4	-6.4	-3.2
DG24	**Chemicals and chemical products**	-1.6	-1.3	-1.1	-2.1	-2.4	-0.3	-0.7	-1.7	-3.1	-1.8	-0.3	-1.3
DH25	**Rubber and plastic products**	-1.0	1.9	3.5	-0.8	1.7	0.8	-0.4	0.8	-0.1	-0.1	-1.0	0.0
DI26	**Other non-metallic mineral products**	-2.9	-1.9	0.7	-2.4	-1.3	-1.1	-2.2	-3.0	-2.3	-1.2	-1.4	-1.9

DJ27	**Basic metals**	-1.9	-2.5	-0.6	-4.3	-5.0	-1.8	-4.7	-3.4	-3.8	-1.5	-0.7	-2.6
DJ28	**Fabricated metal products**	-0.4	0.1	2.1	0.3	0.4	1.1	-1.3	-0.9	0.6	0.5	1.7	0.3
DK29	**Machinery and equipment n.e.c.**	-1.5	-0.6	0.5	-3.0	-2.6	0.0	-1.9	-2.5	-2.5	-0.4	0.5	-1.1
DL30	**Office machinery and computers**	-2.9	1.0	3.1	1.4	0.2	-2.0	-10.0	-7.4	-5.4	-3.1	-0.7	-4.8
DL31	**Electrical machinery and apparatus n.e.c.**	-1.9	-0.8	3.4	-0.8	0.7	1.2	-2.8	-3.2	-0.2	-0.6	2.1	-0.6
DL32	**Radio, television and communication equipment and apparatus**	-1.1	-2.2	1.9	-0.5	5.8	1.0	-8.6	-6.1	-3.8	-2.9	-3.1	-4.0
DL33	**Medical, precision and optical instruments, watches and clocks**	0.2	-0.4	-0.8	-2.4	-0.2	3.0	-1.1	-1.9	0.6	0.5	2.1	0.5
DM34	**Motor vehicles, trailers and semi-trailers**	0.7	1.3	3.0	0.0	1.6	1.3	-1.3	0.2	0.2	-0.8	-0.3	-0.1
DM35	**Other transport equipment**	-3.6	-3.0	-1.3	-2.3	-3.3	0.2	-1.5	-2.7	-1.8	0.8	0.2	-0.8
DN36	**Furniture; manufacturing n.e.c.**	n.a.	0.0	0.4	-1.7	-0.1	0.5	-3.8	1.0	-1.6	-2.0	-1.5	-1.2
DN37	**Recycling**	9.1	3.9	5.1	-3.4	4.7	7.1	4.3	4.5	4.9	4.0	6.0	5.1
E	**Electricity, gas and water supply**	-4.0	-1.7	-2.9	-2.8	-3.0	-2.2	-2.4	-2.9	-2.9	-2.4	-1.0	-2.3
Source: calculated with Eurostat data.													

Table 7.3: EU-27 number of hours worked annual growth rate (%)								
NACE	**Sector**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Average 2001-2006**
C	**Mining and quarrying**	-3.7	-4.7	-5.6	-3.9	-3.3	-5.2	0.0
D	**Manufacturing**	-1.4	-2.8	-2.0	-1.1	-1.5	-0.2	-1.5
DA15	**Food products and beverages**	-1.5	-1.6	-1.7	-1.0	-1.1	-0.3	-1.2
DA16	**Tobacco products**	-1.5	-1.5	-10.1	-5.9	-3.2	-6.7	-4.9
DB17	**Textiles**	-3.3	-4.4	-5.9	-4.4	-6.8	-4.9	-4.9
DB18	**Wearing apparel; dressing; dyeing of fur**	-3.6	-4.0	-4.5	-3.9	-6.2	-4.3	-4.4
DC19	**Tanning, dressing of leather; manufacture of luggage**	-2.5	-4.0	-5.4	-5.6	-6.2	-3.6	-4.5
DD20	**Wood and products of wood and cork**	-2.8	-2.8	-2.3	-0.1	-0.8	0.3	-1.4
DE21	**Pulp, paper and paper products**	-1.7	-2.4	-0.1	-1.8	-2.5	-1.0	-1.6
DE22	**Publishing, printing, reproduction of recorded media**	-0.2	-3.4	-1.3	-2.5	-2.0	-0.2	-1.6
DF23	**Coke, refined petroleum products and nuclear fuel**	-3.4	-2.6	-3.6	-0.7	-3.1	-5.3	-3.1
DG24	**Chemicals and chemical products**	-1.7	-1.5	-1.7	-1.7	-2.7	-1.0	-1.7
DH25	**Rubber and plastic products**	-0.3	-1.8	-0.1	0.5	-0.6	1.1	-0.2
DI26	**Other non-metallic mineral products**	-2.8	-2.9	-3.2	-1.5	-1.6	-1.1	-2.2

DJ27	**Basic metals**	-2.9	-4.3	-5.0	-1.8	-2.5	-0.1	-2.8
DJ28	**Fabricated metal products**	-0.2	-2.0	-1.4	0.3	0.1	1.7	-0.2
DK29	**Machinery and equipment n.e.c.**	-1.6	-2.9	-2.3	-0.9	-1.1	1.1	-1.3
DL30	**Office machinery and computers**	-2.5	-11.1	-5.9	-4.3	-4.7	0.0	-4.8
DL31	**Electrical machinery and apparatus n.e.c.**	-1.1	-2.6	-1.5	0.0	0.1	1.8	-0.6
DL32	**Radio, television and communication equipment and apparatus**	-2.1	-7.9	-5.4	-1.9	-2.6	-2.3	-3.7
DL33	**Medical, precision and optical instruments, watches and clocks**	1.6	-1.7	-1.6	0.2	0.2	1.6	0.1
DM34	**Motor vehicles, trailers and semi-trailers**	-0.4	-2.1	0.4	1.2	0.0	-0.5	-0.2
DM35	**Other transport equipment**	-0.7	-1.9	-2.5	-2.1	0.9	0.9	-0.9
DN36	**Furniture; manufacturing n.e.c.**	0.1	-5.1	-2.1	-0.4	-2.9	0.0	-1.8
DN37	**Recycling**	7.8	2.2	3.4	2.6	6.1	5.0	4.5
E	**Electricity, gas and water supply**	-1.3	-2.8	-2.8	-2.2	-3.0	-1.3	-2.2
Source: calculated with Eurostat data.								

Table 7.4: EU-27 labour productivity (per person employed) annual growth rate (%)													
NACE	**Sector**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Average 2001-2006**
C	**Mining and quarrying**	n.a.	3.8	5.5	12.8	6.7	0.2	5.5	1.5	2.0	-0.5	1.1	0.0
D	**Manufacturing**	1.6	5.1	3.0	3.6	6.7	0.4	1.5	2.5	4.5	2.7	5.2	2.8
DA15	**Food products and beverages**	1.3	3.3	0.1	3.2	2.9	2.4	2.8	1.3	2.7	1.8	1.9	2.1
DA16	**Tobacco products**	n.a.	2.7	5.0	4.5	-0.9	0.6	2.0	0.3	0.3	-1.8	-5.2	-0.7
DB17	**Textiles**	n.a.	6.7	0.2	2.2	6.5	-0.7	0.3	4.4	1.5	-0.5	4.5	1.6
DB18	**Wearing apparel; dressing; dyeing of fur**	n.a.	0.1	-0.8	-6.5	-0.8	0.0	-7.7	-1.3	0.3	-1.5	5.3	-0.9
DC19	**Tanning, dressing of leather; manufacture of luggage**	n.a.	3.6	-1.4	4.0	1.0	-2.5	-6.5	-2.7	-3.5	-2.4	2.0	-2.6
DD20	**Wood and products of wood and cork**	n.a.	4.5	1.9	2.3	5.9	-2.2	1.8	3.2	4.6	1.4	4.8	2.2
DE21	**Pulp, paper and paper products**	0.2	6.5	-0.2	5.9	4.8	-0.5	4.5	4.0	4.8	1.7	5.3	3.3
DE22	**Publishing, printing, reproduction of recorded media**	-0.2	3.4	3.1	3.1	1.6	-1.8	1.3	2.3	3.2	2.5	1.4	1.5
DF23	**Coke, refined petroleum products and nuclear fuel**	n.a.	2.9	9.5	-4.7	7.2	2.3	1.8	4.6	5.8	3.5	6.5	4.1
DG24	**Chemicals and chemical products**	4.5	7.5	4.3	7.0	7.6	3.5	6.0	3.8	4.9	3.8	4.2	4.4
DH25	**Rubber and plastic products**	0.1	3.7	0.9	3.3	3.1	-1.5	0.6	1.2	2.0	0.6	5.0	1.3
DI26	**Other non-metallic mineral products**	0.3	4.8	1.5	4.6	5.2	0.2	0.3	3.8	4.5	1.4	5.5	2.6

DJ27	**Basic metals**	-0.3	9.0	1.5	0.7	12.4	0.2	4.6	3.3	8.4	-0.2	5.8	3.6
DJ28	**Fabricated metal products**	-0.7	3.9	2.4	0.3	5.4	-0.4	1.1	1.4	2.4	1.1	3.5	1.5
DK29	**Machinery and equipment n.e.c.**	1.9	3.6	2.0	0.4	8.7	1.4	0.6	1.9	6.5	4.0	6.9	3.5
DL30	**Office machinery and computers**	11.4	4.4	9.8	7.5	17.2	-0.1	-7.5	7.6	5.2	6.1	7.4	3.0
DL31	**Electrical machinery and apparatus n.e.c.**	1.6	5.8	1.5	4.1	7.0	0.3	-1.0	2.5	4.1	2.6	5.9	2.4
DL32	**Radio, television and communication equipment and apparatus**	5.1	9.4	7.0	12.6	19.0	-11.8	-1.3	7.8	16.9	8.5	17.5	5.7
DL33	**Medical, precision and optical instruments, watches and clocks**	0.2	2.7	4.8	4.0	10.6	1.5	0.9	3.4	1.9	1.4	5.2	2.4
DM34	**Motor vehicles, trailers and semi-trailers**	2.2	6.7	8.0	3.8	6.1	0.7	2.3	2.1	4.9	2.7	2.9	2.6
DM35	**Other transport equipment**	5.1	11.9	5.5	8.3	3.8	2.8	-4.7	5.9	4.8	2.2	10.0	3.4
DN36	**Furniture; manufacturing n.e.c.**	n.a.	1.5	4.1	4.4	2.8	-0.9	-1.0	-3.3	2.3	1.8	4.1	0.5
DN37	**Recycling**	n.a.	n.a.	n.a.	n.a.	n.a.	-3.3	2.2	-4.5	1.8	-1.3	6.6	0.2
E	**Electricity, gas and water supply**	7.6	2.1	4.9	5.3	7.0	4.7	3.3	6.1	4.9	4.1	1.9	4.2
Source: calculated with Eurostat data.													

Table 7.5: EU-27 Unit Labour Cost annual growth rate (%)													
NACE	**Sector**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Average 2001-2006**
C	**Mining and quarrying**	n.a.	1.5	-0.4	-1.7	1.3	6.9	-2.7	4.4	2.6	6.1	8.5	0.0
D	**Manufacturing**	n.a.	-2.7	-0.6	1.0	-1.9	2.6	1.6	0.2	-1.1	0.0	-1.8	0.2
DA15	**Food products and beverages**	n.a.	-1.2	1.4	0.6	1.3	1.7	0.1	1.9	-0.1	-1.2	-0.3	0.3
DA16	**Tobacco products**	n.a.	2.7	1.0	7.0	10.4	4.0	1.3	7.2	10.6	7.4	11.1	6.9
DB17	**Textiles**	n.a.	-2.1	3.7	6.0	0.7	2.8	3.8	1.6	3.2	2.8	1.3	2.6
DB18	**Wearing apparel; dressing; dyeing of fur**	n.a.	3.1	3.9	11.0	4.7	2.0	11.0	2.8	6.8	9.7	1.6	5.6
DC19	**Tanning, dressing of leather; manufacture of luggage**	n.a.	0.8	7.5	5.0	5.8	7.8	8.9	6.8	12.3	9.3	5.3	8.4
DD20	**Wood and products of wood and cork**	n.a.	-3.2	-0.1	0.0	-2.6	4.2	-0.1	-1.2	-0.8	1.2	0.1	0.6
DE21	**Pulp, paper and paper products**	n.a.	-3.0	1.3	0.3	-0.1	4.8	-2.5	-1.9	-2.0	2.0	-2.4	-0.4
DE22	**Publishing, printing, reproduction of recorded media**	n.a.	-1.9	-1.5	0.0	2.0	4.8	1.1	-0.9	-1.9	1.1	0.2	0.7
DF23	**Coke, refined petroleum products and nuclear fuel**	n.a.	1.6	-4.3	6.7	-1.8	3.7	3.9	1.8	1.6	3.4	3.7	3.0
DG24	**Chemicals and chemical products**	n.a.	-5.1	-1.0	-3.0	-1.6	-0.7	-2.5	0.4	-1.1	-0.8	-2.4	-1.2
DH25	**Rubber and plastic products**	n.a.	-2.8	-0.4	1.0	-1.2	3.3	1.2	0.1	1.2	0.4	-2.7	0.6
DI26	**Other non-metallic mineral products**	n.a.	-2.3	-0.2	0.1	-1.1	2.2	3.1	-0.1	-1.4	1.0	-1.2	0.6

DJ27	**Basic metals**	n.a.	-3.9	1.8	4.3	-4.3	-1.0	-0.8	0.2	-2.8	4.2	-1.3	-0.3
DJ28	**Fabricated metal products**	n.a.	-2.1	-1.3	2.2	-2.7	2.9	1.3	0.2	-0.5	-0.1	-1.3	0.4
DK29	**Machinery and equipment n.e.c.**	0.2	-1.6	0.8	4.8	-2.7	1.8	1.9	1.6	-1.1	-1.8	-3.2	-0.1
DL30	**Office machinery and computers**	n.a.	-7.3	-12.4	-5.3	-10.8	5.1	7.2	-7.2	-5.6	-3.5	-6.7	-2.0
DL31	**Electrical machinery and apparatus n.e.c.**	0.5	-5.1	-1.6	-0.4	-3.6	2.0	4.2	-0.5	-1.9	-0.6	-3.8	-0.1
DL32	**Radio, television and communication equipment and apparatus**	n.a.	-4.5	-2.7	-6.5	-14.7	17.1	6.1	-5.9	-11.8	-6.2	-12.6	-2.7
DL33	**Medical, precision and optical instruments, watches and clocks**	1.5	-1.2	-2.1	0.3	-4.9	1.5	1.5	-0.5	0.5	1.5	-3.5	0.2
DM34	**Motor vehicles, trailers and semi-trailers**	0.7	-4.5	-5.8	1.1	-2.6	1.5	1.2	1.3	-2.4	-0.4	0.5	0.3
DM35	**Other transport equipment**	n.a.	-7.1	-1.2	-2.2	1.1	2.8	10.0	-1.1	-2.9	0.8	-6.6	0.4
DN36	**Furniture; manufacturing n.e.c.**	n.a.	-0.2	-2.5	-0.2	-0.4	3.2	5.0	1.3	-0.8	0.3	-0.1	1.5
DN37	**Recycling**	n.a.	n.a.	n.a.	n.a.	n.a.	6.1	-2.0	6.9	0.5	3.7	-5.2	1.6
E	**Electricity, gas and water supply**	n.a.	0.5	-2.9	-0.7	-3.5	0.3	3.7	0.5	0.2	0.1	4.9	1.6
Source: calculated with Eurostat data.													

Table 7.6: EU-25 Relative trade balance (X-M)/(X+M)								
Product	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Food products, beverages and tobacco	0.09	0.09	0.07	0.09	0.07	0.07	0.07	0.08
Textiles	-0.10	-0.08	-0.08	-0.07	-0.07	-0.10	-0.12	-0.15
Wearing apparel; dressing; dyeing of fur	-0.49	-0.50	-0.47	-0.48	-0.50	-0.52	-0.54	-0.55
Tanning, dressing of leather; manufacture of luggage	-0.13	-0.12	-0.13	-0.16	-0.20	-0.20	-0.24	-0.24
Wood and of products of wood and cork	-0.20	-0.19	-0.14	-0.07	-0.09	-0.11	-0.08	-0.08
Pulp, paper and paper products	0.14	0.11	0.15	0.21	0.24	0.17	0.25	0.29
Publishing, printing, reproduction of recorded media	0.27	0.26	0.30	0.31	0.32	0.31	0.27	0.26
Coke, refined petroleum products and nuclear fuel	0.01	0.04	0.01	0.08	-0.04	-0.10	-0.16	n.a.
Chemicals and chemical products	0.21	0.22	0.23	0.25	0.25	0.25	0.23	0.23
Rubber and plastic products	0.03	0.04	0.06	0.09	0.09	0.10	0.11	0.10
Other non-metallic mineral products	0.40	0.36	0.34	0.36	0.34	0.30	0.27	0.27
Basic metals	-0.18	-0.20	-0.19	-0.18	-0.18	-0.19	-0.07	-0.18
Fabricated metal products	0.21	0.15	0.18	0.22	0.20	0.21	0.17	0.17
Machinery and equipment n.e.c.	0.31	0.29	0.33	0.37	0.37	0.40	0.38	0.40

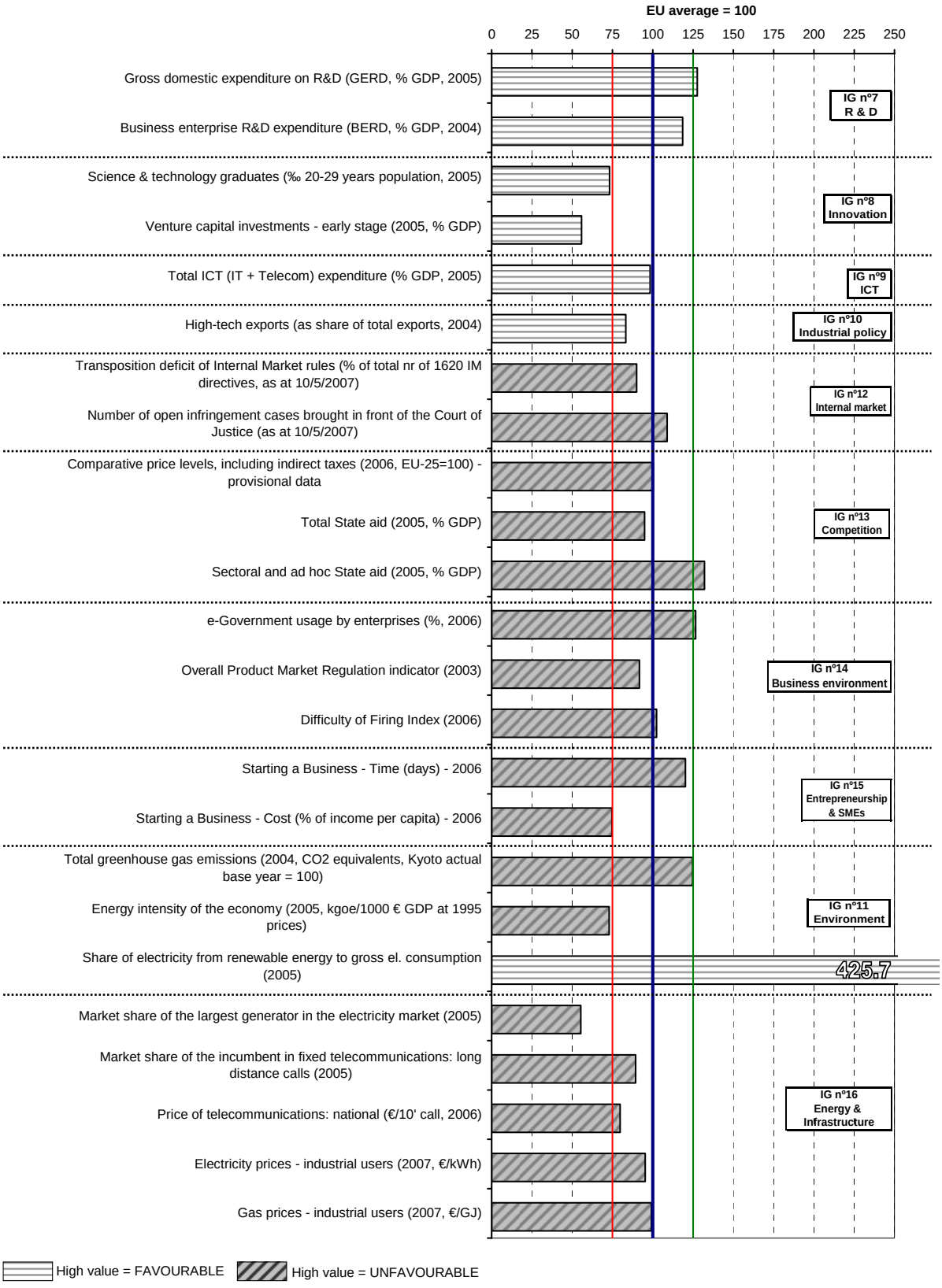
Office machinery and computers	-0.47	-0.44	-0.41	-0.42	-0.44	-0.45	-0.41	-0.45
Electrical machinery and apparatus n.e.c.	0.04	-0.01	0.06	0.07	0.07	0.08	0.08	0.12
Radio, television and communication equipment and apparatus	-0.14	-0.18	-0.16	-0.18	-0.20	-0.19	-0.16	-0.21
Medical, precision and optical instruments, watches and clocks	-0.04	-0.04	-0.02	0.04	0.06	0.12	0.10	0.08
Motor vehicles, trailers and semi-trailers	0.28	0.36	0.40	0.42	0.41	0.40	0.40	0.37
Other transport equipment	0.00	0.01	0.05	0.01	-0.02	-0.01	0.02	0.07
Furniture; manufacturing n.e.c.	-0.05	-0.06	-0.04	-0.06	-0.10	-0.13	-0.16	-0.16
Source: calculated with Eurostat data								

Table 7.7: EU-25 Revealed Comparative Advantage Index											
Product	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Food products, beverages and tobacco	1.12	1.08	1.14	1.10	1.13	1.17	1.06	1.09	1.07	1.07	1.05
Textiles	0.73	0.72	0.73	0.74	0.73	0.72	0.71	0.68	0.69	0.71	0.66
Wearing apparel; dressing; dyeing of fur	0.59	0.62	0.58	0.54	0.55	0.54	0.54	0.53	0.53	0.54	0.55
Tanning, dressing of leather; manufacture of luggage	1.10	1.17	1.13	1.09	1.13	1.21	1.14	1.10	1.08	1.09	1.03
Wood and of products of wood and cork	0.49	0.49	0.55	0.62	0.58	0.65	0.69	0.74	0.77	0.75	0.79
Pulp, paper and paper products	0.95	1.01	1.05	1.00	1.02	1.03	1.01	1.10	1.13	1.16	1.14
Publishing, printing, reproduction of recorded media	1.43	1.47	1.46	1.45	1.46	1.47	1.30	1.35	1.46	1.45	1.46
Coke, refined petroleum products and nuclear fuel	1.28	1.13	1.30	0.93	0.94	0.92	1.11	1.04	1.05	1.00	1.15
Chemicals and chemical products	1.27	1.29	1.33	1.39	1.45	1.47	1.44	1.53	1.45	1.42	1.41
Rubber and plastic products	0.91	0.90	0.93	0.91	0.91	0.91	0.89	0.89	0.93	0.95	0.92
Other non-metallic mineral products	1.57	1.54	1.55	1.56	1.56	1.54	1.47	1.41	1.41	1.39	1.34
Basic metals	0.82	0.86	0.84	0.76	0.74	0.86	0.81	0.78	0.73	0.76	0.80
Fabricated metal products	1.17	1.16	1.14	1.13	1.15	1.09	1.08	1.07	1.10	1.12	1.10
Machinery and equipment n.e.c.	1.50	1.49	1.51	1.51	1.51	1.45	1.46	1.48	1.48	1.49	1.48

Office machinery and computers	0.46	0.42	0.43	0.45	0.48	0.49	0.49	0.45	0.44	0.41	0.45
Electrical machinery and apparatus n.e.c.	0.95	0.96	0.97	0.98	0.96	0.93	0.95	0.91	0.94	0.96	0.94
Radio, television and communication equipment and apparatus	0.51	0.56	0.53	0.59	0.59	0.62	0.56	0.47	0.48	0.49	0.53
Medical, precision and optical instruments, watches and clocks	1.03	1.02	1.05	1.06	1.08	1.08	1.09	1.20	1.14	1.13	1.10
Motor vehicles, trailers and semi-trailers	0.98	0.96	0.98	0.93	0.88	0.96	0.99	0.99	1.09	1.12	1.10
Other transport equipment	1.42	1.33	1.17	1.25	1.34	1.35	1.28	1.35	1.24	1.22	1.23
Furniture; manufacturing n.e.c.	1.09	1.07	1.10	1.04	1.04	1.07	1.03	1.00	0.94	0.87	0.83
Source: calculated with COMTRADE data.											

7. MICROECONOMIC DATA COUNTRY FICHES

Austria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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
Business enterprise R&D expenditure (BERD, % GDP, 2004)
IG n°7 R & D
Science & technology graduates (‰ 20-29 years population, 2005)
Venture capital investments - early stage (2005, % GDP)
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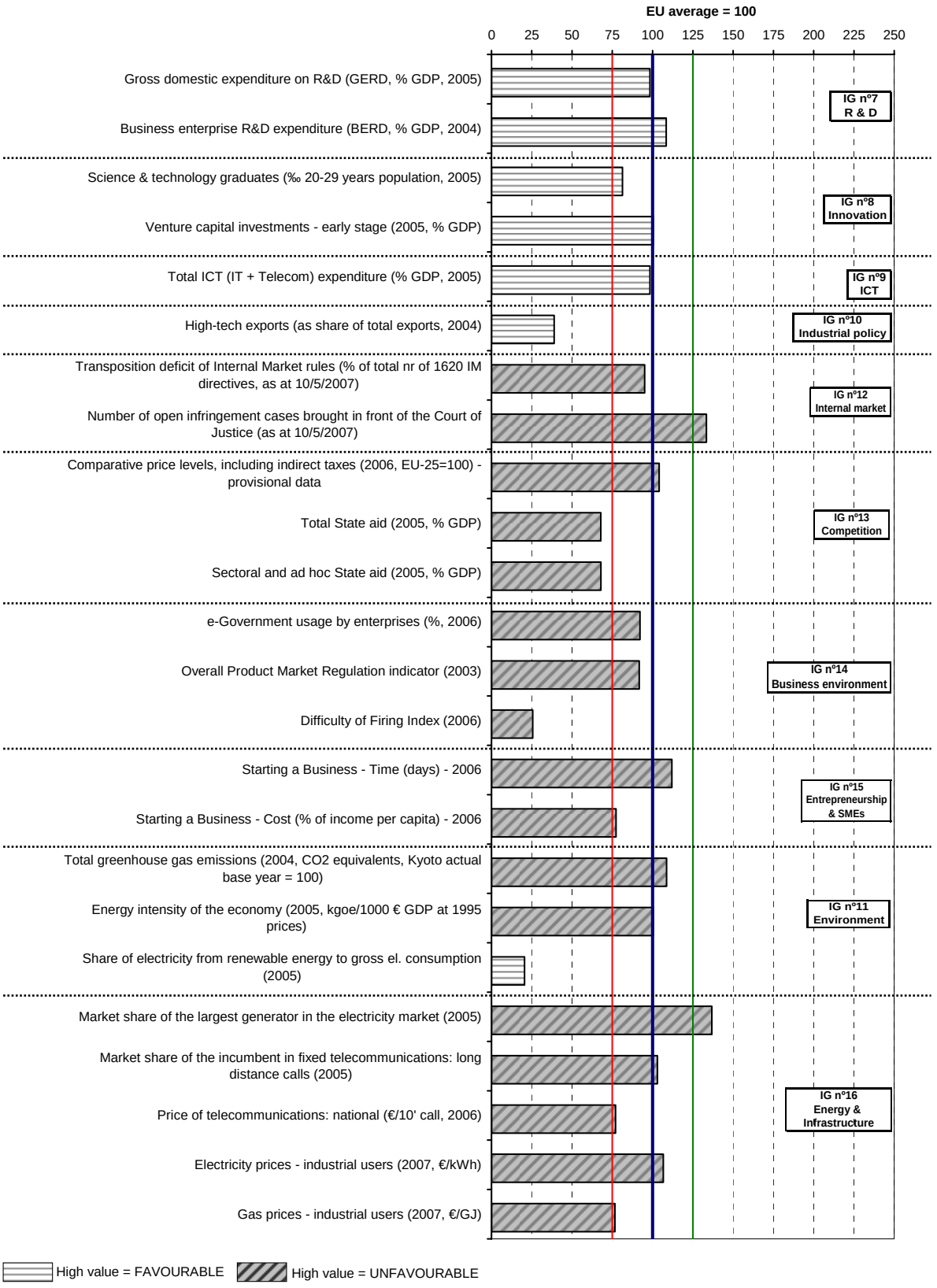
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
IG n°11 Environment
Share of electricity from renewable energy to gross el. consumption (2005)
425.7
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
IG n°16 Energy & Infrastructure
Price of telecommunications: national (€/10' call, 2006)
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Belgium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Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
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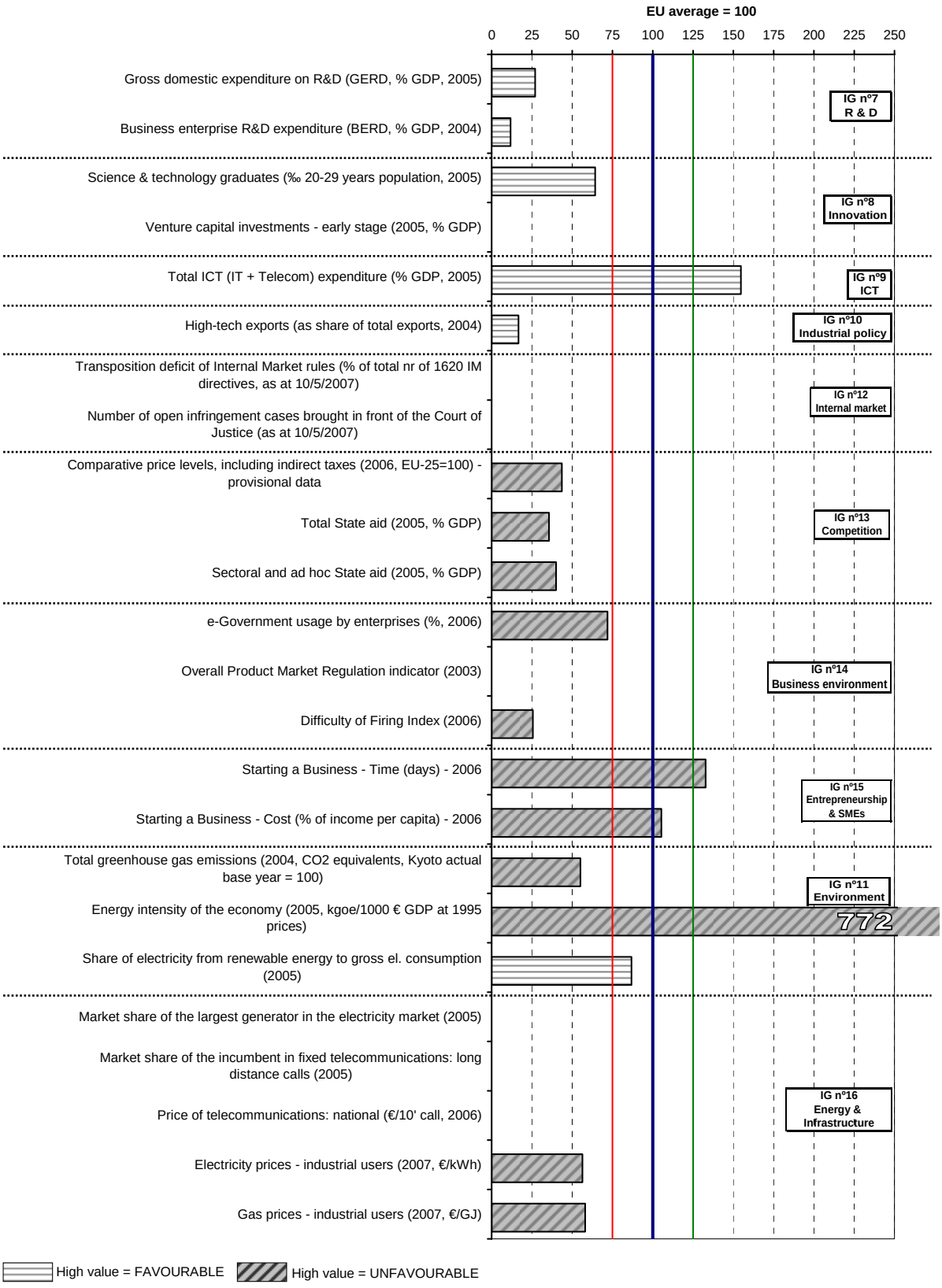
Bulgaria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Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
772
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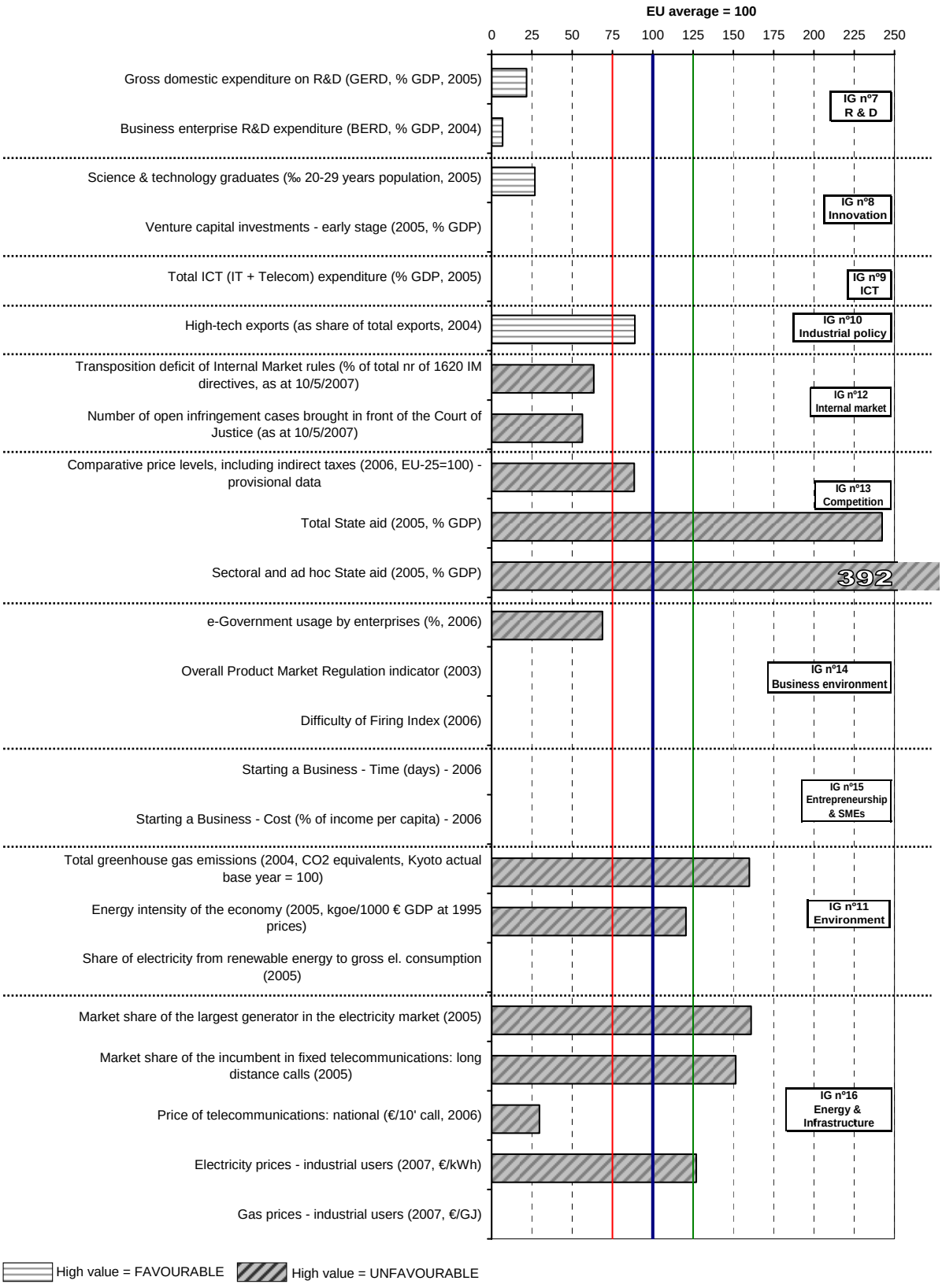
Cyprus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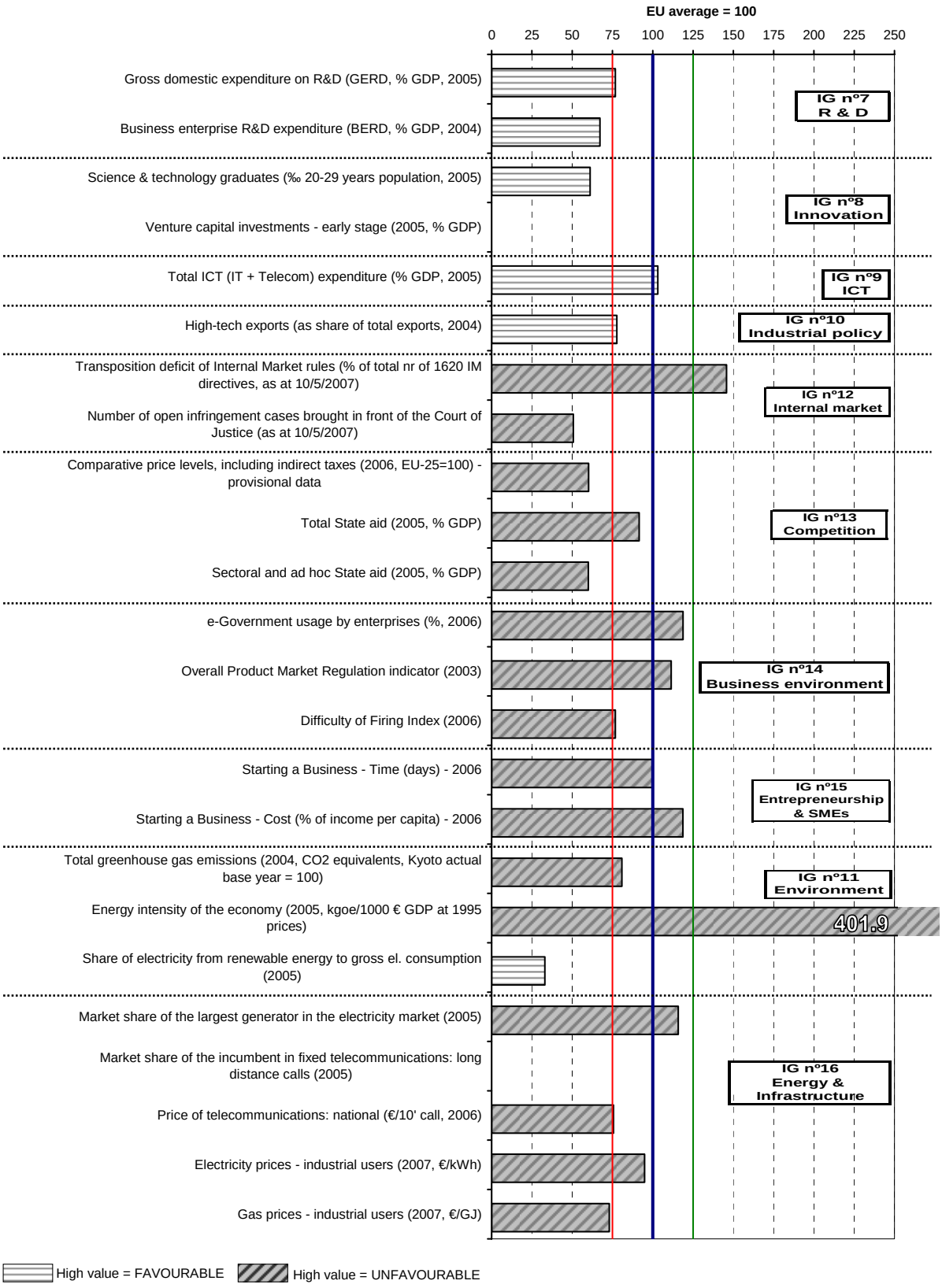
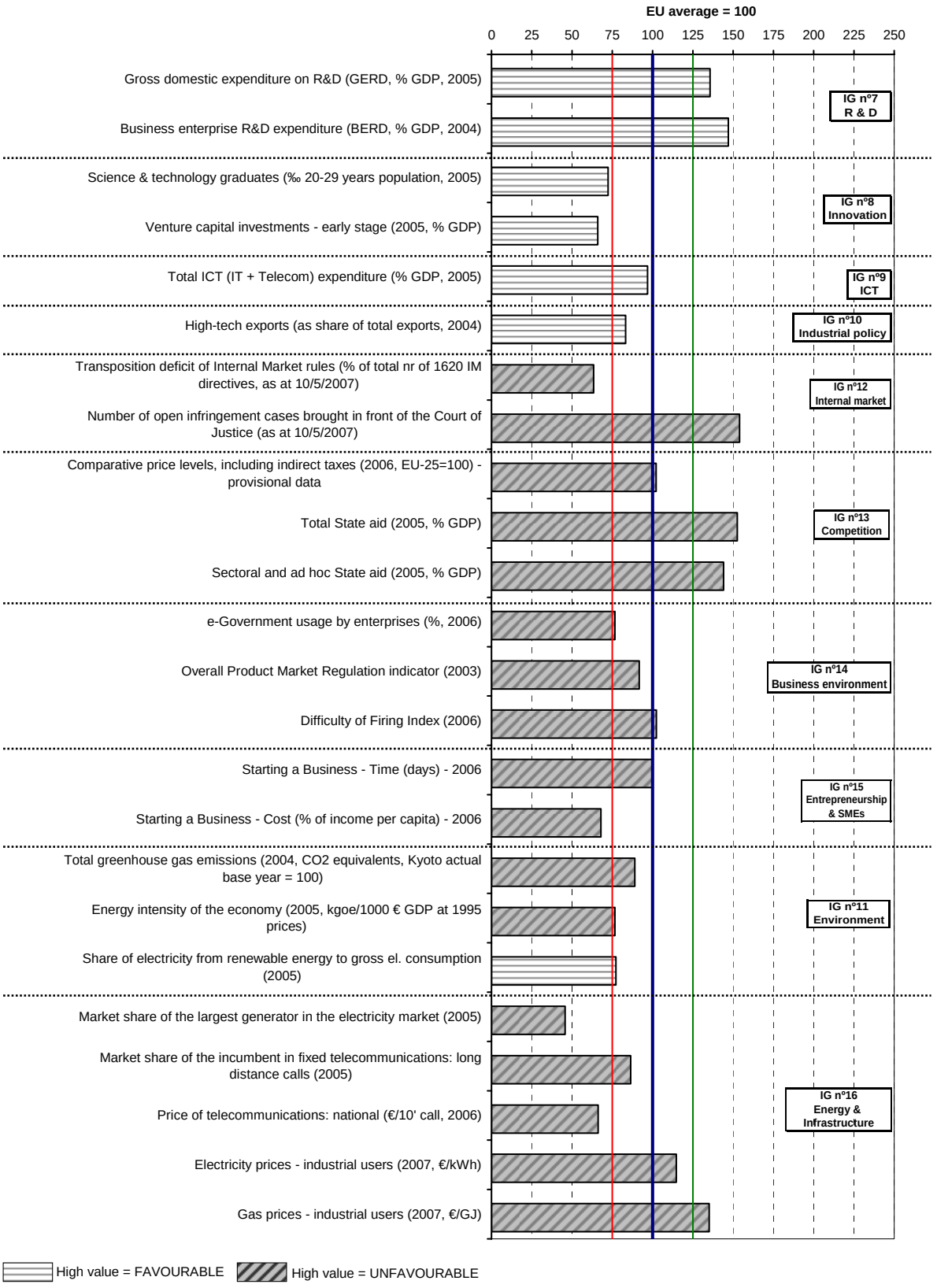
Czech Republic



Germany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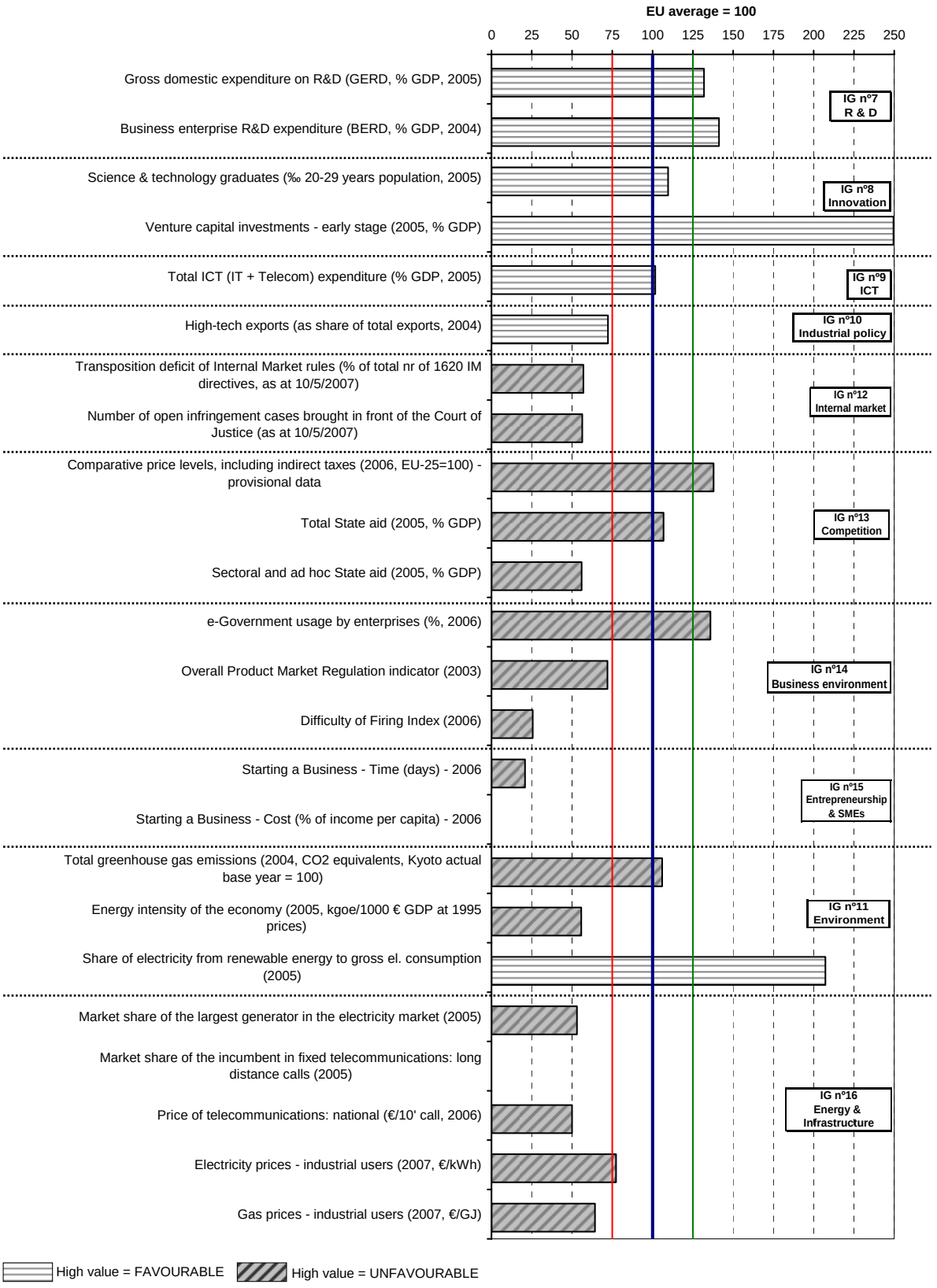
Denmark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High value = FAVOURABLE
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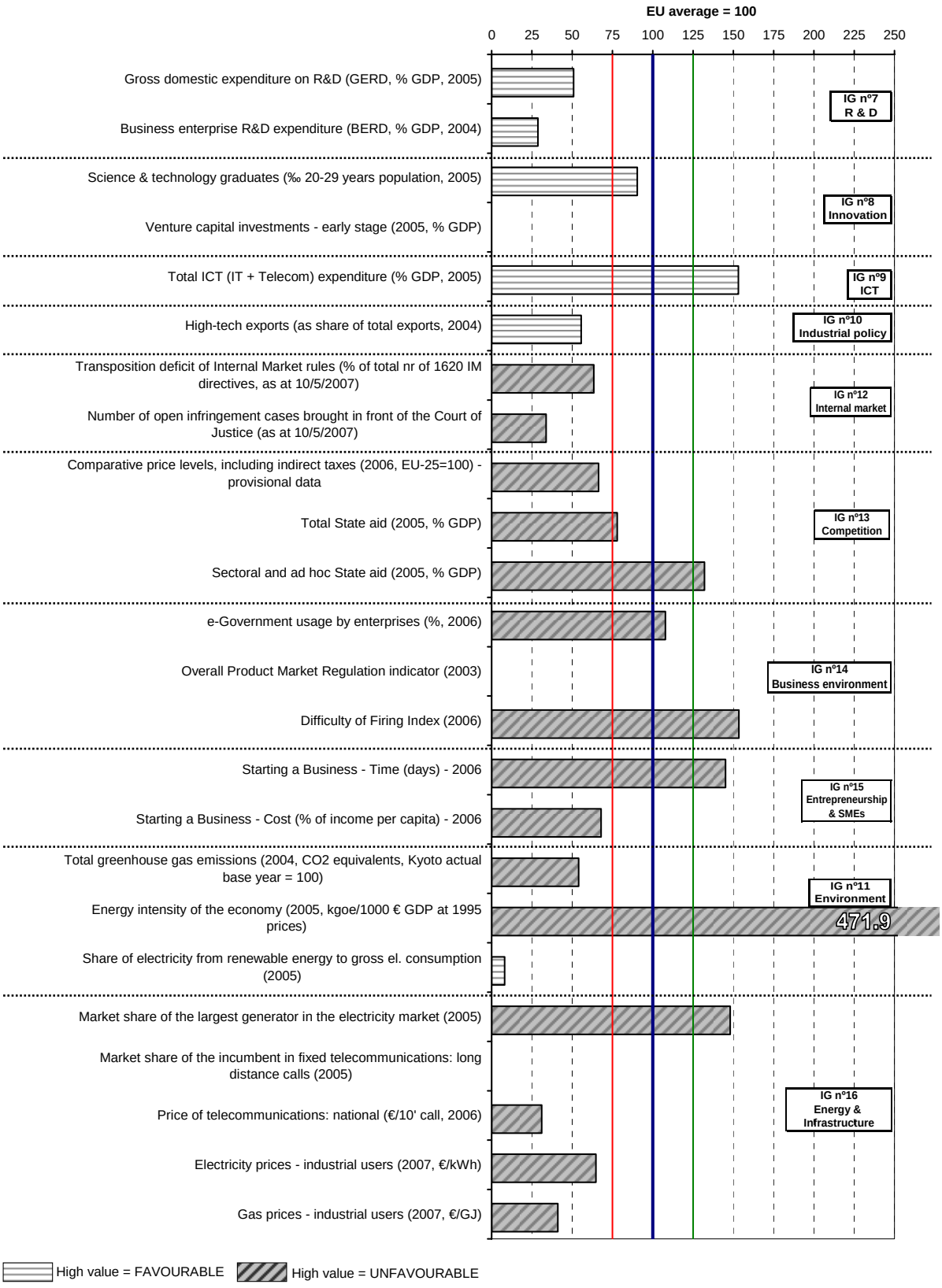
Estonia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Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
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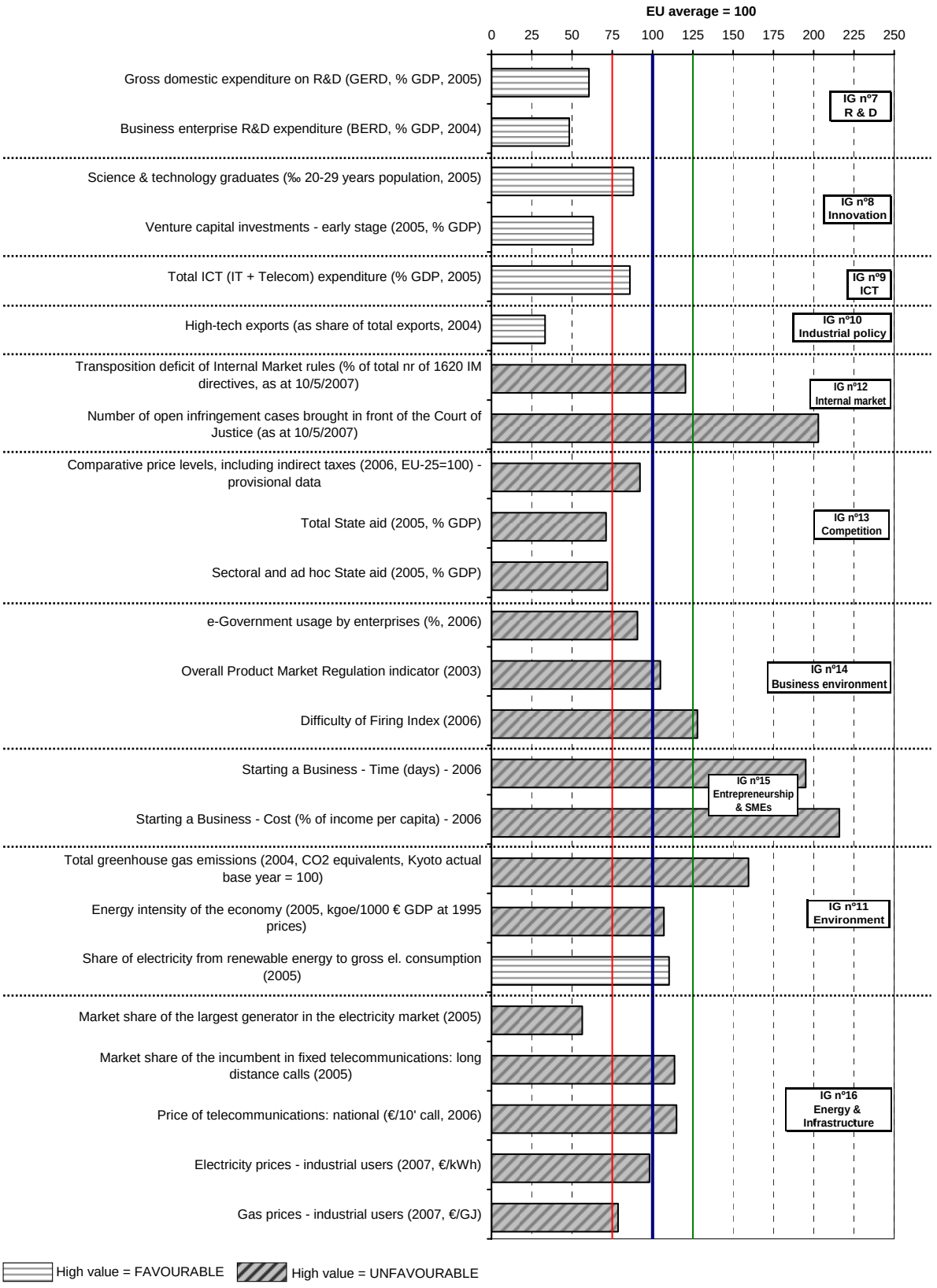
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Spain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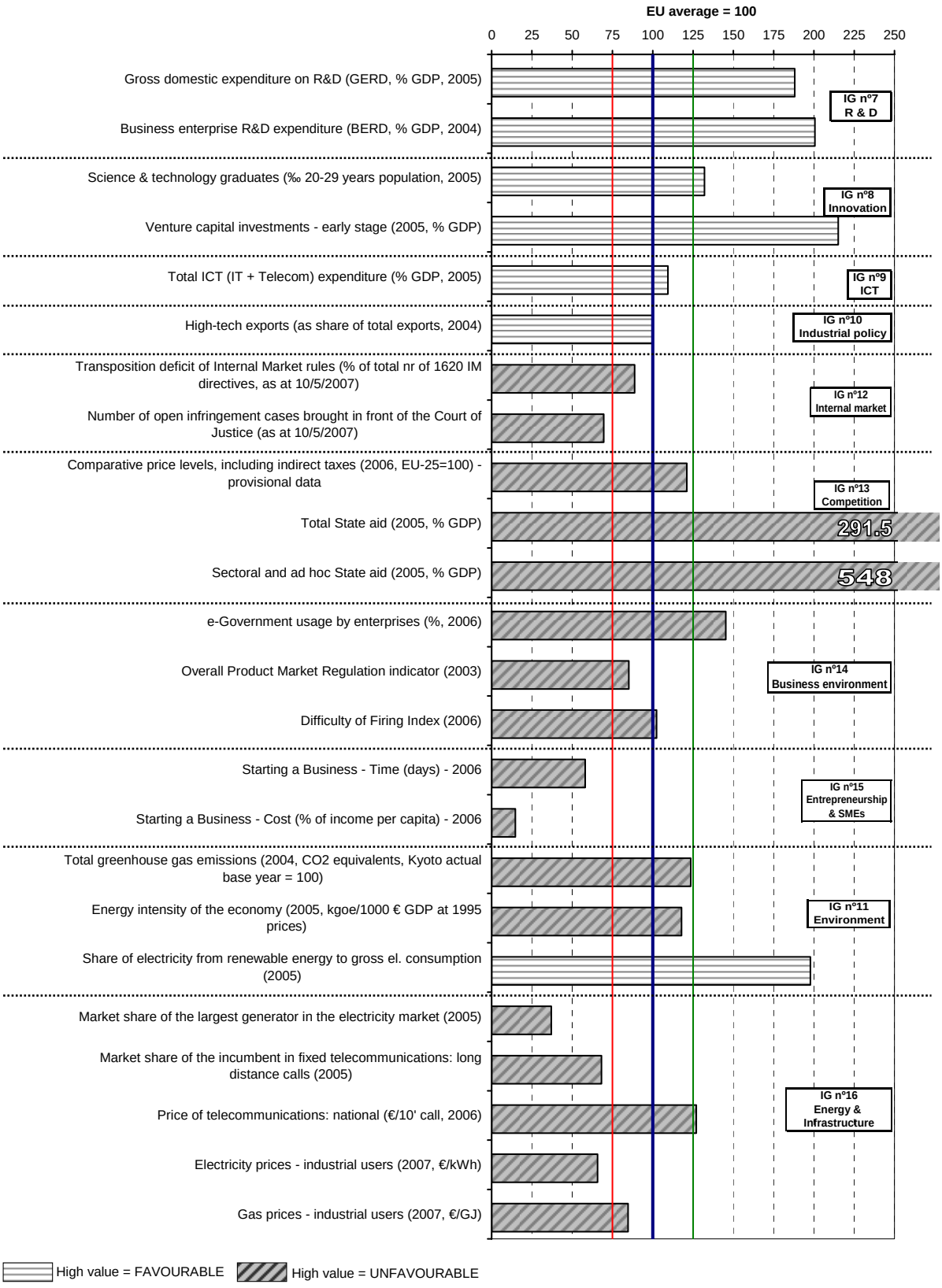
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
Price of telecommunications: national (€/10' call, 2006)
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
IG n°16 Energy & Infrastructure
High value = FAVOURABLE
High value = UNFAVOURABLE

Finland


EU average = 100
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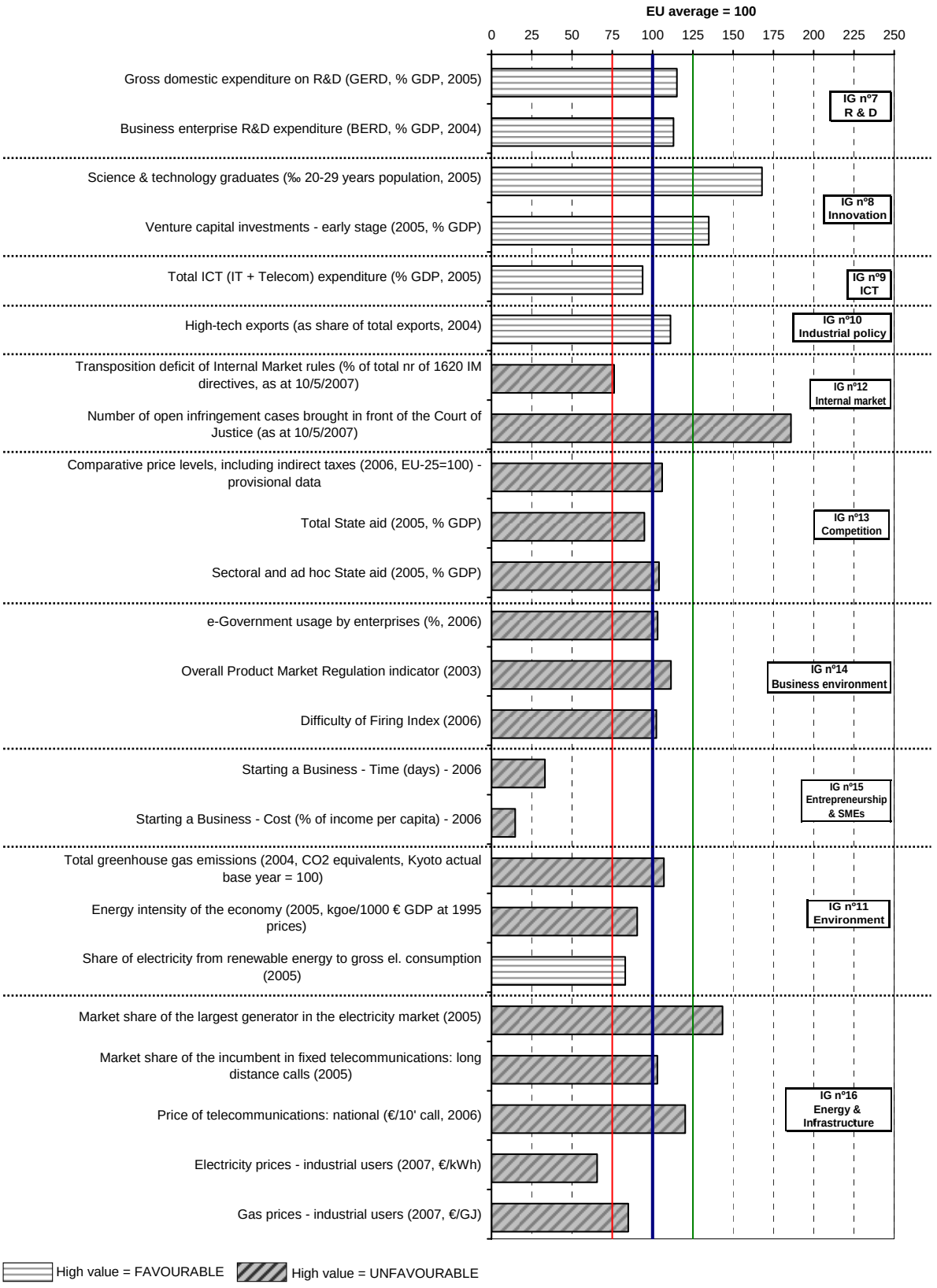
Gross domestic expenditure on R&D (GERD, % GDP, 2005)
Business enterprise R&D expenditure (BERD, % GDP, 2004)
IG n°7 R & D
Science & technology graduates (‰ 20-29 years population, 2005)
Venture capital investments - early stage (2005, % GDP)
IG n°8 Innovation
Total ICT (IT + Telecom) expenditure (% GDP, 2005)
IG n°9 ICT
High-tech exports (as share of total exports, 2004)
IG n°10 Industrial policy
Transposition deficit of Internal Market rules (% of total nr of 1620 IM directives, as at 10/5/2007)
Number of open infringement cases brought in front of the Court of Justice (as at 10/5/2007)
IG n°12 Internal market
Comparative price levels, including indirect taxes (2006, EU-25=100) - provisional data
IG n°13 Competition
Total State aid (2005, % GDP)
291.5
Sectoral and ad hoc State aid (2005, % GDP)
548
e-Government usage by enterprises (%, 2006)
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
IG n°11 Environment
Share of electricity from renewable energy to gross el. consumption (2005)
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
Price of telecommunications: national (€/10' call, 2006)
IG n°16 Energy & Infrastructure
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

France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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
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IG n°7 R & D
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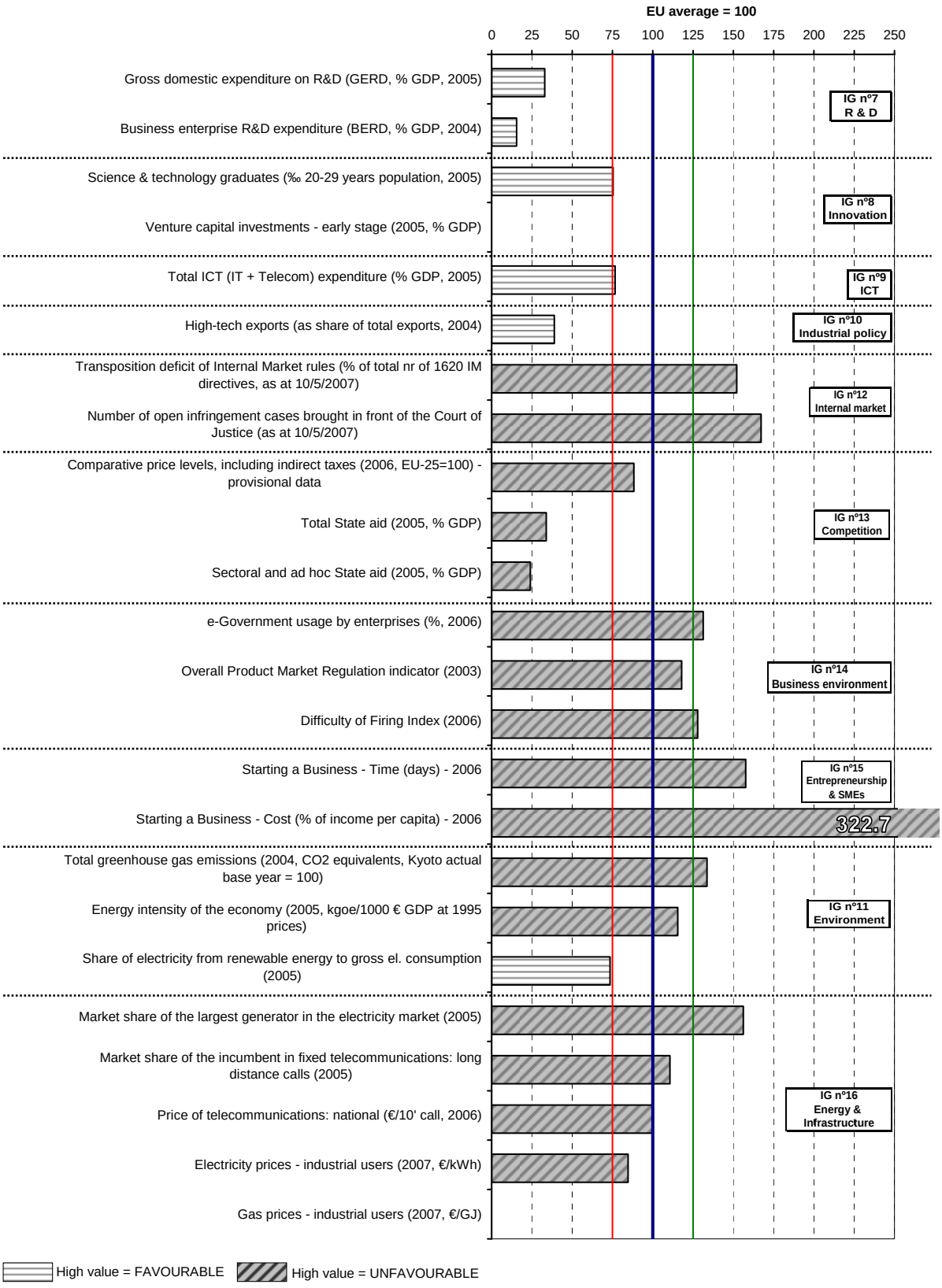
Price of telecommunications: national (€/10' call, 2006)
IG n°16 Energy & Infrastructure
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Greece


EU average = 100
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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
Business enterprise R&D expenditure (BERD, % GDP, 2004)
IG n°7 R & D
Science & technology graduates (‰ 20-29 years population, 2005)
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IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
322.7
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
IG n°11 Environment
Share of electricity from renewable energy to gross el. consumption (2005)
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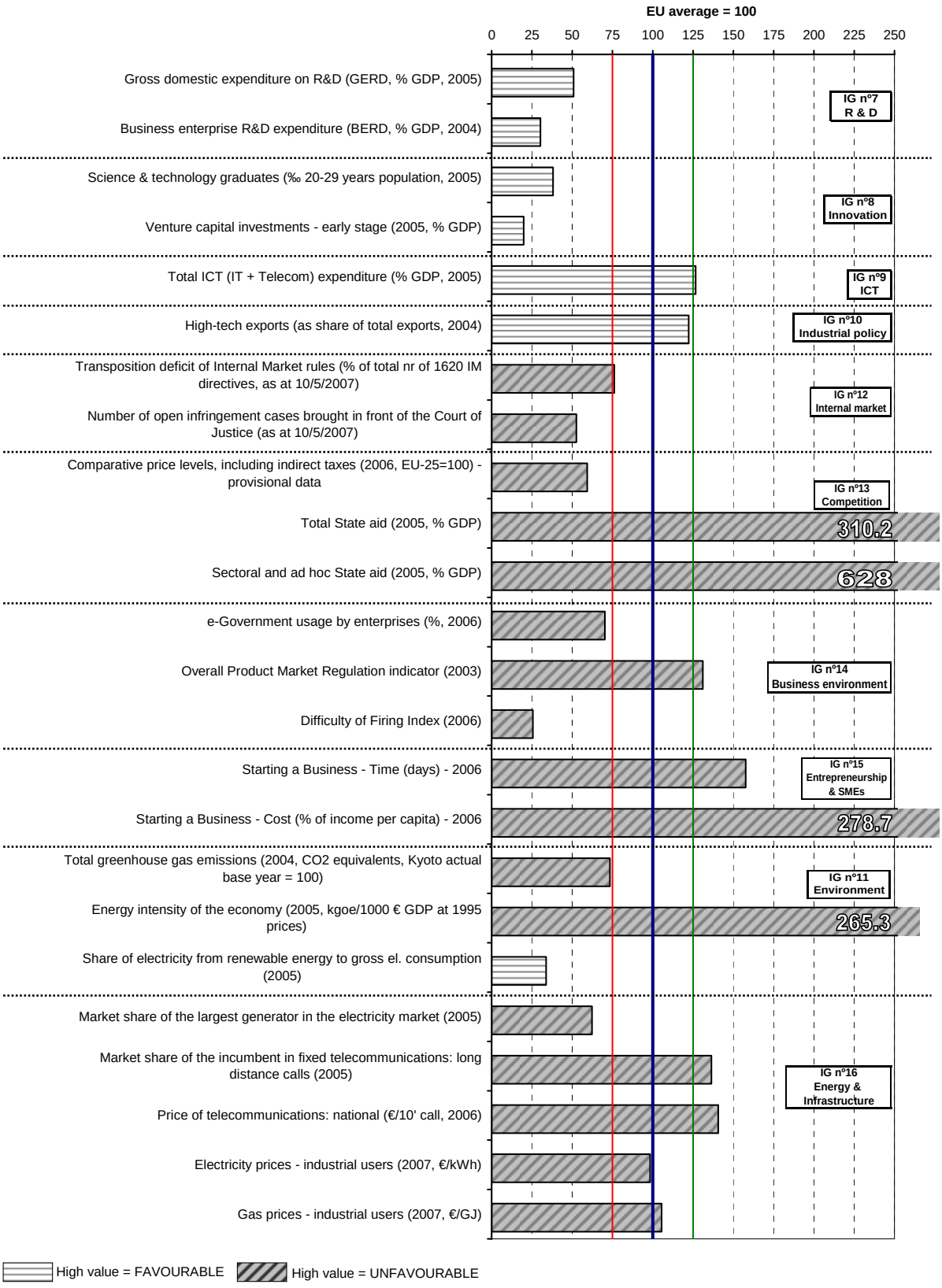
IG n°16 Energy & Infrastructure
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Hungary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IG n°12 Internal market
Comparative price levels, including indirect taxes (2006, EU-25=100) - provisional data
IG n°13 Competition
Total State aid (2005, % GDP)
310.2
Sectoral and ad hoc State aid (2005, % GDP)
628
e-Government usage by enterprises (%, 2006)
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
278.7
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
IG n°11 Environment
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
265.3
Share of electricity from renewable energy to gross el. consumption (2005)
Market share of the largest generator in the electricity market (2005)
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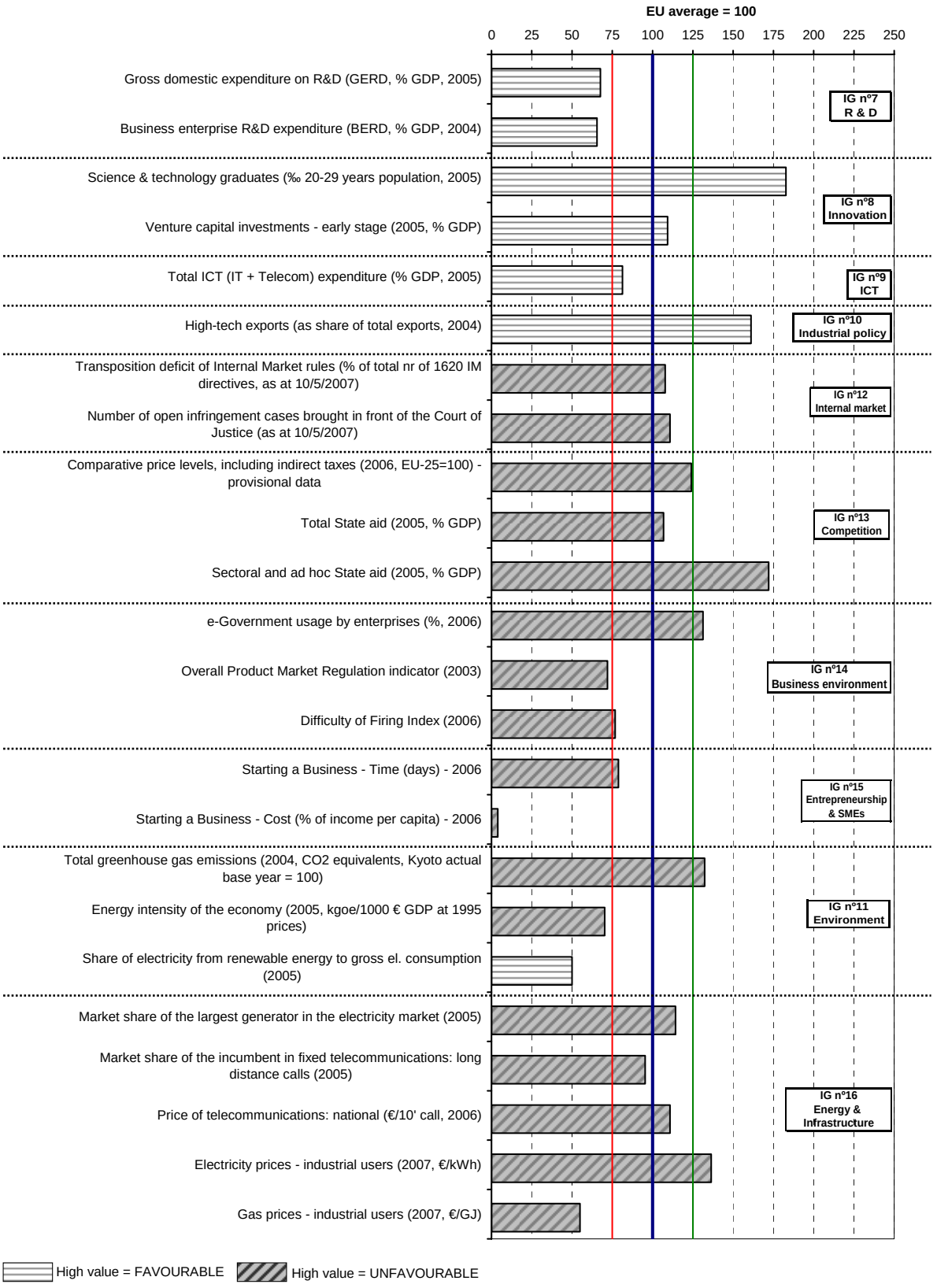
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Ireland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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
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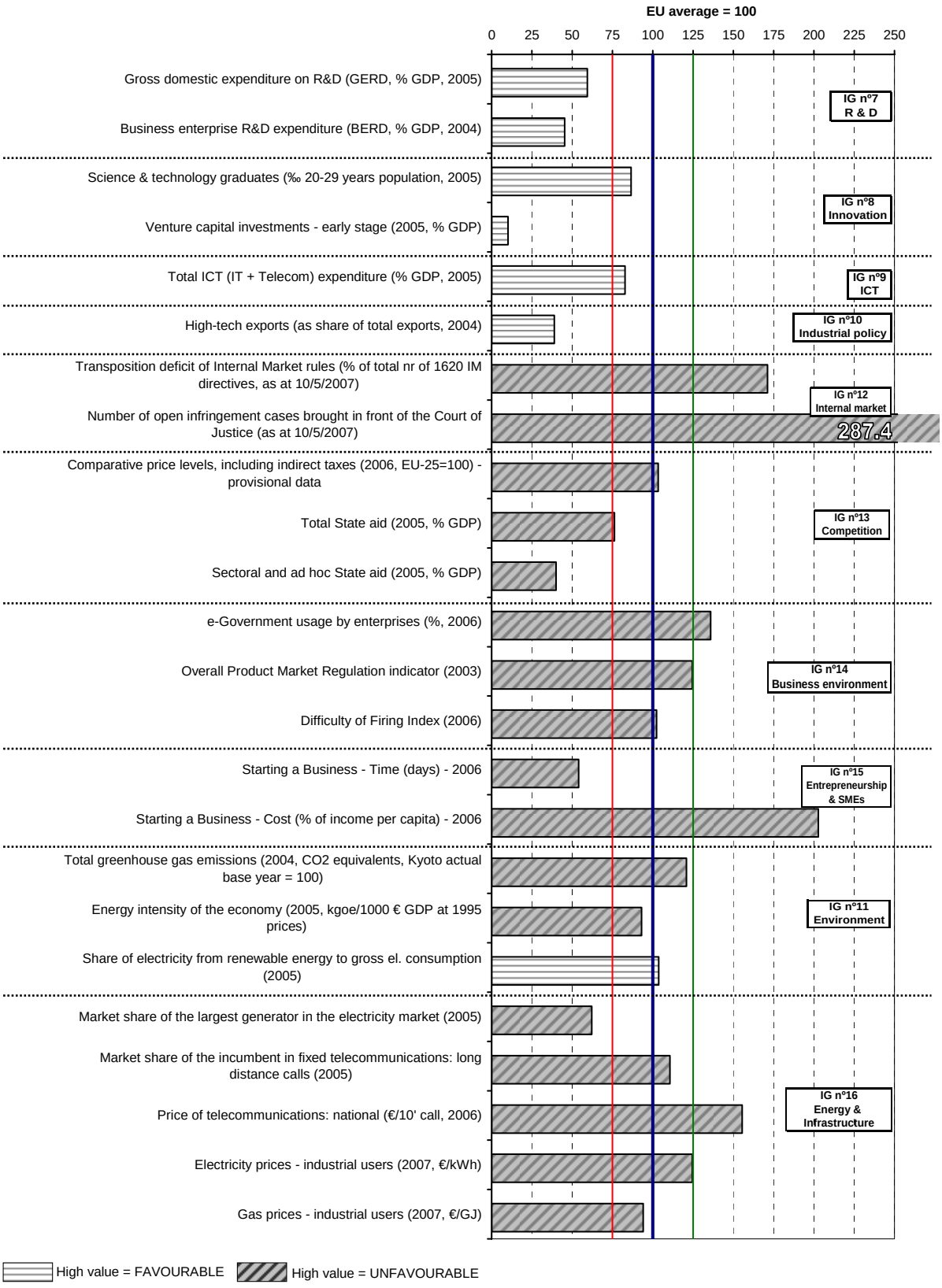
High value = FAVOURABLE
High value = UNFAVOURABLE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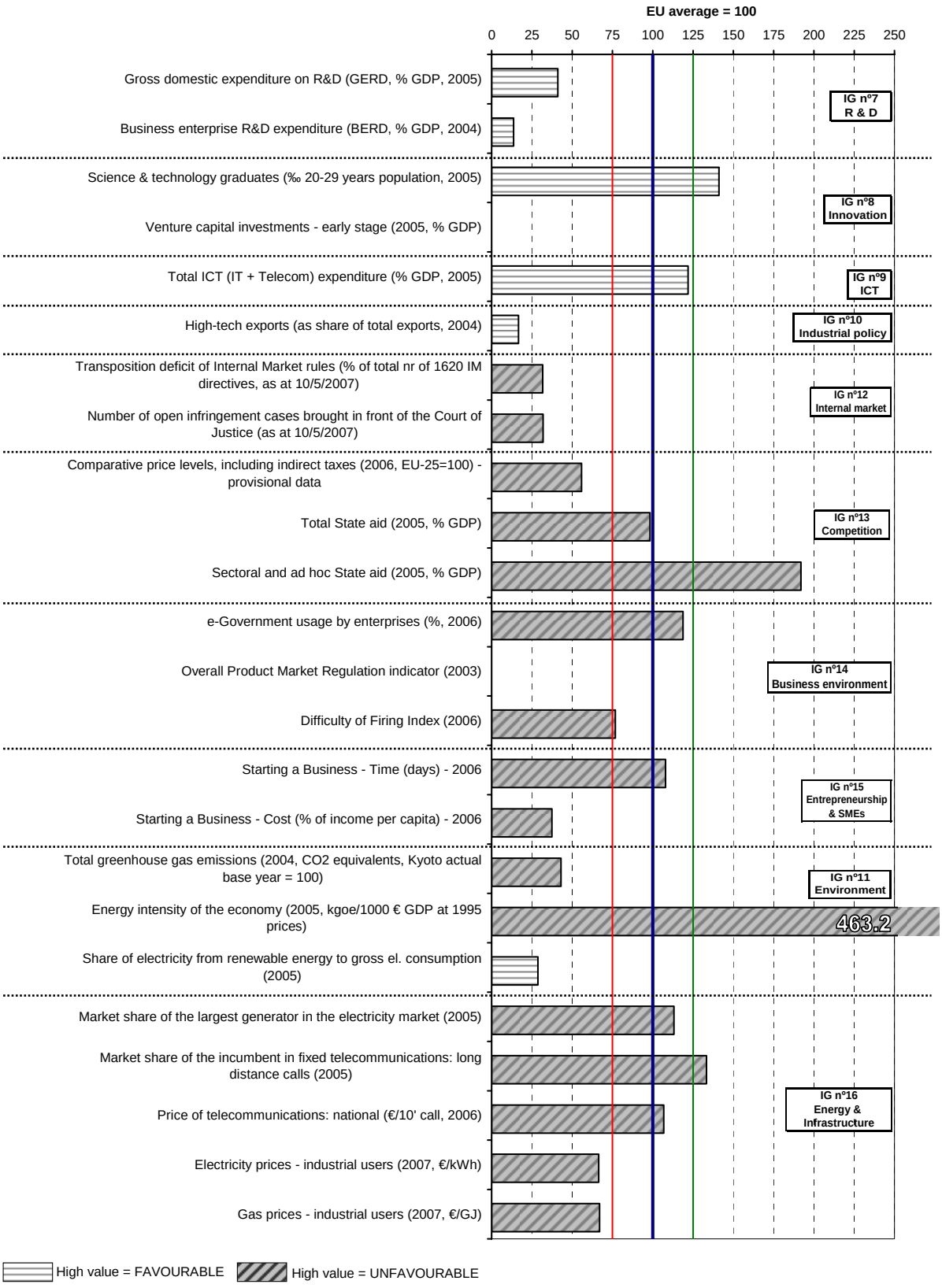
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Lithuania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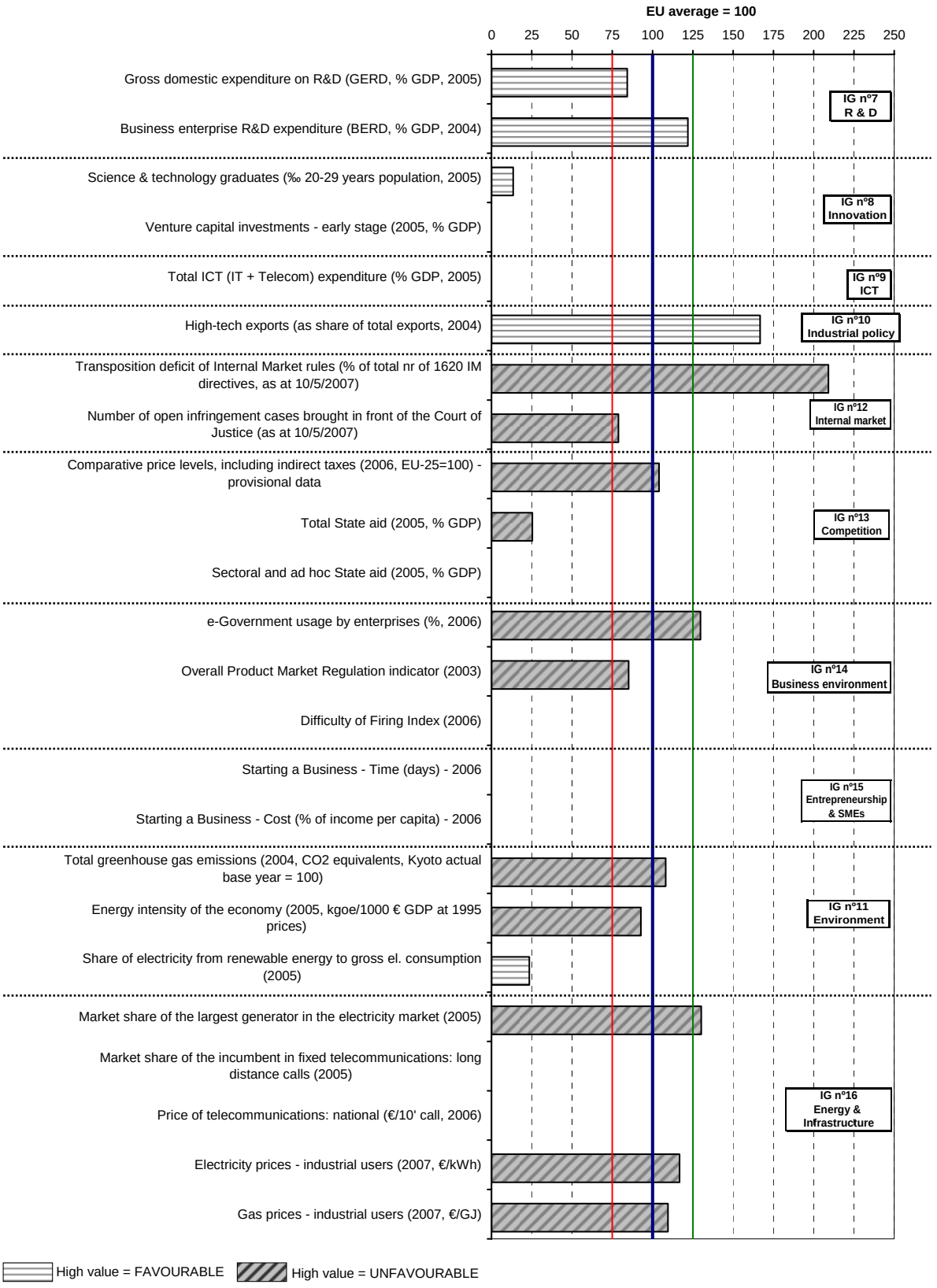
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
IG n°11 Environment
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
463.2
Share of electricity from renewable energy to gross el. consumption (2005)
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
IG n°16 Energy & Infrastructure
Price of telecommunications: national (€/10' call, 2006)
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Luxembourg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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
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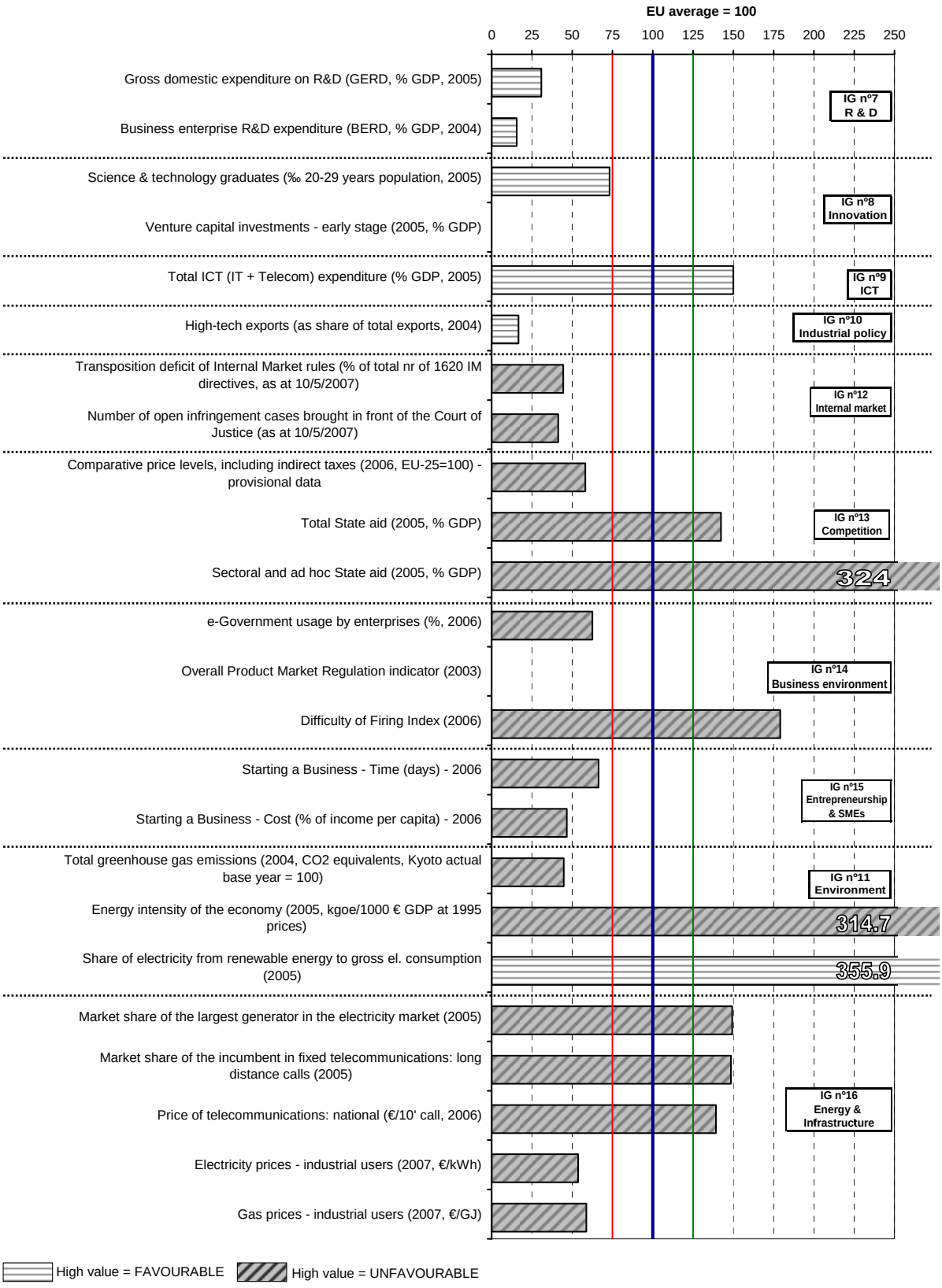
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IG n°13 Competition
Sectoral and ad hoc State aid (2005, % GDP)
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e-Government usage by enterprises (%, 2006)
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
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Share of electricity from renewable energy to gross el. consumption (2005)
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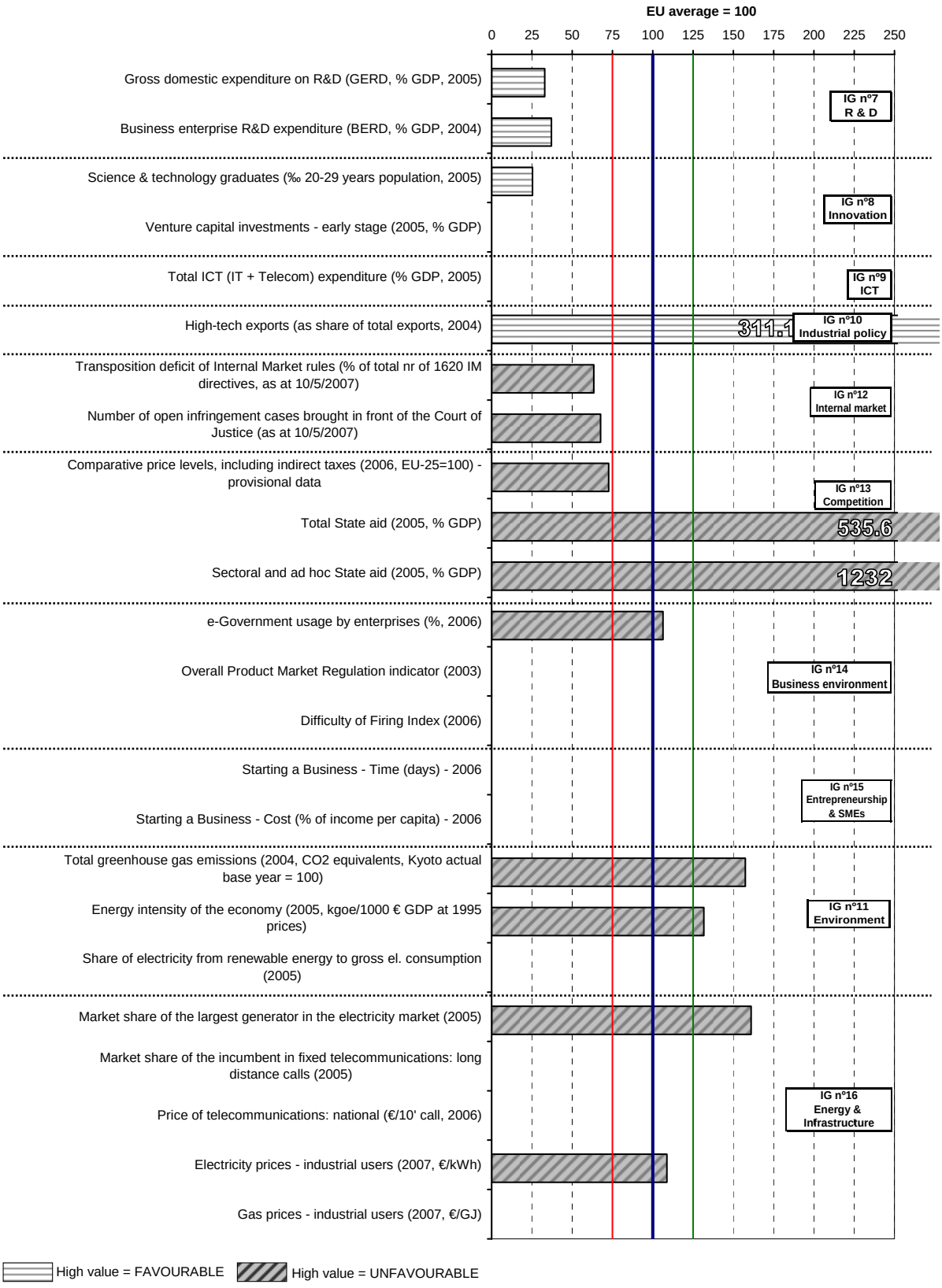
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High-tech exports (as share of total exports, 2004)
311.1
IG n°10 Industrial policy
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IG n°12 Internal market
Comparative price levels, including indirect taxes (2006, EU-25=100) - provisional data
IG n°13 Competition
Total State aid (2005, % GDP)
535.6
Sectoral and ad hoc State aid (2005, % GDP)
1232
e-Government usage by enterprises (%, 2006)
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
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High value = FAVOURABLE
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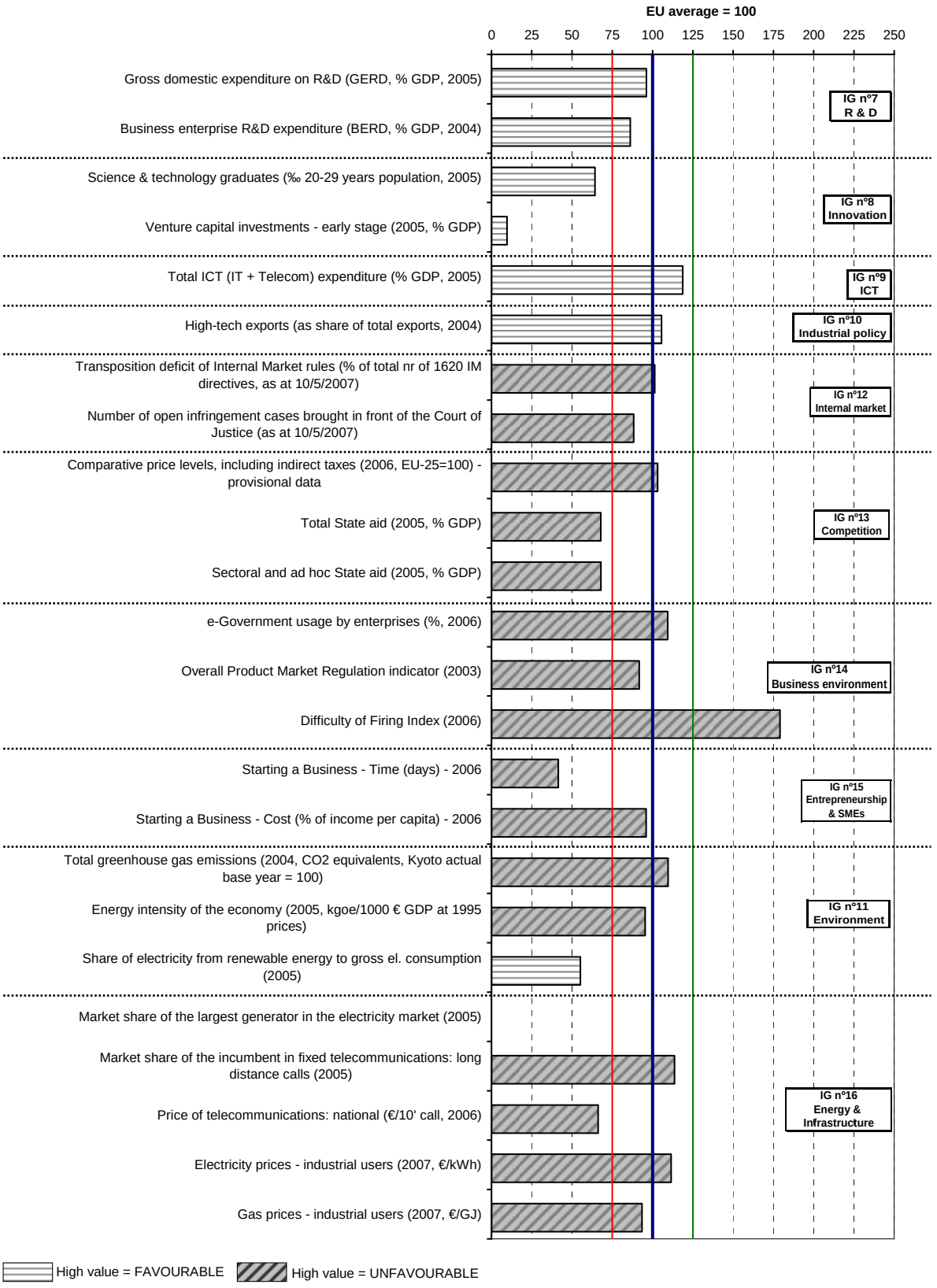
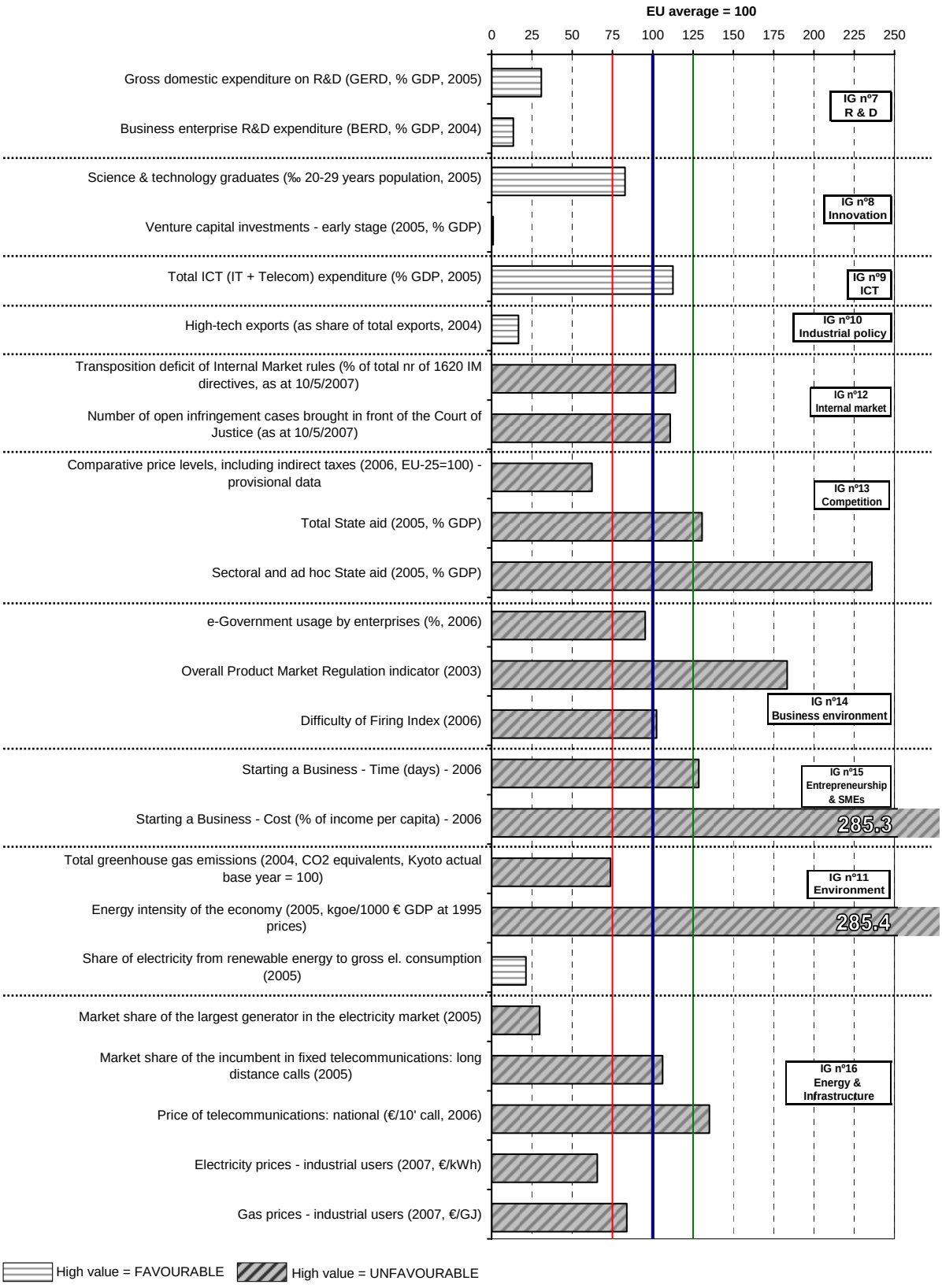
The Netherlands



Poland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IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
285.3
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
IG n°11 Environment
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
285.4
Share of electricity from renewable energy to gross el. consumption (2005)
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High value = FAVOURABLE
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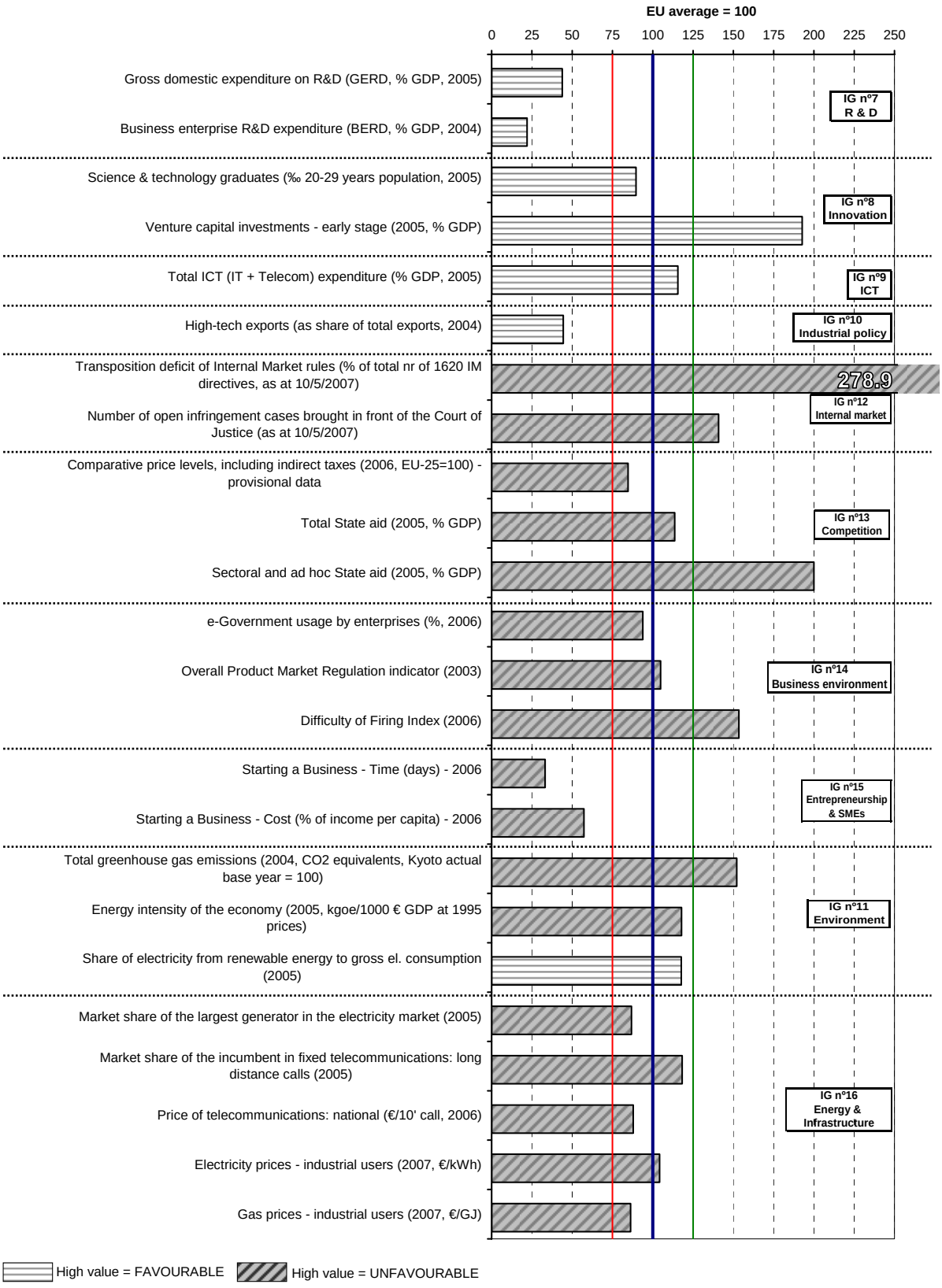
Portugal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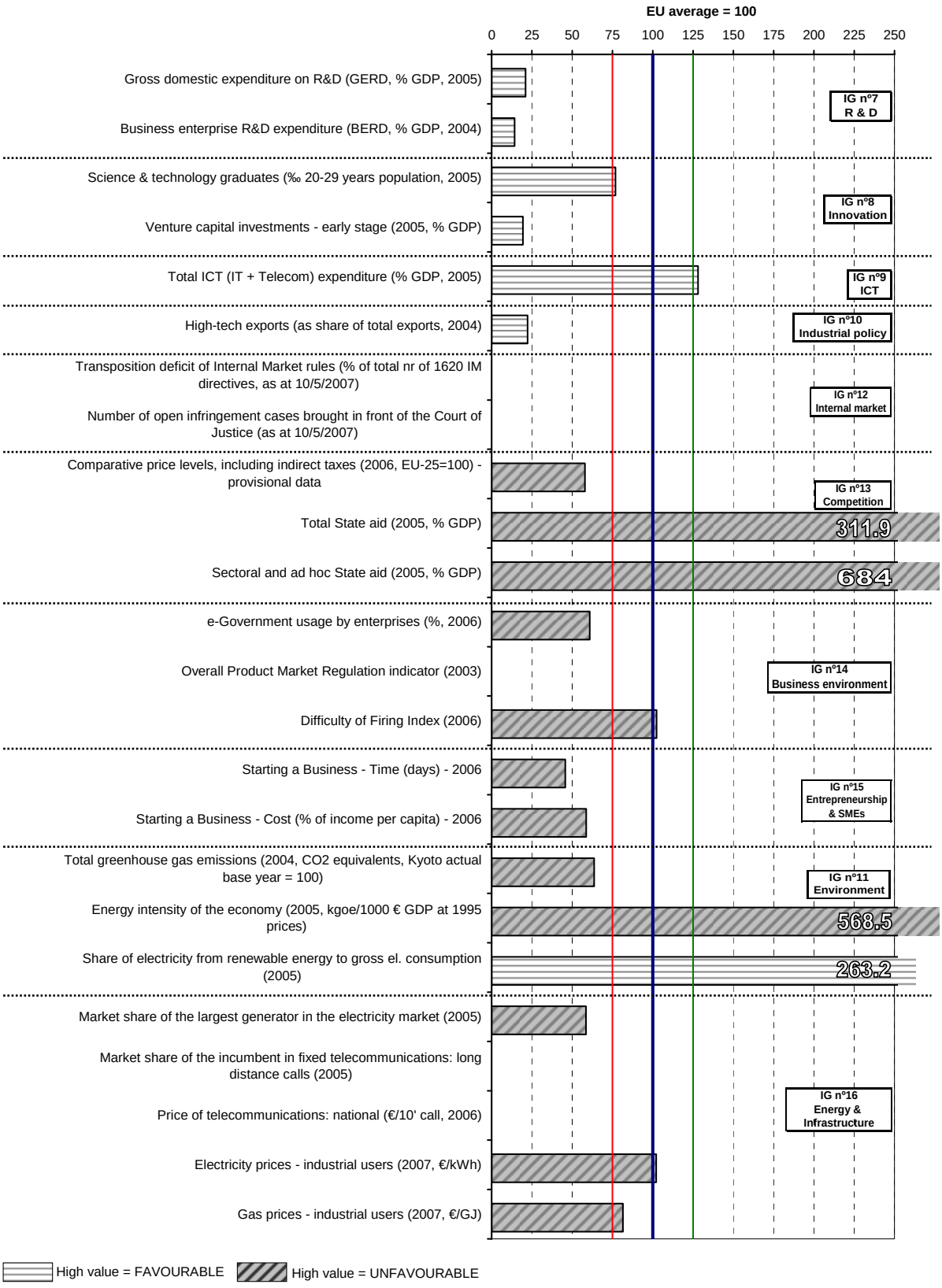
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
IG n°11 Environment
Share of electricity from renewable energy to gross el. consumption (2005)
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
IG n°16 Energy & Infrastructure
Price of telecommunications: national (€/10' call, 2006)
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Romania


EU average = 100
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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
Business enterprise R&D expenditure (BERD, % GDP, 2004)
IG n°7 R & D
Science & technology graduates (‰ 20-29 years population, 2005)
Venture capital investments - early stage (2005, % GDP)
IG n°8 Innovation
Total ICT (IT + Telecom) expenditure (% GDP, 2005)
IG n°9 ICT
High-tech exports (as share of total exports, 2004)
IG n°10 Industrial policy
Transposition deficit of Internal Market rules (% of total nr of 1620 IM directives, as at 10/5/2007)
Number of open infringement cases brought in front of the Court of Justice (as at 10/5/2007)
IG n°12 Internal market
Comparative price levels, including indirect taxes (2006, EU-25=100) - provisional data
IG n°13 Competition
Total State aid (2005, % GDP)
311.9
Sectoral and ad hoc State aid (2005, % GDP)
684
e-Government usage by enterprises (%, 2006)
Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
Difficulty of Firing Index (2006)
Starting a Business - Time (days) - 2006
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
IG n°11 Environment
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
568.5
Share of electricity from renewable energy to gross el. consumption (2005)
263.2
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
IG n°16 Energy & Infrastructure
Price of telecommunications: national (€/10' call, 2006)
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
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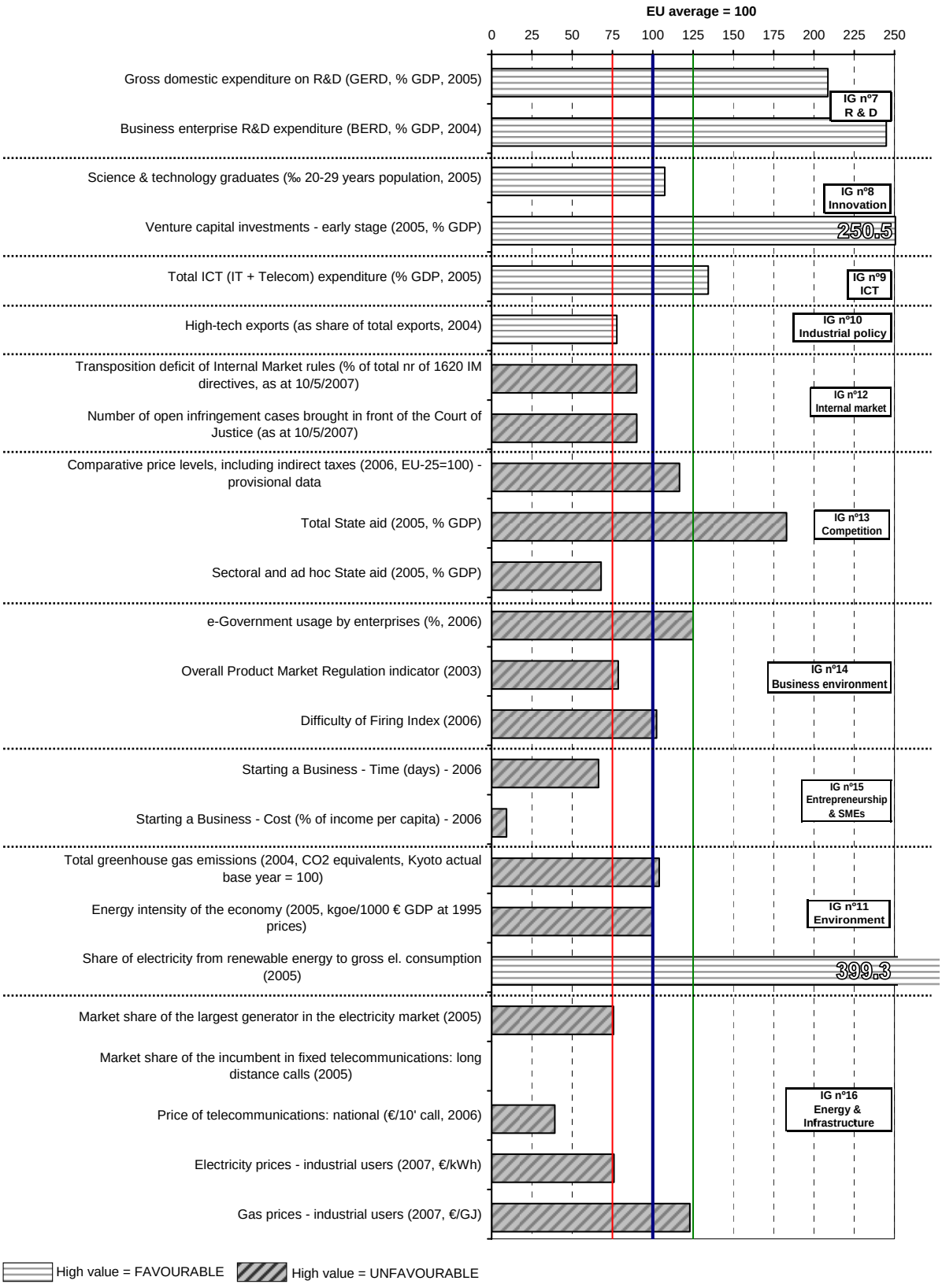
Sweden


EU average = 100
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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
Business enterprise R&D expenditure (BERD, % GDP, 2004)
IG n°7 R & D
Science & technology graduates (‰ 20-29 years population, 2005)
Venture capital investments - early stage (2005, % GDP)
IG n°8 Innovation
250.5
Total ICT (IT + Telecom) expenditure (% GDP, 2005)
IG n°9 ICT
High-tech exports (as share of total exports, 2004)
IG n°10 Industrial policy
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IG n°13 Competition
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Overall Product Market Regulation indicator (2003)
IG n°14 Business environment
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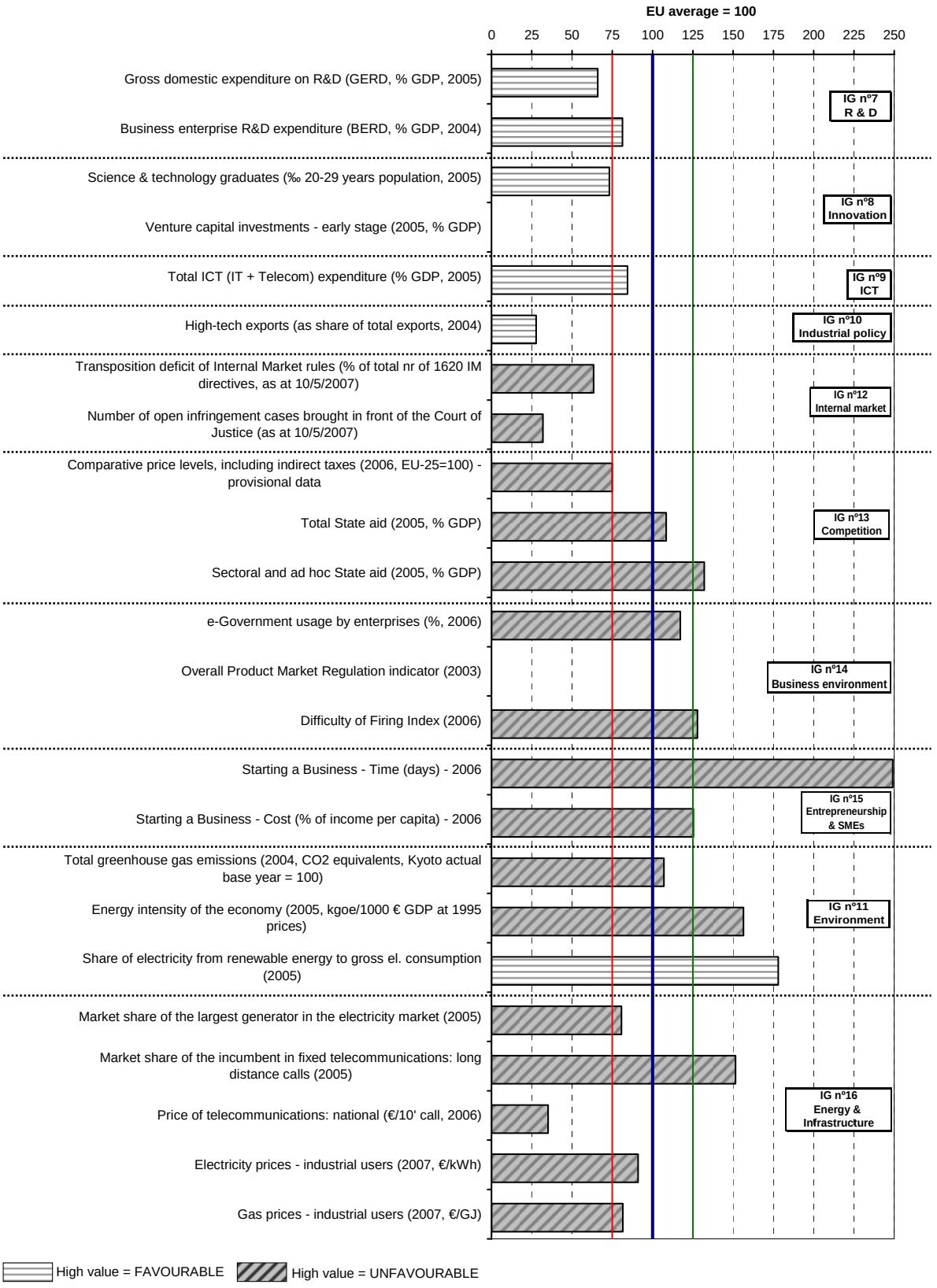
IG n°15 Entrepreneurship & SMEs
Starting a Business - Cost (% of income per capita) - 2006
Total greenhouse gas emissions (2004, CO2 equivalents, Kyoto actual base year = 100)
Energy intensity of the economy (2005, kgoe/1000 € GDP at 1995 prices)
IG n°11 Environment
Share of electricity from renewable energy to gross el. consumption (2005)
399.3
Market share of the largest generator in the electricity market (2005)
Market share of the incumbent in fixed telecommunications: long distance calls (2005)
Price of telecommunications: national (€/10' call, 2006)
IG n°16 Energy & Infrastructure
Electricity prices - industrial users (2007, €/kWh)
Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
High value = UNFAVOURABLE

Slovenia


EU average = 100
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Gross domestic expenditure on R&D (GERD, % GDP, 2005)
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Gas prices - industrial users (2007, €/GJ)
High value = FAVOURABLE
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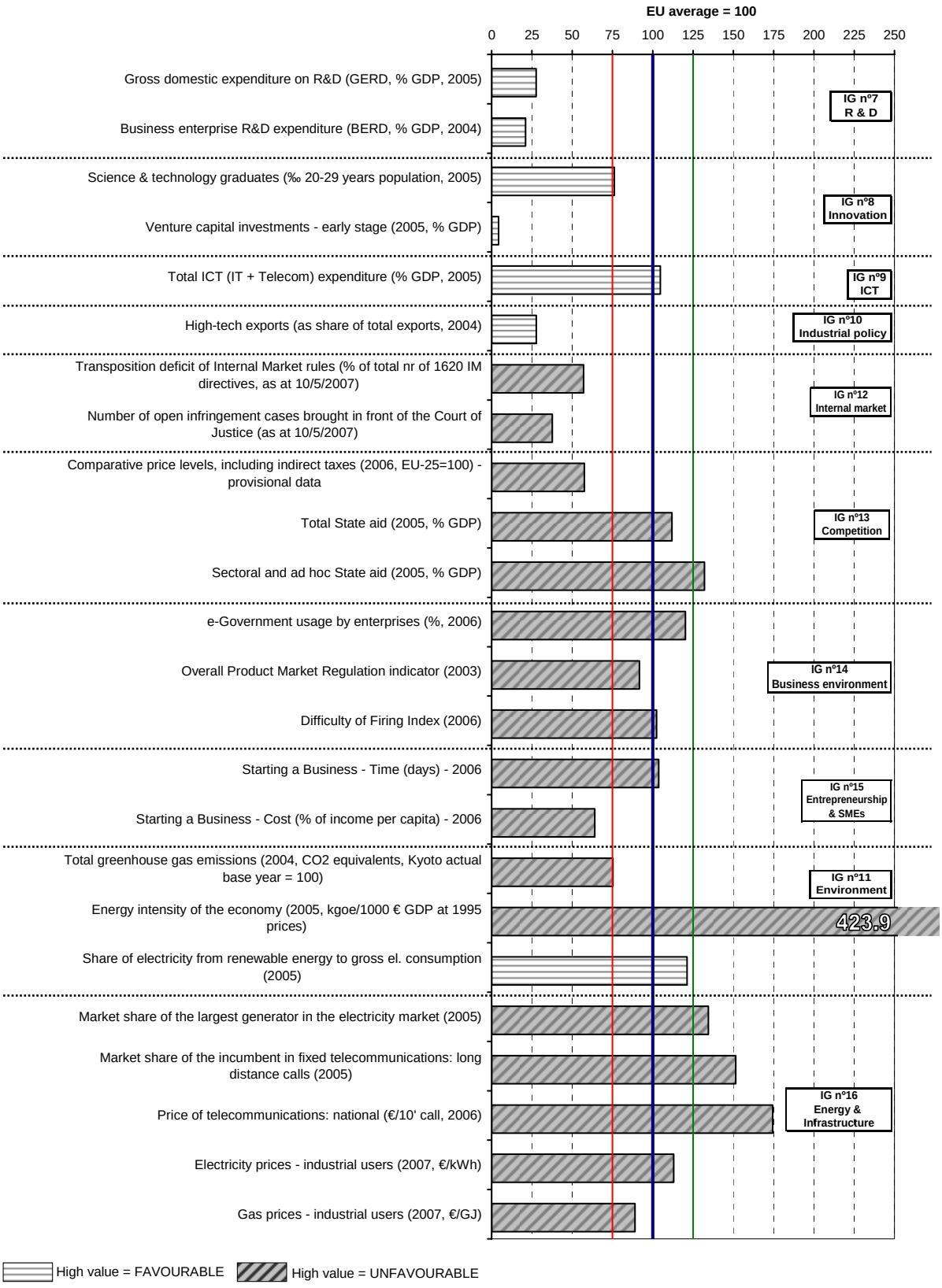
Slovakia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IG n°11 Environment
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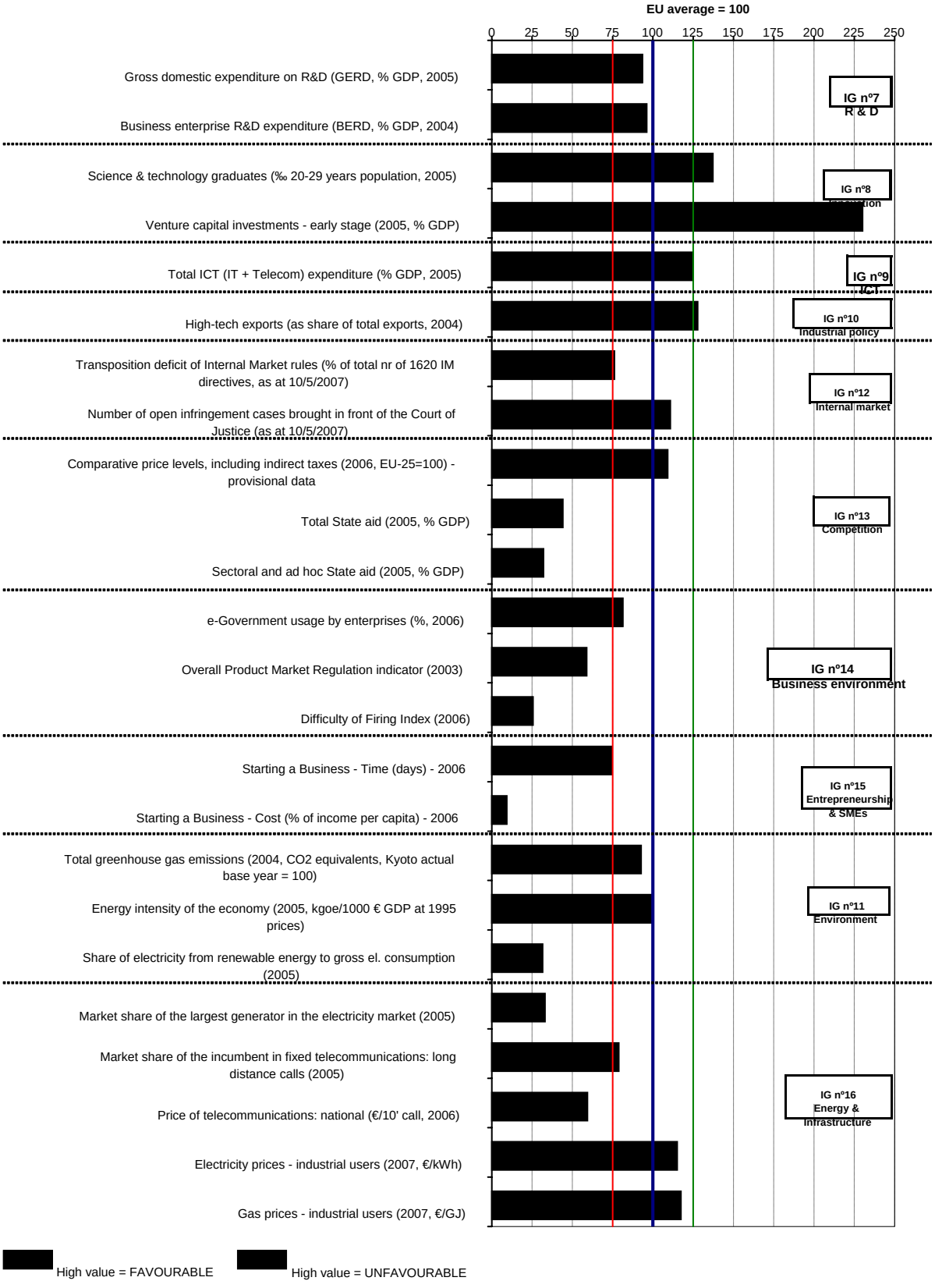
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