Enterprise and Industry

Competitiveness and economic reforms

European competitiveness report 2006

European Commission

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This publication has been prepared by Unit B2, Competitiveness and Economic Reforms, DG Enterprise and Industry. For further Information contact entr-competit-benchmarkg@cec.eu.int

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Introduction

A new report in support of the european strategy for growth and jobs…

This Communication presents findings and messages from the Commission's European Competitiveness Report 2006[1].

The Competitiveness Report focuses mainly on analysing issues related to developments of productivity, as a key indicator for competitiveness over the long term. Competitiveness here is understood to mean a sustained rise in the standards of living of a nation or region and a level of involuntary unemployment as low as possible. At the level of an industrial sector, competitiveness is understood as maintaining and improving its position in the global market.

With the relaunched Lisbon Strategy for Growth and Jobs distinguishing between macroeconomic, microeconomic and employment challenges, the Competitiveness Report has been redesigned to contribute to a solid analytical underpinning of the microeconomic pillar of Lisbon strategy. From this also flows that the analysis of issues in this report has been brought closer to the policy agenda.

The present Communication does not aim at concluding with concrete proposals or an action plan. Its ambition is to support decision making by putting forward a number of policy relevant findings and recommendations resulting from economic analysis.

After a review of recent developments concerning growth, productivity and employment in Europe, the Report addresses various aspects relating to three of the four priority actions of the reform agenda that the Spring European Council of 2006 put forward: *knowledge and innovation*, *unlocking the business potential* and *towards an efficient and integrated energy policy*. Four chapters deal with, successively, the liberalisation of European energy markets, the Regulatory environment in the context of the Strategy for Growth and jobs, the financing of innovation, the concept of "Lead Markets" in innovation policy. In addition, the Report examines the competitive position of two high technology European industrial sectors, the production of Information and Communication Technology goods and services and the pharmaceutical industry. Finally, a statistical annex presents indicators of competitiveness at sectoral level.

Overall competitiveness performance

Encouraging signs that the disappointing performance in improving competitiveness over the past years is being addressed…

In the past decade, GDP per capita growth in the EU-25 has been lower than in the US and the growth rate of real GDP, labour productivity and total factor productivity in the European Union have been slowing down or remained stagnant during the 1990-2004 period. These trends have structural features and this awareness, shared among European policy makers, demands adequate policy responses. In 2000, the European Council agreed in Lisbon to re-launch European competitiveness. In 2005, the Lisbon strategy was revamped, with increased focus on policies aimed at delivering growth as well as more and better employment. In fact, the key areas of the "Growth and Jobs" strategy are concerned, among others, with boosting productivity growth by investing in Research & Development, improving European infrastructure, enhancing human capital and promoting competition. This would contribute to better take advantage of globalisation. This strategy is also to be seen in the wider context of the sustainable development requirement that present needs have to be met with-

[1] Commission Staff Working Paper SEC(2006) 1467, 14.11.2006: *European Competitiveness Report 2006*.

out compromising the ability of future generations to meet their own needs.

A first encouraging sign is the tendency towards higher employment rates in many EU Member States. This is to some extent the result of labour market reforms enacted in past years. Nevertheless, employment rates in most countries remain below the Lisbon targets.

However, the recent progress in employment rates in the EU came along with only small increases in labour productivity. This disappointing performance of EU labour productivity growth can be explained by both weak investment and by an overall slow total factor productivity growth rate. Total factor productivity growth remains low since the slowdown in the mid nineties. This demonstrates the need not to delay any further the reforms in line with the priorities agreed in the Strategy for Jobs and Growth. Productivity gains stemming from re-organization and reallocation of production, from improved labour skills, from the introduction of new products and processes, in particular through ICT, would contribute to increased investment demand and further progress in labour productivity in terms of capital deepening.

More recent developments point to an acceleration of economic growth for the EU, from 1.7% in 2005 to 2.8% in 2006. This would be the best EU-25 growth performance since 2000 and is accompanied by higher employment and productivity growth and a reduction of unemployment. The rise of oil prices has clearly had a negative, if limited, impact on European growth. Model simulations help quantify the effects of energy price variations in the long term and illustrate their wide variety over different countries and sectors. In spite of the increase of energy prices this year, the EU economy is clearly recovering very robustly. Together with the new governance of the partnership for Growth and Jobs, this provides a unique opportunity to vigorously pursue the necessary structural reforms.

Drivers of competitiveness

Energy market liberalisation: strong response to incentives makes careful policy design ever more necessary…

The European energy markets have been going through a process of liberalisation since the early 1990s. The Report presents an assessment of some of the effects of liberalising the European electricity and gas markets and discusses issues arising from liberalisation in general, including experiences outside the EU.

The findings suggest that the introduction of competition has generally resulted in more cost-efficient operations with part of the benefits accruing to the consumers. However, electricity and gas wholesale markets have turned out to be particularly vulnerable to market power resulting from both legacy industry structure and the specific characteristics of these markets. Incumbents continue to have a strong grip on production, imports and key infrastructure. Efficient regulators, in particular, are needed to address this concern. Competition on retail markets is yet to function properly in the majority of cases. This said, the energy Directives provide for universal and public service obligations as well as specific consumer protection rules.

Regarding R&D, evidence on effects on innovation indicates that, following liberalisation, a shift occurs in the composition of R&D efforts: the innovation focus of the companies moves away from (public-interest) technology innovation towards cost-reducing technologies and consumer services. While aggregate R&D spending appears to have diminished, the focus increased. As a result, additional policy measures may be necessary to encourage fundamental energy research to recover its pre-liberalisation situation.

Both theory and evidence indicate that in liberalised markets, prices may fluctuate more in the short run and demand may need to adjust more often than before liberalisation to available capacity. While these price fluctuations are sometimes viewed as undesirable, the larger role of demand in clearing the markets is consistent with an increase in long-run efficiency. Another issue is that inadequate market design may lead to inefficiently low investments[2]. This is especially the case if prices fail to reflect the real value of energy, resulting in lower rates of return or when inadequate unbundling leads network operators to favour their affiliate supply businesses. In regulated markets (i.e. infrastructure), devising mechanisms to foster efficient investments is necessary, especially where (cross-border) transport capacity is concerned. Factors such as complicated procedures imposed by public authorities may also contribute to lower investment. Insufficient investment in power generation risks resulting in electricity shortages and power cuts.

Findings from economic analysis included in the Report indicate that policy responses should firstly focus on clear allocation of rights and responsibilities of market players, especially during periods of scarcity. In addition, the promotion of more liquid wholesale markets, especially for forward contracts, will assist consumers in insuring against price fluctuations. Efficient markets require a higher degree

[2] 'Market design' covers several components: wholesale markets, retail markets, fuel markets, capacity markets, congestion management mechanisms, balancing mechanisms.

of transparency; a mechanism at EU level to better monitor demand and supply patterns on EU energy markets, identifying likely shortfalls in infrastructure, supply and storage would contribute to enhancing transparency on security of energy supply issues within the EU.

Finally, according to both theoretical as well as empirical results, the impacts of liberalisation of the electricity markets on the environment are ambiguous. While reduction of prices would increase consumption of energy, increased fuel efficiency and shifts in technology mix, caused by increased competition, can reduce emissions[3]. In general, liberalisation and environmental objectives are compatible. Liberalisation can also strengthen the effect of market based environmental instruments, such as the European Emission Trading Scheme.

Regulatory environment: a very broad adherence to the principles of better regulation in spite of unequal commitments…

The improvement of the business environment through applying measures fostering entrepreneurship and through application of Better Regulation rules is today a shared goal within the European Union. The diffusion of Better Regulation instruments is therefore a clearly stated priority of the Strategy for Jobs and Growth. It is thus a very positive development that the National Reform Programmes (NRPs) that the Member States adopted in 2005 reflect the will to reform regulatory practices. These reforms are very complementary to the Better Regulation Initiative launched at Community level, which comprises a simplification programme for existing legislation, systematic impact assessments for new legislation, improved stakeholder consultation, as well as the measurement and reduction of administrative burdens. Work on setting quantitative targets for the reduction of administrative burdens is also under way.

Isolating the effects of regulation on the economy is fraught with difficulty. Nevertheless, the – still limited – economic literature in this area provides evidence that regulation can have significant positive or negative (if poorly designed) effects on economic performance and innovation. The Competitiveness Report analyses the multitude of measures which are being proposed in the NRPs and elsewhere across all EU-25 Member States in the area of Better Regulation. While these measures vary considerably in terms of their time-horizon, depth, degree of institutionalisation and likely effectiveness, most Member States do envisage one or more high-profile activities in this area. In addition, Member States present measures with visible short-term beneficial effects, such as one-stop shops for business registration. The NRPs and developments since their publication last year therefore represent a clear step in the right direction for the EU regulatory environment. The large differences observed between the measures proposed by individual Member States often reflect the fact that Member States are at different points in the development of a Better Regulation system.

It is noteworthy in this context that having a Better Regulation system in place does not necessarily lead to substantially less regulation. Among those seven Member States which have been broadly categorised on the basis of existing indicators as having relatively restrictive regulatory environments, as defined by the OECD, two present a set of measures in their NRPs spanning all or almost all elements of the Better Regulation agenda, and that most others take measures in at least two areas. This said, a number of the eight Member States listed among those with less restrictive regulatory environments are also found among those countries with measures in all or almost all elements of the Better Regulation agenda.

An increasing number of countries (18) are implementing, or plan to implement, their own Impact Assessment (IA) systems, mirroring what is already taking place in the Commission and in a small number of Member States. This should help ensure a higher quality of future regulation with regard to issues of importance for national and European competitiveness. Progress so far, however, has been somewhat slow and one should bear in mind that the benefits of implementing an IA system take a few years to materialise. Moreover, there are concerns that in a number of cases resource constraints may be a serious obstacle. Unless this issue of resource redeployment is overcome, new legislation might be deprived of the quality improvement that results from IAs that systematically assess economic, social and environmental impacts as part of an integrated process.

Establishing a fully fledged and integrated Better Regulation system should be the medium to long-term objective of all Member States. Clearly, urgent action is needed to lay the foundations for the system. Doing so in a sustained fashion will help provide better conditions for entrepreneurship, reductions in administrative burdens – which are particularly high in some sectors – and in barriers to market entry and contribute to increased competition, more innovations and ultimately higher economic growth. The general process of Better Regulation is still in its early stages and its ultimate success will be influenced by many factors that cannot easily be accounted for. The earnestness with which existing proposals will be implemented will also play an important role.

[3] The latter effect is sensitive to the country-specific initial conditions.

This analysis suggests that progress has already been made across the EU and that all Member States are taking action regarding Better Regulation, and the business environment more generally, but that real challenges remain. Naturally, for countries with less emphasis on Better Regulation policies up to now, both the urgency of and the potential benefits associated with pushing ahead more strongly with the Better Regulation agenda are greater than for countries that have already attained a more advanced stage. Those Member States in a less positive starting position should make greater efforts towards establishing fully fledged Better Regulation systems.

Financing of innovation receives the attention that it deserves, some policy gaps remain…

The Report focuses first on particular finance-related problems of innovation and the appropriate policy tools to deal with them. Public support can come in various forms: direct measures such as grants and loans, indirect measures such as guarantees or fiscal incentives for R&D, and risk capital measures. The Report discusses good practice of government support, as supported by economic theory, and presents policy relevant conclusions. These conclusions are then complemented by reviewing the innovation financing measures that Member States put forward in the National Reform Programmes issued in October 2005.

Over the last years, an increasing number of countries have been using fiscal incentives for encouraging R&D and, in many countries, benefits provided by R&D tax provisions have been increased. The National Reform Programmes that Member States issued in October 2005 confirm this trend. They also reflect the growing importance for public authorities of having a robust venture capital industry, by reporting ongoing; stepped up or new actions in almost all Member States, with a special focus on early stage investments. A notable group of countries announce actions also for business angels. This said, little attention is paid, overall, to facilitating the cross-border mobility of venture capital. The same applies to debt financing of innovative projects, with only a small number of Member States announcing measures to this respect.

The broad variety of schemes and instruments, as well as the frequently stated intention to overhaul and restructure them indicate that a lot of experimentation is going on. There is clearly scope for mutual learning and exchange of best practice, which would be much easier if evaluations of existing measures were more frequent, more systematic and more comparable. Also, sometimes a wide variety of instruments exists within one country, making necessary more systematic efforts to inform potential users but also to make existing instruments simpler and more accessible.

In conclusion, it would appear that more efforts should be directed towards facilitating the provision of cross-border venture capital and the debt financing of innovative projects. The provision of early stage risk capital is being addressed in many countries; however, this clearly remains an area where more should be done. Also, evaluation and simplification of existing schemes should be carried out more systematically and mutual policy learning should continue.

It must be clear, though, that if these efforts are necessary, they are certainly not sufficient for achieving the more general objective of transforming the European economy into a more dynamic and knowledge-based one. Apart from setting up comprehensive research, development and innovation policies, this will take also implementing those reforms that will tone up economic activity in general, particularly in the areas of business environment, competition, external trade, education and labour markets.

The lead market approach can contribute to innovation policies capable of anticipating global needs…

The Report undertook a literature review of the lead market approach, a useful concept to better understand the factors behind the global success of innovations and new technologies, especially in the case of competing innovation designs.

While the lead markets approach is primarily relevant for firms, it can also help governments to design a more effective technology policy with respect to facilitating the potential global success of companies' innovation activities. For this purpose, some generic criteria for designing various parts of innovation policy (from funding programmes and public procurement to regulation and standard setting) can be applied: incorporation of global market needs and preferences of customers from abroad, transferring domestic market preferences abroad, putting emphasis on lowering costs of production, allowing competition among different innovation designs, and addressing global trends (though the latter is highly demanding since it is difficult to identify a particular change as being a global trend).

It is thus a critical point for any policy that attempts to support the emergence of a lead market to anticipate global markets, develop an innovation design that responds to these upcoming global needs and introduce cost advantages high enough to persuade other countries to follow, without interfering with competitive forces.

In order to make the lead markets concept operational at European level, the Commission has pro-

posed in its recent Communication on Innovation[4] to, firstly consult stakeholders, in particular Technology Platforms and the Europe INNOVA Innovation Panels, to identify possible areas where a combination of supply and demand side policies may help the emergence of innovation-friendly markets and, secondly, to launch pilot lead markets initiatives in the most promising areas in 2007. Based on this experience, the Commission will prepare a comprehensive lead markets strategy.

Competitiveness in sectors

In addition to reviewing economic reform (energy liberalisation, regulatory environment) and policies to improve innovative performance, the Report examined the competitive position of two important, fast growing and high technology sectors, the industry producing Information and Communication Technology (ICT) goods and services and the pharmaceutical industry.

ICT industries need more R&D and policies that make change easier…

Concerning ICT, the Report concludes that the EU has comparative advantages in differentiated goods of higher quality, commanding higher prices. The increased trade in intermediate goods, which is largely intra-firm trade, indicates that some of the imports are used as intermediate products for more complex finished goods of higher value.

Globalisation has multiplied the possibilities to fragment the production process and locate the production of components according to the comparative advantages of the different locations. As a consequence, chip design is made in Europe while mass production of chips takes place in South-East Asia; software development is carried out in European software labs while the coding of software is done in India. Proximity to the customers of specialised products such as customised software is yet another argument for location in the EU. The evidence suggests that knowledge-intensive production, product development and strategic R&D are still located in Europe while labour-intensive production of mature standardised goods has been located to Asia. However, increasing R&D investments in China and India may challenge this situation in the future.

This said, ICT producers in the new Member States have shown that it is still possible to be competitive in EU with low-cost and scale-intensive production such as insulated wire, radio and TV receivers and other consumer electronics, as well as computers. It is however unlikely that this kind of production is competitive in the longer run. It is therefore necessary to further strengthen the links between systems of innovation within Europe in order to reap the full potential of the relatively high skilled labour force in EU-10.

EU is specialised particularly in the production of communication services as well as in IT services and software production. For ICT manufacturing, EU comparative advantages are found in the production of scientific instruments, electronic products and telecommunications equipment of high quality. The answer to the challenge from low-cost producers lies in further climbing up the quality ladder and a fast flow of new innovative products satisfying the growing demand for advanced goods and services. Achieving this objective will be easier if the right sector-specific and more general microeconomic policies are in place.

In comparison with other sectors, the EU ICT sector is R&D intensive. However, given the lags already existing vis-à-vis its main competitors, further raising its R&D investments will be crucial for its future competitiveness. This is not so much a necessity for the larger EU enterprises of the sector as for smaller ones and start ups. This points to the existence of a more systemic weakness in generating – and financing – research in small innovative firms which cannot be addressed by sector specific measures alone; it rather necessitates the horizontal policy responses reviewed in relation with the financing of innovation. Also, this is clearly a sector where the lead markets concept is relevant when considering specific policies.

In sum, ICT markets can move very fast and innovation is a primary factor for longer term competitiveness. Besides the sector specific policy conditions that may facilitate the further development of the sector, the more general business environment and, especially, market regulation and the innovation system are of primary importance in making adaptation to change easier.

Pharmaceuticals: systemic weaknesses restrain a growing industry…

In terms of production and employment Europe's pharmaceutical sector is growing, as well as its share in global exports. This good performance is partially due to a delocalisation of US production in Europe but also to an increase of its cost competitiveness.

Nevertheless, the overall picture gives rise to concern. The European pharmaceutical industry has a considerable gap vis-à-vis the US in labour productivity, much larger than in overall manufacturing. Productivity growth in the US was mostly the outcome

[4] Commission Communication COM(2006) 502, 13.9.2006/ *Putting knowledge into practice: A broad-based innovation strategy for the EU.*

of capital deepening, while the most important component in Europe was total factor productivity (TFP) growth. Capital deepening in Europe increased at a modest rate.

Since 2000, the US has consolidated its central role as a locus of innovation in pharmaceuticals. US firms hold the majority of biopharmaceutical patents, and this dominance continues to expand. Also, US firms play a pivotal role in the global division of innovative labour in pharmaceuticals, as shown by their shares of co-invented patents at international level. These trends are confirmed by data on patent citations. The internal structure of the US national innovation system is a powerful source of competitive advantage and industrial leadership. In particular, the biotech sector plays a vital role in integrating explorations of new research opportunities with clinical and market development.

The US market for pharmaceuticals is both more concentrated and more volatile than markets in Europe. In other words, the higher concentration of the US market does not mean that it is less competitive. On the contrary, the US market is highly contestable; product turnover is much more frequent than in the EU and Japan; and competition from generic producers is substantial. US market behaviour is consistent with that of a market characterized by Schumpeterian competition, where innovators can gain temporary quasi-monopoly profits, which in turn spur innovation efforts by competitors that quickly leads to more innovative products and a high turnover of market shares. Dynamic competition is less evident in the EU as a whole, and especially in certain continental European countries.

Europe is lagging behind the US in its ability to generate, organise, and sustain innovation processes and productivity growth in pharmaceuticals. Moreover, a disproportionate share of pharmaceutical R&D is performed in the US, with negative consequences in terms of both high value-added employment and complementary investments in clinical research.

Cost policies on behalf of European Social Security institutions can explain to a certain extent the different dynamics characterising the EU pharmaceutical industry vis-à-vis the US. However, these cannot be fully explained by sector-specific factors. They are also the consequence of Europe's relative lack of dynamism in reforming its labour and capital markets, education systems, public spending, and regimes of market regulation. This is, for example, illustrated by the relative lack of dynamism of young technology-dedicated firms in generating and developing R&D projects.

Given the shortcomings in European competitiveness attributed at least partially to the distortions created by existing pricing and reimbursement policies, the Commission has taken the initiative to address some of the pressing issues by creating the Pharmaceutical Forum. Established in June 2005, the Forum brings together for the first time senior decision makers in Member States, industry and other stakeholders. Based on previous work, the G10 Medicines process, it will take forward the three topics "Information to Patients, Relative Effectiveness of Medicines and Pricing/Reimbursement".

In particular the two latter issues have been the source of market distortions in the Single Market for pharmaceuticals in the EU since different national pricing/reimbursement decisions and the diverging requirements to measure relative effectiveness have had undesired consequences on other Members States with different systems and have often caused unforeseen ramifications for the EU market as a whole.

The objective of the Forum is to find a way forward which will strike a balance between the public health objective of patients' access to new medicines at affordable costs and the need to create a predictable environment for business with economic rewards for innovators. Finding the right balance and creating an environment conducive to innovation will foster the competitiveness of the industry. Based on the deliberations in this framework, concrete actions will have to follow at EU and particularly at Member States' level in order to regenerate Europe as a world centre of pharmaceutical innovation.

Synthesis

Improving the competitiveness of European economies is a long term and multifaceted endeavour. The European Competitiveness Report 2006 reviewed a number of reforms targeting framework conditions (access to innovation finance, better regulation) and a particularly important input market, energy. It also identified the contribution that the concept of lead markets could have in designing more anticipatory innovation policies. In addition, it discussed recent trends and challenges regarding the competitiveness of two growing, high technology sectors, the ICT and the pharmaceutical industries.

In line with its mission in support of the microeconomic pillar of the Lisbon strategy, the Report documented areas where additional efforts may be necessary, for example, in the case of energy market reforms, as concerns consumer benefits from efficiency gains and efficient regulators, investment in long term fundamental research and infrastructure, reliability and environmental effects. In the area of business environment, the Report suggests that all Member States are

taking some action regarding Better Regulation, and the business environment more generally, but that those Member States in a less positive starting position should make greater efforts towards establishing fully fledged Better Regulation systems.

In relation with Innovation policy, the Report pointed to the need for supporting early stage venture capital and making cross-border venture capital operations easier and highlighted the relative lack of attention to facilitating the financing of innovation through loans. In addition, it identified the factors that would help design a lead market oriented innovation policy, i.e. incorporation of global market needs and preferences of customers from abroad, transferring domestic market preferences abroad, putting emphasis on lowering costs of production, allowing competition among different innovation designs, and addressing global trends.

The ICT producing industries and the pharmaceutical industry have little in common, other than being both high technology sectors. Trends in the first are driven mainly by technology while in pharmaceuticals health cost policies play an important role. Yet, some weaknesses, as a marked deficit in R&D intensity and the relative lack of young innovative firms are the same. It is also clear that beyond sector-specific measures – which are necessary and are pursued in specific fora – their competitiveness would improve substantially by the more horizontal reforms prioritised in the Lisbon agenda, such as those regarding innovation finance, the overall business environment, research, education and the functioning of the labour markets.

Chapter 1: Introduction

This is the ninth 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. Maintaining and improving its position in the global market is the main competitiveness criterion at the level of an industrial sector.

Over the last years, the Report has focused on analysis of the determinant factors of productivity developments, as the most reliable indicator for competitiveness over the longer term and connected issues, such as the likely impact of enlargement and the role of the public sector in the competitiveness of European economies.

The present Report continues in the same direction but, in the same time, marks a new beginning. Continuity as concerns its ambition to approach the issues from the point of view of economic theory and empirical research and its objective to contribute to policy making by discussing analytically the likely outcomes of the various policy options. A new start in its ambition to support much more directly than before the Lisbon process by focusing on the microeconomic issues of the Strategy for Jobs and Growth.

Thus, the Report addresses various aspects relating to three of the four priority actions of the reform agenda that the Spring European Council of 2006 put forward: *knowledge and innovation, unlocking the business potential* and *towards an efficient and integrated energy policy*. In addition, the Report examines the competitive position of two high technology European industrial sectors, the production of Information and Communication Technology goods and services and the pharmaceutical industry.

The Report is structured as follows: a first chapter reviews recent developments concerning growth; productivity and employment in Europe. Following chapters deal with, successively, the liberalisation of European energy markets, the Regulatory environment in the context of the Strategy for Growth and jobs, the financing of innovation, the concept of "Lead Markets" in innovation policy, the competitiveness of the ICT sector and the competitiveness of the pharmaceutical industry. Finally, a statistical annex presents indicators of competitiveness at sectoral level. This structure of thematic and sector specific chapters, followed by a statistical annex should continue in future versions of the Report.

Chapter 2:
Economic growth and standards of living

2.1. Introduction

A popular view sees countries competing among each other in the same way as enterprises are competing for a market of a given size. But comparing competition between countries with competition among enterprises is misleading. Losing market shares to other countries is not necessarily synonymous of losing competitiveness. Indicators such as the trade balance recording a deficit are often invoked as suggestions that a country is losing competitiveness. However, a surplus may be a sign of weakness (such as when the economy is not growing) and a deficit a sign of strength (such as when the economy imports international capital to finance domestic investment opportunities).

A widely accepted definition of country competitiveness refers to the ability of an economy to provide, on a sustainable basis, its population with high and rising standards of living and employment for those willing to work. This is the approach we follow in this chapter: competitiveness describes the overall economic performance of a nation. The objective is to provide an aggregate picture of recent trends in the EU-25 and to describe main differences among the Member States.

In the past decade GDP per capita (taken as a measure of the standards of living) in the EU-25 has been lagging behind that of the US and the growth rate of real GDP, labour productivity and total factor productivity in the European Union have been slowing down or remained stagnant during the 1990-2005 period. It is by now clear that these trends have structural features and this awareness, shared among European policy makers, dictates that adequate policy responses are needed. In 2000, the European Council agreed in Lisbon to re-launch European competitiveness. In 2005, the Lisbon strategy was revamped, with increased focus on policies aimed at delivering growth and employment.

Clearly the rise of oil prices in 2005 and 2006 has had a negative impact, though limited, in the EU growth performance. In order to put into perspective the current debate over effects of the fast rising of oil prices since 2003, the chapter also includes a simulation of the impact on the EU of alternative oil price shocks.

The chapter is organised as follows. Section 2 reviews evidence on GDP per capita and GDP growth. Section 3 analyses the supply determinants of GDP growth, distinguishing between the contribution of factors affecting employment and the supply of labour and of those having an impact on labour productivity, Section 4 concludes.

2.2. GDP per capita and GDP growth

Between the mid 1990s and up to 2000, the growth of EU-25 GDP per capita accelerated and remained at a good pace (annual average growth rate of 3%). The deceleration witnessed after 2000 seemed to start reversing in 2003, although 2005 turned out to be rather disappointing.

Table 2.1 (last column) illustrates the standards of living across individual Member States, the EU-25 and the US. With the exception of Luxembourg, where GDP per capita is more than twice as high as the EU average, living standards in the EU-25 range from 50% of the EU average (Latvia) to 139% (Ireland). Four Member States have a GDP per capita level below 60% of the EU-25 average.

Over the period 1990-2005, differences in developments in GDP per capita were mainly driven by GDP growth, the contribution from population growth being of a secondary importance. As Table 2.1 shows GDP in the EU grew less fast than in the US both during the slow-growth period in the first half of the 90s and during the high-growth, "new economy" years of the second half of the

decade. In the 2000-2005 period, growth again slowed down considerably in most EU Member States. Many of the new Member States however continued to register strong growth rates exceeding 7% annual averages in the three Baltic States. Encouraging recent data point to an acceleration of economic growth in the EU from 1.7% in 2005 to 2.7% in 2006. [5]

[5] See European Commission, *Interim Forecast, September 2006.*

Overall, the growth pattern in Europe follows quite closely the convergence hypothesis according to which countries with relatively low levels of per capita GDP grow more rapidly. Graph 2.1 plots the average annual growth rate of GDP per capita from 1990 to 2005 against the initial level of GDP per capita in 1990 for each the 25 Member States, the EU-25 and US. Even in this relatively short time period, there is a clear negative relation between the initial level of GDP per capita and its growth rate since 1990: countries that lagged behind in 1990 have typically grown faster.

Table 2.1: Real GDP Growth & real GDP per capita in PPS (EU25=100)

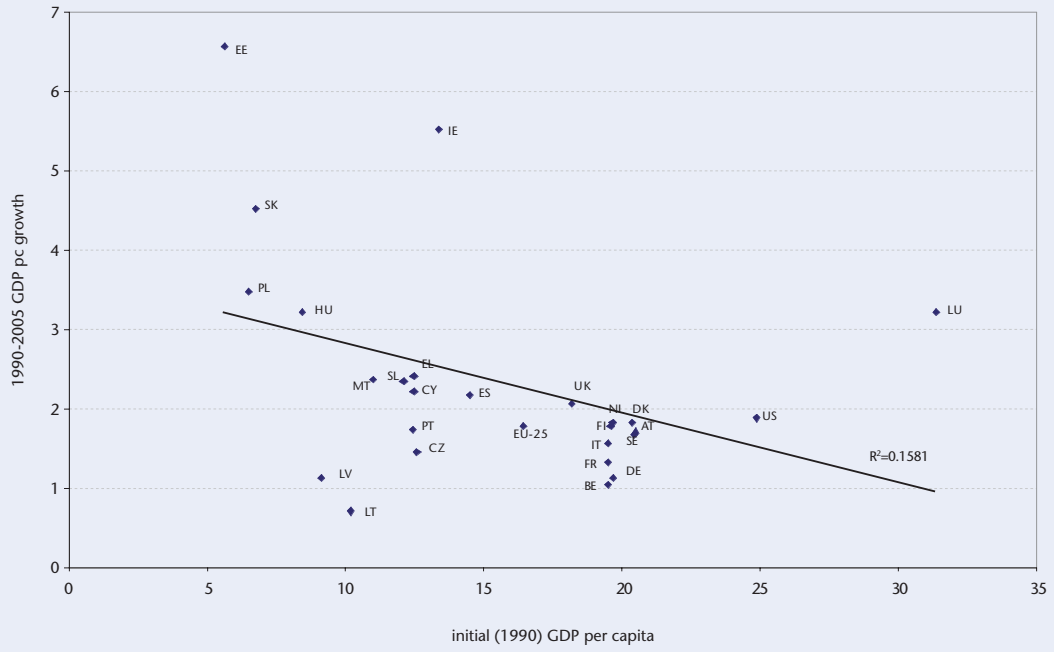
	Average annual GDP growth				2005 GDP per capita
	1990 – 1995 (*)	1995 – 2000	2000 – 2005	2005	
Austria	2.2	2.9	1.5	2.0	123
Belgium	1.6	2.7	1.5	1.1	115
Cyprus	5.3	3.8	3.2	3.8	81
Czech Republic	-1.0	1.5	3.6	6.1	73
Denmark	2.3	2.9	1.4	3.0	124
Estonia	*1.4*	5.6	8.3	10.5	60
Finland	-0.8	4.8	2.5	2.9	119
France	1.2	2.8	1.5	1.2	111
Germany	*2.2*	2.0	0.6	0.9	108
Greece	1.2	3.4	4.4	3.7	83
Hungary	*0.4*	4.0	4.2	4.2	61
Ireland	4.7	10.4	5.2	5.5	139
Italy	1.3	1.9	0.6	0.0	106
Latvia	-11.8	5.4	8.1	10.2	50
Lithuania	-10.3	4.2	7.6	7.6	53
Luxembourg	4.0	6.1	3.3	4.0	235
Malta	*5.3*	4.5	0.3	2.2	72
Netherlands	2.1	4.0	1.2	1.5	120
Poland	2.2	5.4	3.0	3.2	51
Portugal	1.7	4.1	0.6	0.4	75
Slovakia	*6.4*	3.7	4.6	6.0	56
Slovenia	-0.6	4.4	3.4	4.0	80
Spain	1.5	4.1	3.2	3.5	94
Sweden	0.7	3.2	2.2	2.7	122
United Kingdom	1.7	3.2	2.4	1.9	115
EU-25	*1.7*	3.0	1.8	1.8	100
US	2.5	4.1	2.4	3.2	152

(*) Hungary, Malta '91-'95; Slovakia '92-'95; Estonia '93-'95; Germany, EU-25 backward extrapolations of respectively West-Germany, EU-15.

Source: Commission Services, AMECO.

The GDP growth reported was obtained in spite of strong increases in oil prices in 2005 and 2006. However, persistently high oil prices could trigger potential second-round effects in wage and price-setting behaviour, which pushes up inflation and as a consequence dampens Europe's potential economic performance. Evidence on the macroeconomic effects of oil price fluctuation on economic performance is ample. During the surge in crude oil prices in 1999, for example, household savings rates declined by more than 2 percentage points in the Euro area, directly impacting investment behaviour and hence

Graph 2.1: Real GDP per capita growth (1990–2005) versus real GDP per capita in 1990 (*)



(*) Germany, Hungary, Malta '91; Slovakia '92; Estonia '93.

Source: Commission Services, AMECO.

economic performance during this period (cf. European Commission 2004, Graph 19).

But why should oil prices remain high? For a disruption in global oil supply by 7% an OECD (2004) study estimates an increase of international oil prices by 20-25%. But security of supply and associated price premiums are not only determined by production, but also by the demand side. Over the decade 1995-2004, China and India accounted for more than 30% of the incremental demand in crude oil (OECD 2004). Given their continuously high economic growth the two countries are likely to demonstrate further incremental demand for crude oil in the future, hence contributing to persistently high prices for crude oil.

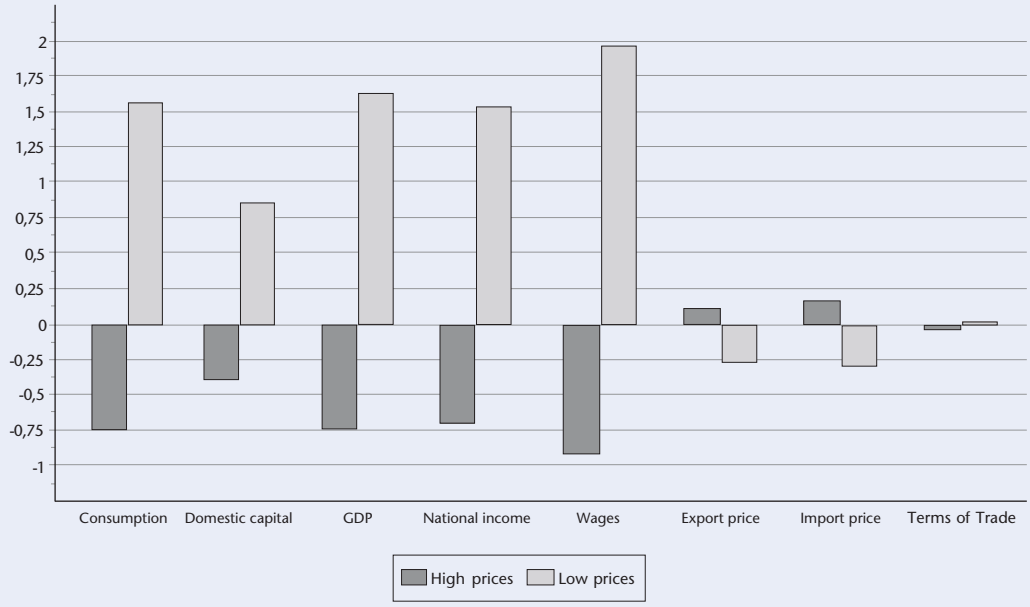
As we have observed crude oil prices to increase throughout 2006 from 60US$/barrel to about 80US$/barrel in a rather erratic manner and to plunge back to 60US$ within only two months, the debate about the impact of such rapid and radical price changes remains highly topical. In order to contribute to the quantification of the potential effects of changing oil prices on the EU economy, we provide an analysis of two alternative oil price scenarios, which is presented in Box 1 below.

Box 1: Changes in energy prices and EU economics performances

The relative price of energy vis-à-vis other commodities is an important determinant for economic performance and the growth of GDP. This is particular true for international crude oil prices, but also for the prices of other primary energy sources. Over the past two decades, crude oil prices show substantially larger volatility than other commodity prices (OECD 2004), which reflects the frequent disruptions in global oil supply. Such disruptions may occur through adverse weather conditions (hurricanes), technical interruptions (leaks, fires), sabotage, and geo-political risks.

Using the WorldScan[6] model (Lejour et al, 2006), we estimate the effects of an increase in average EU import prices for crude oil of *10%* ***(approx. 6.5 US$/barrel)*** **and their decline of** ***22% (approx. 14.0 US$/barrel) respectively***.[7] While the first scenario reflects continuously high energy prices, the second scenario mimics the possible return from the currently high oil price levels to more moderate levels, a medium-term prediction of many analysts.

Graph 1
Changes in some macro indicators for the EU-25 in 2020
(% change from the baseline in 2020)



The economy-wide effects of both scenarios for the EU-25 are presented in Graph 1.[8] If the average import prices for crude oil increase by 10% in 2006 (and persistently remain at such higher levels until 2020), real GDP for the EU-25 is 0.75% lower as compared to the baseline (business-as-usual) scenario in 2020.[9] Individual Member States are affected quite differently depending on their respective sectoral structure, the energy intensity of their production processes, and their dependency on energy imports (see Graph 2). The drop in GDP, which is caused by a decline in real wages that is due to the lower average productivity in the economy, corresponds to a decline in national income of the same magnitude. While final private consumption is in line with the change in GDP, the change in domestic capital stocks is more moderate reflecting their sluggishness even over medium-term periods. Since the EU is a net importer of energy, higher international energy prices translate to a relatively larger increase in aggregate import than export prices for the EU-25 area and hence a slight decline in Europe's terms of trade vis-à-vis the rest of the world.

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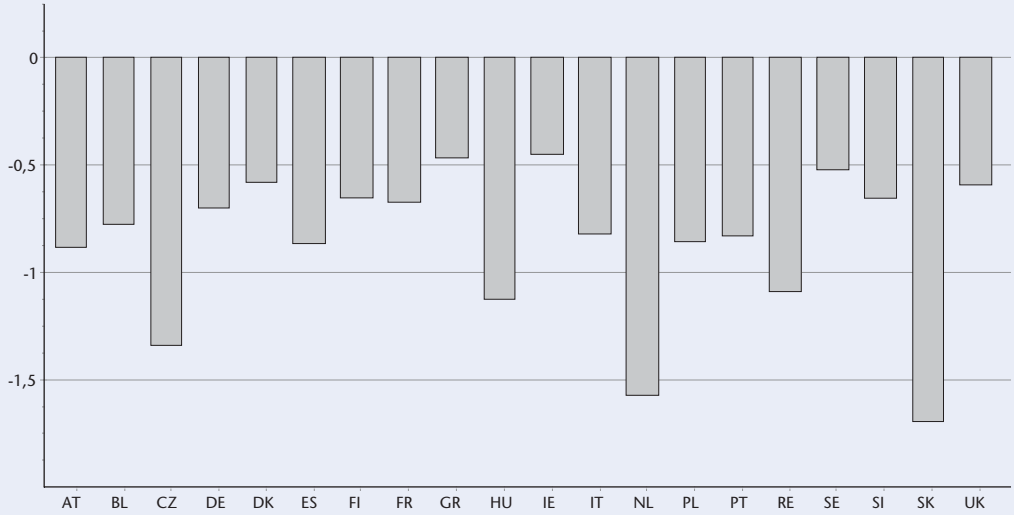
[6] WorldScan is a global (recursive) dynamic computable general equilibrium model that has been developed at The CPB Netherlands Bureau for Economic Policy Analysis (www.cpb.nl).

[7] The approximation of the changes in average EU import prices for crude oil are implemented as follows: we mimic a reduction (increase) in global energy supply of 3.2% (7.1%) through a 10% decline (27% increase) in total factor productivity levels in the energy production sectors for all regions. Assuming a 40% share of crude oil in the international energy mix the changes in global energy supply and price could be interpreted as an 8% (18%) reduction (increase) in global oil supply and a corresponding price increase (decrease) of about 10% (22%). The decrease of 22% in the second scenario would correspond to a decline in import prices for crude oil from 65 US$/barrel to 51 US$/barrel. For further details on model and scenarios refer to Wobst (2006).

[8] Given that WorldScan is a simulation model these results have to be interpreted as mere approximations. However, the magnitude of the results is in line with several other studies applying the EC ECFIN QUEST model, the OECD interlink, and the NiGEM model as summarized by the ECB (2004). The study by the European Commission (2004) using the QUEST model suggests potentially lower impacts, which can be attributed to the lower initial oil prices in 2003/04 and to the second round general equilibrium effects captured in WorldScan.

[9] All changes reported are annual effects and not accumulative effects over the entire simulation period.

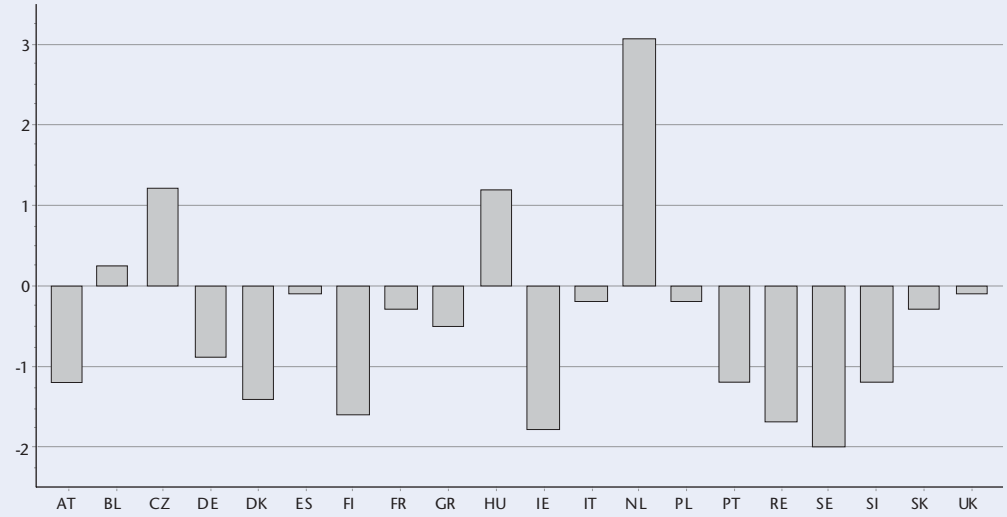
Graph 2
Changes in GDP across EU economies in 2020
(% change from the baseline in 2020 for "High prices" scenario)



Note: BL combines Belgium and Luxembourg; RE combines the Baltic Member States, Malta and Cyprus

The effects vary across sectors and countries as illustrated in Graph 3 for the changes in production of low-tech manufacturing across European economies in 2020 as compared to the baseline. Most obviously, the relative changes in the low-tech sector output differ substantially at individual country level. In part, this reflects country-differences in total energy intensity of production and dependency on energy imports. More importantly, it also reflects differences in the relative energy-intensities across *sectors* (by country), which not only cause different relative adjustments, but may also cause different directions of adjustment.

Graph 3
Changes in production of low-tech manufacturing across EU economies in 2020
(% change from the baseline in 2020 for the "High prices" scenario)



Note: BL combines Belgium and Luxembourg; RE combines the Baltic Member States, Malta and Cyprus

The second scenario approximates the impacts of a permanent decline in average EU-25 import prices for crude oil by 22% as compared to the price levels for 2006-20 in the baseline. The economic gains from such persistently lower energy prices would be substantial, accounting for a 1.6% increase of GDP

in 2020 vis-à-vis the baseline. The mechanisms at work are the same as explained above just taking effect into the opposite direction. Apart from the favourable conditions for most net energy importing European economies the marginal improvement of the terms of trade allow for some additional benefits. Consequently, the relative changes are even slightly larger than twice the changes of the first scenario.

Due to its relatively high energy demand and its dependency on energy imports, the European economy undoubtedly is going to suffer measurably under prevailing high energy prices and potential further increases herein. However, the economic losses can be dampened through structural adjustment and technology innovation that aim at increasing energy efficiency of production processes. In this respect, the current analysis does not capture the full potential benefits, because it does not consider technological change through (endogenous) R&D investment beyond the steady technological progress defined in the baseline. In particular, it does not consider the substitution from current technologies generating conventional energy sources to innovative technologies generating alternative energy sources such as, for example, second generation biofuels.

2.3. Growth determinants

Output per capita growth can be broken down into employment growth and labour productivity growth. The first captures the contribution to output arising from growing labour inputs available for production. The latter summarizes the contribution to GDP growth related to additional capital inputs, enhanced quality of labour inputs and technological progress.[10]

2.3.1. Employment

Employment rate in the EU-25 fell in the first half of the nineties. This was followed by a rapid increase until 2001; since then, the employment rate has remained nearly unchanged at 65% of the 15-64 year old population.[11] Clearly, progress towards the EU Lisbon target of a 70% employment rate by 2010 has been slow and significant efforts will need to be made for this objective to be reached.

Although some Member States recorded an increase in employment growth in 2000-2005 (see Table 2.2), for the EU-25 as a whole the employment growth in this period declined to 0.6%, or half of that in the late 1990s. In 2000-2005, total employment declined slightly in Germany (which has an employment rate significantly above the EU-25 average), and steeply in Poland (which currently posts the lowest employment rate in the EU-25). Luxembourg, Spain and Ireland recorded strong employment growth, exceeding 2.5% at annual level, although also these countries experienced a deceleration of employment growth in comparison to the late 1990s.

The employment rate in the EU-25 is some 7 percentage points lower than in the US, this difference explaining a great deal of the persisting gap in the level of GDP per capita between the two economies. But to assess fully the contribution of employment to GDP growth, data on employment rates need to be complemented by information on average working hours per worker. This information is relevant especially for the comparison of the EU with the US as that Europeans work now fewer hours than Americans. In the 1970s the number of hours worked per employee in the then EU-5 was around the same as in the US, but since then the number of hours worked has fallen in both the US and the EU-15, with a steeper reduction in Europe. Shorter working weeks and longer holidays seem to explain the trend.

2.3.2. Labour productivity

Labour productivity (GDP over total employment) in the EU showed a rapid convergence towards the higher US productivity level until 1995. Since then a marked divergence emerged, despite an annual average labour productivity growth in Europe of around 2% for the period 1995-2000 and 1.3% afterwards. Latest available data suggest that labour productivity accelerated in the first semester of 2006 (on a year to year basis the annual growth rate in the second quarter of 2006 was 1.7% for the EU25).

Table 2.3 presents the labour productivity growth rates by Member State. Most of the new Member States – in particular the Baltic States, Poland, Hungary and Slovakia – as well as Greece and Ireland recorded strong labour productivity growth rates in the period 2000-2005. Conversely, productivity growth was weak in Malta, Luxembourg, Italy, Portugal and Spain.

[10] More specifically, GDP per capita can be decomposed into labour productivity times employment rate times a demographic factor (which contribution we do not analyze here given that its contribution is of secondary importance).

[11] Although the employment rate has increased only slightly since 2001, the rate did not decline during then period of economic slowdown of 2001-2003, unlike in the US, demonstrating the resilience of the EU labour market to the slowdown.

Table 2.2: Employment growth and 2005 Employment rate

	Average annual employment growth				2005 Employment rate
	1990 – 1995 (*)	1995 – 2000	2000 – 2005	2005	
Austria	0.2	1.0	0.2	0.3	74
Belgium	0.1	1.1	0.5	0.9	61
Cyprus	:	1.3	1.5	3.2	65
Czech Republic	:	-0.8	0.1	1.6	69
Denmark	-0.1	1.0	0.1	0.7	78
Estonia	-5.3	-2.0	1.1	2.0	66
Finland	-3.7	2.3	0.9	1.3	69
France	-0.1	1.4	0.6	0.3	62
Germany	*0.0*	0.8	-0.2	-0.1	70
Greece	0.6	0.6	1.1	1.3	55
Hungary	*-4.0*	1.2	0.2	0.0	56
Ireland	1.7	5.7	2.9	4.6	69
Italy	-0.6	1.0	1.2	0.2	63
Latvia	-7.2	-0.5	1.6	1.5	65
Lithuania	-2.4	-1.1	1.1	1.4	64
Luxembourg	2.8	4.1	3.1	2.9	100
Malta	1.5	0.8	0.8	1.5	54
Netherlands	1.3	2.6	0.0	0.0	75
Poland	*-0.9*	-0.4	-0.6	2.3	53
Portugal	-0.6	1.9	0.4	0.0	71
Slovakia	*0.2*	-0.8	0.6	1.4	54
Slovenia	:	-0.4	0.6	0.3	66
Spain	-0.3	3.9	2.9	3.8	64
Sweden	-2.1	0.8	0.3	0.3	74
United Kingdom	-0.8	1.3	0.9	1.0	72
EU-25	*-0.3*	1.2	0.6	0.9	66
US	1.0	2.1	0.7	1.8	73

(*) Hungary, Poland '92-'95; Slovakia '94-'95; Germany, EU-25 backward extrapolations of respectively West-Germany, EU-15.

Source: Commission Services, AMECO.
Note: "employment rate" means persons employed in all domestic industries as % of population 15 to 64 years.

Productivity per worker can be decomposed into productivity per hour and average working hours per worker. In fact, when labour productivity is measured by hours rather than by worker, a reduction of almost 25% in the productivity gap between US and EU is observed. Since the short EU working hours do not apply for all member states -people in Central and Southern European countries tend to work longer hours- results change when comparing worker and hour productivity. Thus Belgium, France, Ireland, Sweden and Denmark where the average number of hours worked per year and per person employed is lower than the EU average, present higher hourly productivity while the reverse is true in the Czech Republic, Estonia and Greece. The last two columns in Table 2.3 present data on productivity per worker and per hour worked in 2005.

An ongoing debate concerns whether this difference in the supply of working hours is due to different preferences for leisure in the EU and the US, to different taxation systems, or to differences in labour market regulations (see Blanchard (2004) and Prescott (2003), CPB (2006) contains a recent literature review).

2.3.3. Capital deepening, total factor productivity

Developments in labour productivity may stem from changes in the per-employee capital stock, i.e. capital deepening, or by technological progress, as measured by growth in total factor productivity (TFP). Capital deepening is usually the prevalent source of labour productivity growth for middle income countries, the catching up process being characterized by relatively high investment rates and a capital/labour ratio approaching that of high income countries. Conversely, TFP growth is the dominant source of

Table 2.3: Growth of Labour Productivity per person employed & 2005 levels of real GDP per person employed (ppe) and real GDP per hour worked (phw)

	Average annual labour productivity growth				GDP ppe 2005	GDP phw 2005
	1990 – 1995 (*)	1995 – 2000	2000 – 2005	2005		
Austria	2.0	2.2	1.0	0.7	120	108
Belgium	1.5	1.5	0.9	0.1	118	137
Cyprus	:	2.4	1.6	0.5	76	71
Czech Republic	:	2.7	2.4	4.4	62	56
Denmark	2.5	1.8	1.3	2.2	100	114
Estonia	6.5	8.2	6.5	8.3	53	45
Finland	3.1	2.4	1.5	1.6	107	110
France	1.5	1.5	0.8	0.9	117	116
Germany	2.9	2.2	1.6	1.6	117	116
Greece	0.7	2.8	3.3	2.3	92	78
Hungary	5.4	2.9	3.9	4.3	68	58
Ireland	2.9	3.7	2.2	0.9	122	132
Italy	2.1	1.1	0.0	0.4	107	102
Latvia	-5.0	5.9	6.4	8.6	47	43
Lithuania	-8.2	5.4	6.5	6.1	50	48
Luxembourg	1.2	1.9	0.2	1.0	145	161
Malta	3.8	3.8	-0.7	0.7	78	80
Netherlands	1.3	1.5	1.3	1.8	125	124
Poland	*6.2*	5.8	3.6	0.9	57	50
Portugal	2.3	2.2	0.3	0.3	66	68
Slovakia	5.6	4.5	4.0	4.6	60	59
Slovenia	:	4.8	2.8	3.7	72	74
Spain	1.9	0.3	0.4	0.4	93	91
Sweden	2.9	2.4	1.9	2.4	105	116
United Kingdom	2.4	1.9	1.5	0.9	100	106
EU-25	2.2	2.0	1.3	1.1	100	100
US	1.3	2.0	2.2	1.8	137	129

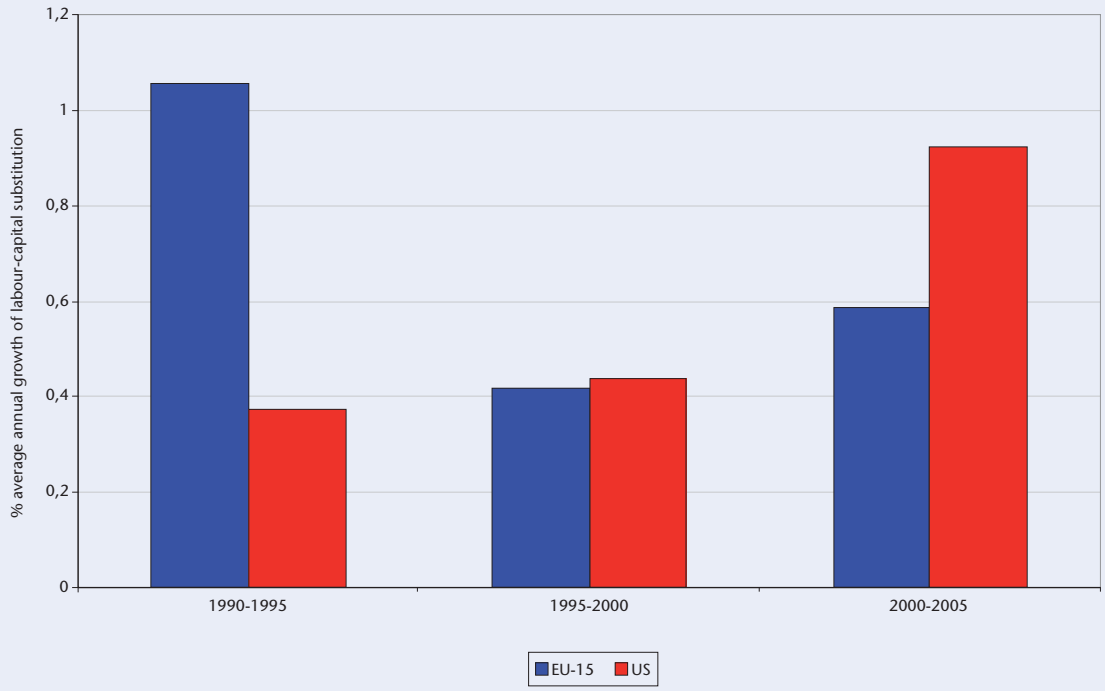
Source: Commission Services, AMECO.

labour productivity growth in high-income countries, whose potential growth is mainly driven by product and process innovations, reallocation and reorganization of production activities, and enhancement of factor quality. Recent analyses (e.g. European Commission (2006)) show that for most EU-15 countries during the 2001-2004 period, TFP growth was the major contributor to output growth, while in the EU-10 countries the picture is mixed, with some of these new Member States having a stronger contribution from capital accumulation.

In past decades, the capital/labour ratio in most EU countries has been growing faster than in the US. Graph 2.2 shows that an increasing capital/labour ratio in the EU-15 helped to catch up with the US until the mid nineties. Subsequently, capital deepening in the EU slowed down, while that in the US grew at a faster pace, especially during the period 2000-2005. Changes in EU capital deepening are mostly related to changes in employment. Where capital deepening is most marked is where performance in terms of employment growth was weak, while the opposite is true where employment has grown. However, the decreasing trend of capital deepening in the EU is also related to a downward trend in gross fixed capital formation. Gross fixed capital formation contributes, also, in explaining the EU - US differences in growth. There is consensus that the faster investment growth in the US was related with higher investment in enhancing productivity information and communication technologies (ICT), which manifested, inter-alia, in more sustained dynamics of TFP growth.

Table 2.4 shows that all the EU-15 countries have exhibited a decline in the growth rate of their capital/labour ratios compared to the first half of the 1990s. As for the EU-10 countries, over the 2000-2005 period capital deepening growth in these countries was on average higher than in the EU-15 (see European Commission 2005) and in the US, but with declining growth rates.

Graph 2.2: Capital Deepening



Source: Commission Services, AMECO.

Table 2.4: Capital Deepening growth rate (*) 1990 - 2005

	1990 – 1995	1995 – 2000	2000 – 2005
Austria	1.1	0.8	0.7
Belgium	0.9	0.4	0.4
Denmark	0.4	0.3	0.6
Finland	1.4	-0.5	0.3
France	1.0	0.3	0.6
Germany	1.5	0.9	0.7
Greece	0.6	0.7	0.9
Ireland	0.3	-0.2	0.9
Italy	1.0	0.4	0.5
Luxembourg	0.6	0.2	0.8
Netherlands	0.4	0.0	0.8
Portugal	1.4	0.9	0.9
Spain	1.4	0.0	0.6
Sweden	2.0	0.7	0.8
United Kingdom	0.7	0.3	0.5
EU-25	1.1	0.4	0.6
US	0.4	0.4	0.9

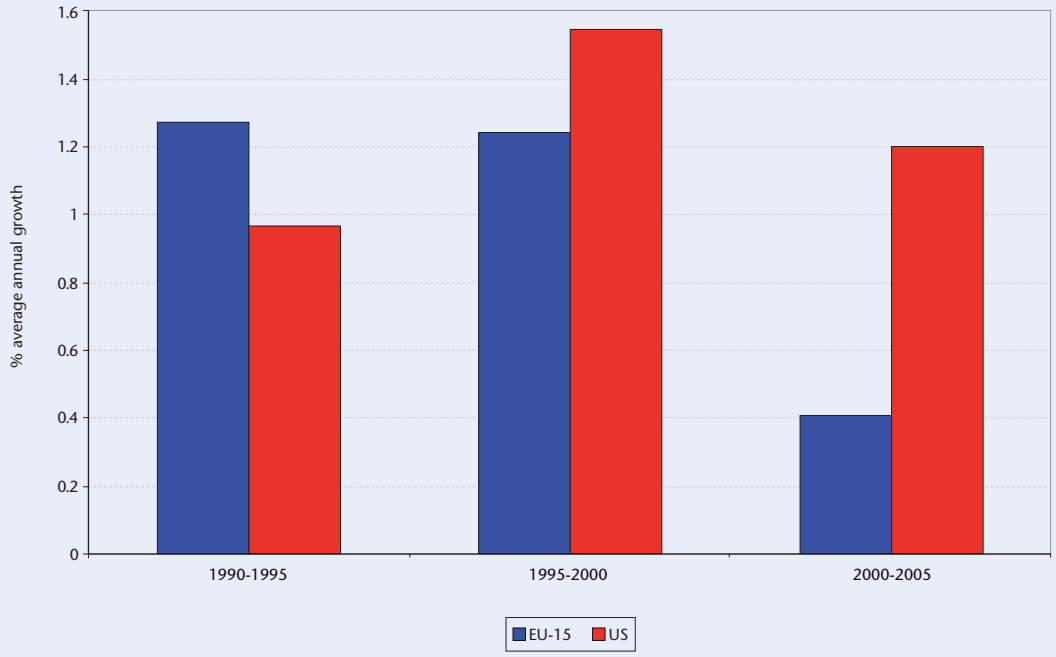
(*) Average annual growth rates of the labour-capital substitution ratio (%), 2000 = 100. Germany '91–'95.

Source: Commission Services, AMECO.
Note: data for EU-25 are not available.

The rate of growth of total factor productivity corresponds to what is also called "Solow residual" in growth accounting exercises. It measures the excess of the actual growth of output over the growth attributable to growth of labour and capital inputs. TFP incorporates the effects of changes in the degree of factor utilisation, in their quality, and in innovation and technological progress. One of the key factors enhancing TFP in recent years has been investment in new ICT capital goods which have a higher marginal product than others.

Graph 2.3 shows that during the first half of the nineties TFP growth in the EU was higher than in the US, while since then TFP growth has always been higher in the US. By historical standards, TFP growth in the EU was very low in the period 2000-2005.

Graph 2.3: Total Factor Productivity Growth



Source: Commission Services, AMECO.

Several explanations have been put forward to explain the disappointing TFP performance of the EU.[12] First, it has been argued that EU countries have been less concerned by innovations in IT-producing sectors and less prone to benefit and adopt such innovations in IT-using industries (e.g. Colecchia and Schreyer (2002)). Secondly, it has been emphasized that EU countries have been lagging behind especially in TFP growth in service industries, notably in the retail sector, due to stricter national regulations compared with the US (Van Ark (2002)). Third, the general point has been raised that the EU lags behind the US in terms of fundamental infrastructures and institutions for competing in innovative industries on a global scale (e.g. Sapir et al. (2003)).

Table 2.5 shows that the picture is quite differentiated across the EU Member States. Nordic and Anglo-Saxon countries have in general TFP growth rates that are high on a global standard, higher than those of the US in some cases. At the opposite end, most South European countries (with the notable exception of Greece) performed poorly. A great deal of the sharp slowdown in EU TFP growth since 2000 is related to slow TFP growth in several large euro-area economies.

2.4 Concluding remarks

During the period 1990-2005 the competitiveness performance of the EU-25 has been characterized by a slight acceleration of GDP growth accompanied

[12] See e.g. Sapir et al. (2003) and Blanchard (2004) for a general assessment.

Table 2.5: Total Factor Productivity Growth 1990 – 2005 (average annual growth rate)

	1990 – 1995 (*)	1995 – 2000	2000 – 2005
Austria	1.0	1.4	0.4
Belgium	0.6	1.1	0.5
Denmark	2.1	1.5	0.6
Finland	1.7	2.9	1.4
France	0.6	1.2	0.2
Germany	*1.4*	1.3	0.7
Greece	0.1	2.2	2.4
Ireland	2.6	4.6	1.4
Italy	1.1	0.7	-0.5
Luxembourg	0.6	1.7	-0.6
Netherlands	0.9	1.5	0.7
Portugal	0.8	1.3	-0.6
Spain	0.5	0.3	-0.1
Sweden	1.5	2.2	1.5
United Kingdom	1.7	1.6	1.0
EU-25	*1.3*	1.2	0.4
US	1.0	1.5	1.2

(*) Germany, EU-15 '91-'95

Source: Commission Services, AMECO.
Note: data for EU-25 are not available.

with stagnant productivity growth. Although recently there has been some progress in terms of increasing employment rates, the gains in labour productivity are sluggish. Both weak investment and slow total factor productivity (TFP) growth explain the weak performance of EU labour productivity growth.

Despite an increase in employment in many EU Member States, the overall employment rate in the EU remains low. Regarding TFP growth, no visible sign of recovery is present since the slowdown started at mid nineties. In fact, TFP growth further decelerated over the 2000-2005 period. Productivity gains stemming from re-organization and reallocation of production, from improved labour skills, from the introduction of new products and processes, would pave the way also for increased investment demand and further progress in labour productivity in terms of capital deepening.

These developments highlight the dual challenge facing Europe, i.e. raising employment rates and generating faster productivity growth at the same time. Yet both are necessary for sustaining standards of living and social welfare over the medium to long term, especially with regards to a fast ageing population.

The policy response lies in the Strategy for Jobs and Growth. The paramount emphasis put on reforms improving the business environment and innovative capacity, on enhancing human capital and on making labour markets more efficient reflect the focusing on improving the performance of European economies as concerns potential growth, productivity and employment. In following chapters, the Report will review three of these reforms, the liberalisation of energy markets, Better Regulation and in financing innovation as well as developments in two growing sectors of the economy, the ICT and the pharmaceutical industries.

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Chapter 3:
Liberalisation of European Energy Markets: challenges and policy options

3.1. Introduction

3.1.1. Liberalising European energy markets

The European energy markets have been going through a process of liberalisation[13] since the early 1990s in order to increase efficiency of the supply of energy (e.g. EC, 2005). This liberalisation process of the electricity and natural gas market is managed through EU Directives, prescribing non-discriminatory regulated third-party access to the networks in order to accommodate entry by competitive suppliers, and open end user markets to competing suppliers.

According to the EU Directives on the liberalisation of the electricity and natural gas market, the management of both transmission and distribution networks has to be legally and functionally unbundled from commercial activities by 2007. European countries have made progress in satisfying this requirement in particular in the case of transmission networks. Almost all countries have legally or fully (ownership) unbundled transmission of both electricity and gas, although a few unbundled Transmission System Operators (TSOs) do not have an independent management (EC, 2006). Nevertheless, concerns exist about third-party access to the transmission infrastructure, in particular in the gas market where third-party shippers appear to be subject to more costly access procedures. Moreover, distribution system operators remain closely linked to the supply business of the incumbents in a large number of EU countries. Consequently, the current level of unbundling in electricity and natural gas markets is viewed as being insufficient by regulators and many participants in these markets (EC, 2006). During 2006 the Commission lauched infringement cases against twenty Member States whose transposition of the Directives was considered to be insufficient.

In its preliminary report on the inquiry on the energy markets, the European Commission (EC, 2006) concludes that the functioning of the gas and electricity markets is seriously hindered by a number of factors, i.e. horizontal concentration, vertical foreclosure (e.g. entrants having limited access to the infrastructure), lack of market integration at EU level (e.g. incumbents controlling import capacity), lack of transparency (e.g. insufficient information on technical availability of interconnectors) and the still ill-developed price-formation process (e.g. prices not responding to changes in supply and demand).

Although the potentially adverse effects of concentrated markets are widely acknowledged, the EU Electricity Directives have not required horizontal separation of dominant producers and retailers to achieve less concentration in wholesale and retail markets. The electricity market has shown an ongoing process of concentration, which may seriously limit effectiveness of competition (Jamasb, et al., 2005).[14] For both the electricity and gas market, wholesale supply is often highly concentrated. For example, in all countries except the United Kingdom, incumbent natural gas firms control a large majority of imports as well as domestic production. Moreover, market opening is as yet not fully realised in all EU-countries. Currently, about 75% of the gas in the EU-15 countries is consumed by end-users who are free to choose their gas suppliers (Eurostat, 2005).

The welfare effects of introducing competition in energy markets have been subject to significant debate. As Joskow (2003) states, "replacing the hierarchical governance arrangements with well functioning decentralised market mechanisms is a very significant technical challenge, about which even the best experts have disagreements". The key challenge in electricity markets is to create an optimal design

[13] By 'liberalisation' is meant all measures changing the structure or rules on the energy markets, such as privatisation, vertical separation, merger control and (de)regulation.

[14] In many European countries, the share of the largest three generation firms is above 60%, while comparable figures exist for the retail market (Jamasb et al., 2005).

of regulating institutions to ensure effective working of market mechanisms and to induce sufficient long-term investment in each segment of the markets.

In decentralised competitive electricity markets, price uncertainty could possibly lead to too low levels of investment. In less competitive (oligopoly or monopoly) markets, control over prices reduces this uncertainty but results in allocative inefficiencies and possibly also in too high levels of investment, for which consumers pay the price.

In his assessment of experiences in the United States, Joskow (2003) concludes that the liberalisation process "has encountered more problems and proceeded less quickly than some had anticipated when the first restructuring and competition programs were first being implemented in the late 1990s". In California, for instance, retail prices increased by 30 to 40% due to market design imperfections, market power problems and poor responses of federal and state authorities. On the other hand, liberalisation of electricity markets in the United States has also produced successes, such as substantial investments in new generating plants by merchant generating companies as well as lower electricity prices for the largest customers (Joskow, 2003).

The most appropriate structure of the electricity industry is also still under debate, also because models which work well in some circumstances perform less well in other places (Newbery, 2002A). On some issues, however, theoretical and empirical evidence is quite straightforward. For instance, practice shows that ownership unbundling of the transmission system operation from competitive activities improves welfare.

In addition to the efficiency considerations, the liberalisation of the gas market has generated concerns about security of supply. IEA (2004A), for instance, states that the key question is "whether the (gas) market itself will value security of supply and deliver timely signals and competitive incentives for investments to guarantee secure and reliable gas supply all the way to the final consumer». Furthermore, the introduction of competition is also likely to impact on patterns of energy production as well as consumption and, hence, affects environmental outcomes. The direction of the net effect is not clear in advance as both price and substitution effects could emerge: both price and substitution effects. For instance, the opening of markets might encourage the supply from small-scale combined-heat-power (CHP) power plants. This substitution effect would lead to a reduction in overall emissions. On the other hand, the opening of markets may also lower prices and, hence, raise total emissions.

This chapter presents an assessment of the effects of liberalising the European electricity and gas markets, addressing the following questions:

What are the expected potential effects of liberalisation of energy markets in terms of efficiency, security of supply and environment?

What are the policy challenges in addressing the performance of energy markets and what other complementary measures might be needed to deliver Community competitiveness objectives?

The analysis of the effects on efficiency as well as security of supply covers both the gas market and the electricity market. The environmental section is restricted to the electricity industry, given its relatively high environmental impact compared to gas.

3.2. Liberalisation and efficiency

3.2.1. Introduction

The liberalisation of the energy industry is largely motivated by expected efficiency improvements. A more efficient supply of energy contributes to the competitiveness of the European economy and, hence, increases welfare. In order to assess the effects on efficiency, three efficiency concepts have to be distinguished: productive, allocative as well as dynamic efficiency.[15]

In theory, the relationship between competition and *productive efficiency* is at least non-negative (neutral or positive). Traditional theoretical models assume profit-maximising and cost-minimising behaviour of firms, which implies that firms should be always productively efficient. Agency models[16], however, stress the effect of the competitive environment on firms' incentives, concluding that competition increases productive efficiency.

Liberalisation might also improve *allocative efficiency* as price reductions will lead to a higher demand for services, hence, increasing the sum of consumer and producer surplus. Moreover, if consumer surplus is weighted higher than producer surplus, a lower price would result in even stronger improvements of total welfare.

The effect on *dynamic efficiency* is complex. On the one side, firms need to have profit in order to innovate (the Schumpeterian view); on the other side competitive pressures may also create incentives to innovate in some areas. Moreover, competitive pressure is also a source of dynamic efficiency to the extent that it leads inefficient firms who do not catch up to exit the market, being replaced by more efficient firms.

[15] These concepts will be made more precise in the next subsections.

[16] Agency models address situations of imperfect information, where tasks or decisions are delegated to an agent with an informational advantage which gives rise to a rent (hence the term agency models).

This section first gives a brief overview of empirical literature on the efficiency effects of liberalising the energy sector. Afterwards, the focus is on policy options to improve the performance of the energy markets.

3.2.2. Performance of energy markets in improving efficiency

3.2.2.1. Productive efficiency

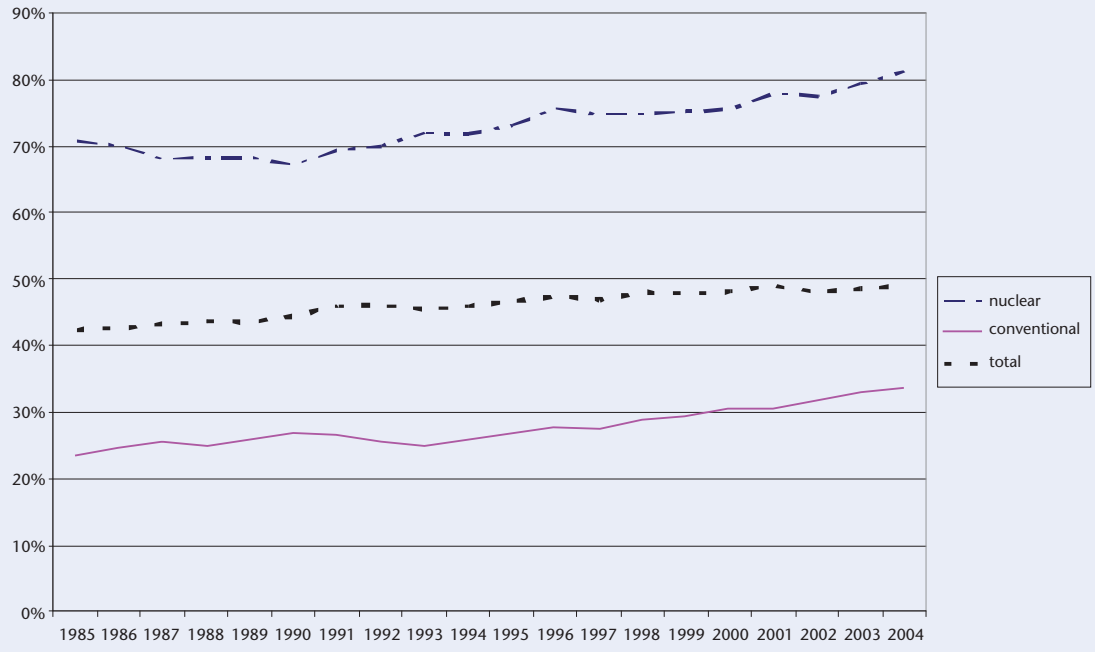
An economy achieves productive efficiency when it produces a given amount of output at minimum total costs. The empirical literature generally finds positive effects of liberalisation on productive efficiency of generation plants, both in and outside the EU. Newbery et al. (1997) document benefits from privatisation and restructuring of the Central Electricity Generating Board (CEGB) in the UK. These benefits are achieved by shifting from inefficient coal production supported by the government to a less costly technology,[17] resulting in a structural reduction of generation costs by about 5%.

Empirical studies by Bushnell et al. (2005) and by Fabrizio et al. (2006) for the US also show an improvement in the efficiency of generation plants after the implementation of reforms. In the course of these reforms, some plants were divested and began to compete in the market, while some other (non-divested) plants were subject to more stringent regulation. According to Bushnell et al., both competition and incentive regulation of generating plants have lead to fuel efficiency improvements (up to 2%). The authors argue that the change of incentives, but not the change of ownership itself, was the main driver of these improvements. Fabrizio et al. (2006) find that competitive pressures reduce non-fuel operating expenses of electricity plants. In anticipation of increased competition, plant operators most affected by restructuring reduced their labour and non-fuel expenses per unit of output by 3-5% relative to other investor-owned plants, and by 6-12% relative to government and cooperatively owned plants which were not affected by the reforms. Also IEA (2005A) finds an increase in labour productivity in the energy industry as a result of reforms.

Besides fuel efficiency and operational efficiency, liberalisation might affect the utilisation of production capacity. IEA (2005A) reports a 12% higher utilisation of generation capacity in New South Wales (Australia) compared to the pre-liberalisation period. Also in Europe, the utilisation rate of generation capacity increased over the past decades which might be partly the result of liberalisation (figure 3.1).

[17] Strictly speaking, shift to another technology has also aspects of dynamic efficiency improvement.

Graph 3.1: Utilisation of generation capacity in EU-15



Source: Eurostat. Utilisation is measured as the ratio between actual production and theoretical maximum production given the size of the generation capacity.

In some circumstances, however market power might lead to inefficient productive decisions, in the sense that production is not always undertaken by the least-cost units. This may happen when firms on both sides of the spot market (selling electricity as generator and buying it as retailer) gain market power. Kühn et al. (2004) find for the Spanish market that although market power of large vertically integrated sellers and buyers has had little effect on spot market prices, substantial productive inefficiencies may have arisen from the exercise of bilateral market power. However, this effect might be overstated. Mansur (2003), analysing the effect of vertical links among firms on market efficiency and firm conduct in the Pennsylvania-New Jersey-Maryland (PJM) electricity markets, emphasizes the effect of production constraints (such as start up costs). Accounting for these constraints, the author finds that the costs in the PJM markets were only 3.4% above the competitive levels.

Productive efficiency of energy transportation and distribution networks may increase as a result of the introduction of incentive regulation. Regulators in Europe often choose a price-cap mechanism, according to which the prices should change by no more than RPI-X, where RPI represents a price index and X represents a productive efficiency target.[18] Firms outperforming this target (with efficiency increases above X) can keep the resulting increased profit during the regulatory period. The empirical literature shows that firms respond to regulatory incentives and reduce their costs. For the UK, there is evidence on cost reductions by the National Grid after adoption of sliding scale incentive mechanism (see, e.g., Joskow, 2005).[19] Several other studies (Burns et al., 1996, Tilley et al., 1999, and Domah et al., 2001) report cost reductions of UK distribution firms after the introduction of price-cap regulation, especially towards the end of the second regulation period (the end of the 90s). Both selling the golden shares – shares held by the government, giving it potentially large influence over the companies – by the British government in 1995 and stronger regulatory incentives in the second regulatory period could be seen as drivers behind these productivity gains.

Hjalmarsson et al. (1992) find no significant impact of ownership and economic organisation on productivity change of Swedish electricity retail and distribution firms. However, they find a substantial influence of economies of density, as well as a relative increase in productivity in rural areas. These authors relate this to the mergers of small regional utilities, thereby implicitly implying the existence of economies of (regional) scale. In a reaction, Mork (1992) states that the lack of impact of ownership results from the fact that neither private nor the public utilities are profit maximising. In a later Swedish study, Kumbhakar et al. (1998) find that privately owned firms in electricity retail and distribution are more efficient than municipal companies. The difference in technical progress between public, private and mixed firms, however, appears to be small.

It has been argued that in retail, liberalisation has introduced new costs, such as loss of potential economies of scope between the network and retail activities. However, since retail cost is a small part of the overall cost, a large effect of these costs on overall productive efficiency is unlikely. The conclusion from this evidence is that liberalisation of energy markets (such as change of regulation and ownership structure) improves firms' productive efficiency, if this process succeeds in changing firms' incentives.

3.2.2.2. Allocative efficiency

An economy is allocatively efficient when it produces the quantity of goods that maximises total welfare. This generally implies that prices equal marginal costs of production.[20] For the energy industry, which is capital intensive, this usually refers to long run marginal costs. Liberalisation is expected to lead to competitive pricing and, hence, to improved allocative efficiency. In practice, however, the relationship between liberalisation and allocative efficiency may be affected by the market situation. Market power of firms may lead to inefficient outcomes. Therefore, when evaluating the impact of liberalisation on allocative efficiency, it is necessary to address the question whether market structure in the energy sector is adequate for delivering sufficient competitive pressure.

Market power can be measured by the margin between price and the marginal cost of production. However, in electricity markets market power can still be present even when the price equals the marginal cost of the most expensive producing unit since dominant companies might raise prices by withdrawing generators with lower marginal costs.

Borenstein et al. (2000) present an indicator of market power that reflects the difference between the price and the marginal cost that would occur *if all firms*

[18] Sometimes CPI (Consumer Price Index) is used instead of RPI (Retail Price Index).

[19] Under such a mechanism, the price that the regulated firm can charge is partially responsive to changes in realized casts and partially fixed ex ante.

[20] In the presence of scale economies (which is typically the case in energy markets were fixed costs are very important) the price equal to marginal cost rule leads to negative profits. Ramsey pricing addresses the problem of social welfare maximisation pricing under a constraint on profit. The solution of this problem requires that the price markup be inversely related to the price elasticity of demand. This pricing rule has been often applied to public utilities and in regulation of natural monopolies.

behaved as price takers. According to their estimate for California, the average mark-up over the competitive outcome was 15.7% in the period June 1998 to September 1999. Mansur (2001) and Bushnell et al. (2002) provide similar analyses for the Pennsylvania-New Jersey-Maryland (PJM) and New England electricity markets respectively, using somewhat different indicators that are based on the same idea. Comparing the results of these three studies over the period when they overlap (May to December 1999) controlling for the level of spare generation capacity at the various demand level Bushnell et al. conclude that "the performance of the two eastern markets was comparable, and that both were more competitive than California at all but the highest capacity ratios".[21] Hence, market power can be present even in a fairly unconcentrated electricity market.

There is also some evidence on the allocative efficiency effects of reforms in the UK. Newbery et al. (1997) conclude that the productive efficiency gains achieved by privatisation and restructuring of the electricity industry mainly went to producers, not to customers. However, according to a comment by Littlechild (2006), one should take into account that the prices would probably have gone up under state monopoly (regulated by rate-of-return regulation). In this view, the benefits of reforms in the UK were actually shared between consumers and producers.

However, as competition in the European wholesale market is currently seriously hindered by lack of market integration and by horizontal concentration (EC, 2006), European energy markets do not perform as well as they could in terms of allocative efficiency.

In transmission and distribution, allocative efficiency effects are likely positive. Most networks are subject to regulated Third-Party Access (TPA). Not only does regulatory pressure encourage firms to operate more efficiently, it also leads to more efficient pricing of services, and hence to closer to optimal use of the network by the firms and customers. Customers in many countries (such as UK, the Netherlands, and Norway) benefited from the price decreases that were forced by the X-factors set by regulators. For example, in the Netherlands, only for electricity the X factors saved the consumers 1.1 billion euros over 2001-2006 (Haffner at al., 2005).

In retail, liberalisation generally increases allocative efficiency in the large consumer segment, but the effect in the small consumer segment is ambiguous. Large industrial users face lower prices than small users[22] for three reasons: their stronger buyer position, less fluctuating demand, and lower network cost, since these users are often connected at a higher network level, e.g. to transmission networks. Empirical work by Steiner (2001) (for earlier years of reforms) presents evidence that liberalisation is associated with a reduction of industrial user prices in the EU.

The effect of liberalisation on retail prices is less straightforward for small users. Joskow and Tirole (2004) stress the problems for retail competition associated with the absence of real-time pricing for small users. This is currently dealt with via load profiling but there is some evidence that the lack of a real-time price signal for smaller users creates additional volatility, for instance in the UK market in 2005-06 where winter peaks in demand leading to wholesale price volatility were created by households paying a flat price for gas for the whole year.

When assessing market performance, an important issue is what would be the alternative to retail competition. Littlechild (2006) discusses two policy options that seem to be the most reasonable alternatives: regulation by benchmarking and tendering. He stresses that both alternatives require a large involvement of the regulator, which is costly. Besides, benchmarking is not always feasible because of the insufficient number of benchmarks. In the case of tendering (applied in some states in the US), the regulator has to determine the terms of tendering, but it is unlikely that the regulator knows more about consumer preferences and is able to make a better choice for consumers that the consumers themselves. So, both alternative policies are unlikely to outperform competition. This conclusion is much stronger if we account for the welfare increase from product innovations in retail (stressed by Littlechild, 2005; see also next section), especially those promoting energy-efficient technologies (addressed in Directive 2006/32/EC[23]).

The overall picture here is that the allocative efficiency benefits of liberalisation of European energy markets may have been limited due to imperfect competition on the energy markets up to now. If the reforms succeed to adequately improve competition on these markets, allocative efficiency benefits could be significant. In networks, however, regulation has generated allocative benefits by imposing more efficient prices.

[21] Capacity ratio is the ratio of residual demand over capacity. Given that electricity is not storable market power is intertemporal. Since capacity is constrained, market power is larger in high-demand periods. For example, Müsgens (2004) finds significant market power in the German electricity market, mainly exhibited during peak periods.

[22] For example, across member states, current electricity prices for large industrial users are 40-55 euros per MWh, while 60-150 euros per MWh for small consumers (EC, 2006).

[23] Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

3.2.2.3. Dynamic efficiency

Dynamic efficiency relates to the extent to which process and product innovation occurs. The relationship between liberalisation and dynamic efficiency is not straightforward. Competition might stimulate as well as dampen incentives to innovate, and is also likely to change the type of research and development. [24]

Evidence on private R&D expenses, which is often used as a measure for innovations [25], in liberalised energy industries suggests that the overall effect of market reforms on private innovation activity is negative. R&D activities in the electricity industry in many countries have declined over the past decades (e.g. Eurelectric, 2003; Hattori, 2006; IEA, 2005C; Jamasb et al., 2005; Sanyal et al., 2005). In the Japanese electricity industry, for instance, the R&D intensity, i.e. the ratio between R&D expenditures and total sales, declined somewhat since the mid 1990s when the process of liberalisation started (see graph 3.2). We should note that R&D expenditure may have been either inefficiently high or ill-directed before liberalisation, when it was carried out by regulated public utilities, which did not necessarily act as profit-maximisers. A lower level of R&D expenditures might be closer to optimal and is therefore not necessarily an indication of a lower level of dynamic efficiency.

Jamasb et al. (2005) conclude that vertical as well as horizontal unbundling [26] of the industry negatively affects R&D spending and technology adoption. This negative relationship follows from the fact that the size of a firm is an important factor behind innovation. Uncertainty created by the introduction of competition is also seen as a factor reducing the level of innovation. Regarding the effect of ownership, these authors conclude that privatisation shifts the focus of research towards applied and commercial projects. The overall conclusion of Jamasb et al. (2005) is that "competitive electricity markets will deliver sub-optimal amounts of R&D input and output". According to these authors, the lower emphasis on profits of public utilities before liberalisation, as well as the larger scale of companies, would have allowed for the positive externalities associated with knowledge spillovers. These authors also argue that the introduction of competition dampens incentives to conduct fundamental research, thereby requiring additional policy measures to encourage fundamental energy research if the pre-liberalisation situation is to be restored.

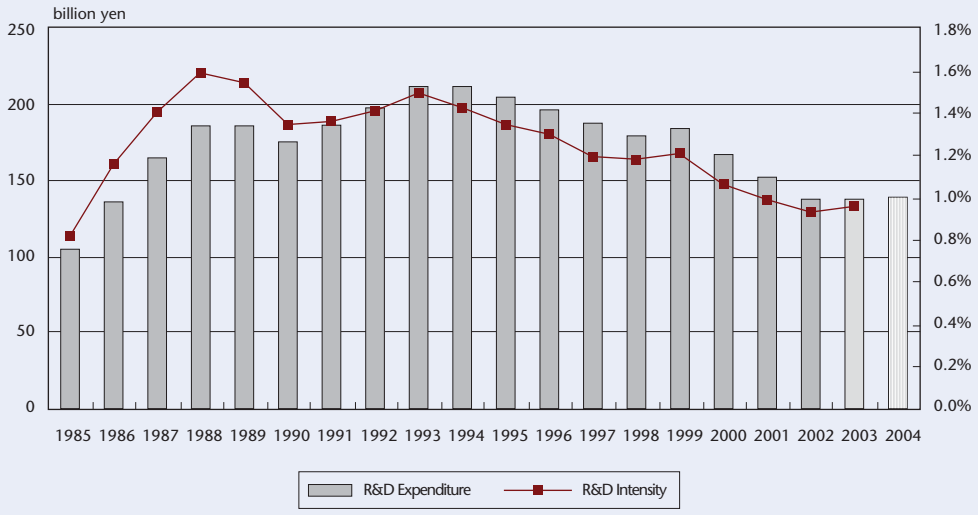
This conclusion is challenged by the results of other authors. In their analysis of the relationship between

[24] See Aghion et al. (2004) who find an inverted U shaped relationship between competition and innovation in manufacturing, suggesting that intermediate levels of market concentration are likely to lead to more innovation than the extreme cases of perfect competition and monopoly. The reasoning behind this result is that some market power is required to be able to reap the benefits from innovation (this argument relies on imperfect intellectual property markets, leading to imperfect appropriability of research results), while too much market power can deter innovation by dampening incentives to stay ahead of competitors.

[25] Clearly, not all innovation results from R&D and this is particularly true for process innovation.

[26] Vertical unbundling is a vertical separation of the companies operating in different segments of the industry production chain, and horizontal unbundling is a separation of companies operating in one segment of the industry production chain.

Graph 3.2: R&D Expenditure and R&D intensity in Japanese Electricity Industry



Source: Hattori (2006)

liberalisation and R&D in the US electricity industry, Sanyal et al. (2005) find mixed results. They conclude that even if the uncertainties in the face of anticipated restructuring and deregulation have adversely affected R&D activities by energy utilities, once these have occurred, a higher level of deregulation and competition positively affect R&D. A higher likelihood of changing the structure of the industry probably creates uncertainty about future benefits of investments and, hence, reduces the incentive to invest in R&D. When a higher level of competition has been reached, R&D might be encouraged by the prospects of using new technologies to achieve competitive advantages. Liberalisation might also affect the composition of R&D. Hattori (2006) finds for the Japanese electricity industry a shift in the R&D mix towards cost-reducing technologies while R&D in joint research programmes for public-interest technologies seems to be reduced. In the latter programmes, research is directed at technologies such as clean-coal generation, fuel cell power generation and power-system technologies to address the further development of generation techniques using combined cycle power and renewable energy. The author notes, however, that the decline in public-interest research may be a result of R&D activities having been genuinely ill-directed before liberalisation.

A shift of R&D towards efficiency-enhancing technologies due to liberalisation is confirmed by Markard et al. (2006). These authors find a move from technology-oriented innovation towards market-oriented innovation. The latter includes both cost-reducing activities and innovations directed at new products for consumers. In general, they conclude that liberalisation increases the variety of innovations paths. This picture of the impact of liberalisation on R&D is also described by Eurelectric (2003).

Hence, liberalisation of the electricity industry does affect the innovation process. R&D seems to be more directed at technologies contributing to cost reductions in the short term. Conversely, company funding for more basic research has been reduced in several countries, but it is still an open question whether this is the result of termination of inefficient R&D activities or whether it indicates a market failure which calls for additional government intervention compared to the pre-liberalisation situation.

Liberalisation and the ambition to create a single energy market have not been mirrored by a similar effort to better structure energy related research, where one can witness a large fragmentation of Member States' activities. A better coordination of Member States' energy research efforts between themselves and with the Research Framework Programme could ultimately improve the efficiency of energy research funding.

Besides evidence on R&D expenses, there is also evidence on product innovations in retail. Littlechild (2005) stresses the effect of competition on product innovation in retail businesses. From the experience of the Nordic electricity market, Littlechild concludes that retail competition stimulates the development of new value-added services to customers, such as offering new terms of contracts, fixed-price contracts of different duration and spot-price related contracts. In addition, Littlechild (2006) lists numerous recently emerged products, such as energy efficiency packages, duel fuel contracts, various discounts (e.g. for self-reading meters, for prepayment meters), green tariffs, etc. The recent European Energy Services Directive (2006/32/EC) stresses the positive role of product innovation in retail for the development of more efficient energy services.

3.2.3. A review of measures used to improve market efficiency

3.2.3.1. Introduction

Policy options to improve efficiency of the energy supply industry concern measures to improve competition in the markets and to encourage optimal use and expansion of network capacity. These measures can be divided into structural (i.e. affecting the industry structure) and behavioural measures. Although structural measures are often more effective for competition, they also involve higher cost. We discuss below some of these policies.

3.2.3.2. Unbundling, merger control, divesture and privatisation

A key component of the liberalisation of energy markets has been the vertical unbundling of networks from production and supply, in order to ensure efficient pricing of network transportation services and to create a level playing field for power generators and suppliers, including entrants. The latest EU directives require legal unbundling (by 2007) of the networks but, given the importance of independent functioning of transmission networks for good market facilitation, several EU countries have fully unbundled these networks from commercial businesses. The net benefits of ownership unbundling of transmission from production and retail are widely acknowledged (see e.g. Joskow, 2003A, and Jamasb et al., 2005). In contrast, in the distribution industry less experience has been developed. In New Zealand, for instance, separation of network activities from retail and generation was followed by an increase in competition and a decrease in wholesale prices. However, some of this improvement came

from improved switching possibilities and splitting of the dominant incumbent. Despite a clear theoretical argument regarding the adverse effect of a high concentration in the industry on the performance of firms, empirical evidence on the effect of merger control is scarce because of the unclear counterfactual: what would be the market development if a merger actually takes place? Especially in emerging markets, the consequences of a wrongly approved merger can be large. Therefore, some economists plea for more proactive policy in such markets, emphasising the relevance of strengthening merger control (see e.g. Canoy et al., 2003). The key issue here is that of the relevant market. At the moment, energy markets in Europe are still largely segmented, which underlines the importance of getting the market structure right at the national level. At the same time, several important market players are becoming active in many countries. Hence, merger control at the EU level becomes important too, especially in the light of more integration of the EU markets and more interconnections.

The studies on the US show that the performance of generation plants improves after restructuring because of the improvement of the incentive structure, which is achieved by privatisation and the change of regulation in divested generation plants. Although such divestitures are effective, they may involve high cost or be infeasible in practice for political reasons. Especially with the trend towards more integration of the EU market, some countries are afraid to split their energy companies as they may be taken over by large foreign utilities. In these conditions, political lobby groups push towards creating national champions. Behavioural measures (discussed hereafter) have also been used to mitigate market power.

3.2.3.3. Virtual Power Plants, long-term contracts and site availability

An alternative to actual divestiture to remedy market power in the wholesale market is virtual divestiture in the form of a Virtual Power Plant (VPP). VPPs reduce the scope for strategic behaviour in the market by reducing the amount of the generation capacity over which the dominant producers have discretion in bidding. They can be physical or financial. A physical VPP is a contract to deliver electricity (against some fixed price); a financial VPP is a contract on price which works similarly to a usual insurance contract. Willems (2006) argues that the type of the virtual divestiture is unimportant in the case of monopoly, but it does matter in oligopoly markets. This is because a physical VPP involves the delegation of production decisions by the dominant generator, while a financial VPP does not. Hence, in the oligopoly setting, the spot market is more competitive with a physical VPP divestiture that with a financial VPP divestiture.

Practical applications of VPPs can be found in several EU countries (such as Belgium, France, Italy, Denmark and Czech Republic). For example, in accordance with the agreement between the EC and Electricité De France (EDF), the company had to make available access to 6000 MW of generation capacity in France available (in exchange for the approval from the EC to acquire a further interest in the German electricity utility EnBW in 2001), which is partly done through VPPs and partly through Power Purchase Agreements.

Long-term forward contracts decrease both the possibility for a dominant producer to exercise market power and the gains from doing so. Examples are the so-called vesting contracts that have been used in the US and UK when their electricity industries were restructured. Many economists (e.g., Newbery, 2002, Wolak, 2001, Bushnell, 2004) emphasise the importance of long-term contracting for stability of electricity markets. For example, Wolak (2001) stresses the necessity of "sufficient forward market commitment for fixed-price wholesale electricity to cover retail obligations."

However, long-term forward contracts may create problems for entrants, as they may decrease the liquidity on the market. Another problem arises in particular in gas markets, where the incumbent large producers/traders have bought a large number of such contracts, increasing their market power.

Incumbent producers often also own or control many of the suitable sites for new generation plants, enabling them to foreclose the market for new entrants. Options to improve site availability are enforced (negotiated) release of sites, requirements to auction vacant sites and revising the licensing agreement to limit the scope for capacity expansion by the dominant player. This would limit the scope for incumbent firms to engage in strategic behaviour to control the number of market players.

3.2.3.4. Efficient allocation and extension of transmission capacity

Optimal use of the European transmission grid involves sending efficient price signals to both generators and energy users. Since power flows along different transmission lines are interrelated, individual lines cannot be viewed (and priced) in isolation. Coordination among TSOs can enhance efficiency of TSO decisions in the EU context. Also, harmonisation of regulation is essential for efficiency of the future integrated European market. In order to achieve this goal a greater consistency is needed in actions of

national regulators in different countries (High Level Group on Competitiveness, Energy and the Environment, 2006). A necessary condition for this is that the regulators have similar powers to promote the market development and to adopt efficiency-increasing policies, as well as policies enhancing security of supply.

With respect to the allocation of network capacity, non-market mechanisms are often replaced by market mechanisms, such as explicit auctions.[27] These mechanisms are supposed to deliver efficient capacity allocation, though in practice this is still not always the case due to inconsistent trading rules on either side of the border. Efficiency would imply that in the presence of a price difference between two regions, all transport capacity available between these regions is fully utilised (as a result of arbitrage). Frequently, however, one observes unutilised capacity in the presence of large price differences between neighbouring countries. This may result from illiquidity of markets, uncertainty in scheduling flows on a day-ahead basis, or the existence of market power.

Theoretically, the problem of assigning transmission capacity in an efficient way, including capacity taken up by the loop flows,[28] can be solved in a competitive market by so-called locational marginal pricing (or nodal pricing). This assigns a different generation price to each 'node' in the transmission system. Such systems of locational marginal prices are in operation in some regions in the US. However, appropriate determination of locational prices is only feasible in a centralised system where power markets in the system are centrally cleared, which is a long way from the European system based mostly on bilateral, decentralised markets that operate in the different countries.

One approach currently actively pursued is market coupling. In this set-up, instead of auctioning interconnection capacity on individual borders to individual market participants, the allocation of transmission capacity on all borders in one region is jointly carried out, on the basis of the bids for supply and demand of energy on the power exchanges in the regions involved. In this way, energy markets and transmission markets are simultaneously cleared, taking into account the relations between flows on the different borders.[29] Issues in gas transmission markets are to some extent similar to those in electricity transmission. The key difference is that gas wholesale markets are currently much less developed than electricity markets in Europe. Access rights to cross-border gas transmission connections are largely allocated in long-term contracts, leaving little room for market-based allocation of short-term capacity. Furthermore, short-term wholesale markets for gas in most countries are still in their infancy. Given the longer distances between gas production regions (often outside Europe) and consumers and the associated larger specific investments, there may be a greater need for long-term contracting, making market-based allocation of short-run capacity more difficult.

In the long run, efficiency of the transmission market involves efficient investment in transmission capacity expansion. Major policy issues arise with respect to accommodation of transit flows and extension of interconnection capacity.

The first issue involves the remuneration of transit flows: expansion of capacity for transporting power flows between two regions usually not only involves investment by the two regions' transmission system operators themselves, but also expansion of capacity in grids that are used for transit flows. The incentive for capacity investment by the operators of these transit grids depends on the ways in which such transit flows are remunerated.

A second issue is to what extent investment in new interconnections may be carried out by independent 'merchant' parties, and if this occurs, whether these merchant operators should be subject to regulation. The trade-off here may be between market failure, leading to potential underinvestment by private investors, and regulatory failure, leading to overinvestment by regulated transmission investors.

3.2.3.5. Enhancing end-use efficiency

In addition to policies directed at the efficiency of the energy production, transportation and supply, policies stimulating the efficient use of energy by consumers can contribute to European competitiveness as well. Retail competition might play an important role in moving towards energy-efficient technologies on the consumer side. The recent European Energy Services Directive stresses this positive role of product innovation in retail for energy end-use efficiency. It requires Member States to create the conditions for a market for energy services in order to improve the implementation of energy-efficiency measures by final consumers.

In a competitive retail market it is likely that retailers extend their activities to end-user services contributing to a more efficient use of energy by reducing the costs of implementing energy-saving measures.

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[27] This is a requirement in the EU due to Regulation 1228/03.

[28] Electricity power flows according to the path of least resistance. However, electric transactions are scheduled from one specific location to another without regard to the actual flow of energy. Loop flow refers to power flow along an unintended path that loops away from the most direct geographic path or contract path.

[29] This is sometimes referred to as zonal pricing, similar to locational marginal pricing but on the basis of zones consisting of Member States, rather than individual nodes in the network.

Environmental policy measures raising the price of energy, such as the European emissions trading scheme, can have a significant effect on energy use (see further on this issue in section 4).

3.3. Liberalisation and security of supply

3.3.1. Introduction

In the pre-liberalisation era, investments in electricity and gas sectors were centrally coordinated. Security of supply was generally the responsibility of the incumbent vertically integrated monopolist incorporating engineering reliability standards in its decisions on capacity investments. The concept of supply security was chiefly that "all customers should be able to consume as much electricity as they want at a constant price at any given time" (Bushnell, 2005). As a result, the pre-liberalisation energy industry was characterised by a high level of overcapacity where costs could be passed on to consumers. Moreover, the role of the demand side in achieving supply-demand balance was hardly recognised. Liberalisation has led to a shift of investment risk from consumers to the investors themselves, creating incentives to increase efficiency. In addition, liberalisation gives stronger incentives to consumers to respond to supply shortages.

A consequence of the abolition of the supply monopoly is that the responsibility for supply security is no longer explicitly assigned to an identifiable party. Rather, in the liberalised environment the market mechanism is relied upon to generate optimal investment. The question, therefore, is to what extent the security of supply is compromised by the decentralised management of energy supply. In order to address this question, it is important to note that two different perspectives on 'security of supply' can be distinguished.

Some view security of supply as guaranteeing a stable supply of energy at an 'affordable' price, no matter what the circumstances are (see e.g. EC, 2000).

The North-American Electricity Reliability Council (NERC) defines adequacy as "the ability of the system to supply the aggregate electric power and energy requirements of the consumers at all times", and security as "the ability of the system to withstand sudden disturbances" (Meade, 2006).

The 2005 Directive on Security of Supply (2005/89/EC) defines: "security of electricity supply means the ability of an electricity system to supply final customers with electricity, (...) the satisfaction of foreseeable demands of consumers to use electricity without the need to enforce measures to reduce consumption". This definition implies that supply and demand should not be artificially made equal through "enforcement" measures such as rota cuts and brownouts, but through a normal response to market conditions by producers and consumers. Similarly the definition recognises that some disturbances are not foreseeable and that the system cannot be 100% reliable 100% of the time.

Some of these definitions are close to pre-liberalisation goals as they take demanded volumes as an exogenous factor.[30] From a purely economic point of view, however, the concept of security of supply should be related to the efficiency of the provision of electricity or gas to consumers. Markets will always show variations in supply and demand, and, hence, in prices.

These differing definitions indicate that there are sometimes conflicting policy goals. From an economic welfare point of view supplying all demand is bound to be inefficient, and prices will have to fluctuate to clear the markets. However in some cases the extreme movements in prices could be viewed as politically unacceptable.[31] The remainder of this section looks at supply security from both perspectives.

3.3.2. Performance of energy markets in delivering stable and secure supply

3.3.2.1. Volatility of prices

Liberalisation of markets leads to decentralisation of operational and investment decisions, coordinated through the price-formation process. Comparison of prices (or marginal value derived from consuming energy) with short-run marginal costs of supplying to the market informs market participants in making these strategic decisions. In the days of the vertically integrated monopolists supplying to consumers in a centralised fashion, such short-term price signals were not required, and consumers typically faced average prices for energy (which for gas were usually indexed to oil price fluctuations). Liberalisation resulted in more volatile wholesale short-run prices, which were effectively hidden under the centralised regime. Typically, however, prices for final consumers are based on longer term wholesale markets, typically for one year forward contracts, hiding the effect of day to day variations.

[30] Although the EC Directive (2005) also stresses the importance of "removing barriers that prevent the use of interruptible contracts" and "encouragement of the adoption of real-time demand management technologies".

[31] Moreover, as Joskow et al. (2006) point out, in an efficient market price insensitive consumers' demand may have to be involuntarily curtailed.

Compared to other commodities, the volatility of short-run prices of electricity and gas in a liberalised environment is large. As examples of the volatility in energy markets, figure 3.3 plots the daily spot prices for the Dutch APX electricity market as well as the UK gas market spot prices NBP. While overall volatility of prices is noticeable, the short-lived price spikes to values which may exceed normal prices by tenfold are particularly visible.

The volatility of prices results from the particular characteristics of electricity and gas, in particular the inelasticity of both demand and supply in the short term. These in turn are related to the difficulty of storing electricity and the high costs of storing gas, respectively, as well as to the strict capacity limit of production and transmission capacities. The high investment costs of production equipment discourages companies to keep large amounts of spare capacity available, which leads to congestion on infrastructure in times of high demand, and therefore to rising spot prices.

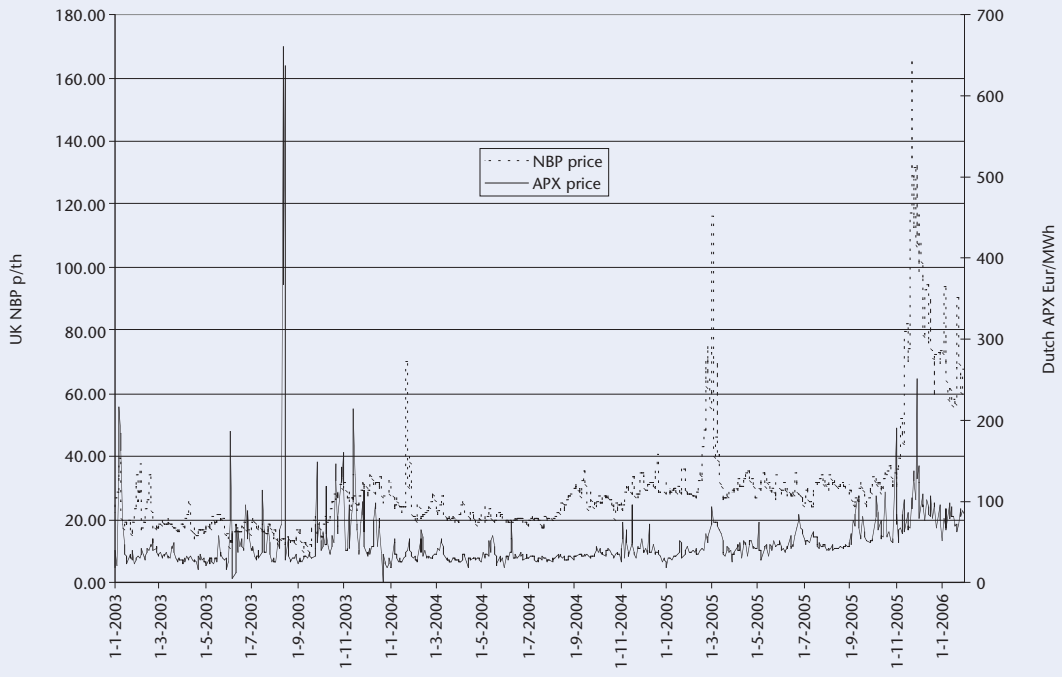
The volatility of short term prices need not be worrying for consumers if they can sufficiently contract their electricity and gas in longer term contracts. The extent to which longer-term contracts are available differs according to the maturity and liquidity of markets. IEA (2005A) notes that in the mature Nordic market, traded volumes of longer-term contracts equal over four times annual consumption.[32] The financial market for electricity contracts has grown to over eight time's total consumption over the first decade of liberalised markets. Also in the US Pennsylvania-New Jersey-Maryland (PJM) market, liquidity of the over-the-counter (OTC) market is growing fast. Even in slightly less mature markets in Northwest Europe (e.g. in the UK and Scandinavia), contract prices for 2 to 3 years in advance are quoted and traded (IEA, 2005A).

Also liberalised retail markets seem to be able to provide for longer term contracts to smaller consumers. Littlechild (2006) documents the wealth of contract structures that evolved, partially in response to price increases due to drought, in the Nordic market. Similarly, in the liberalised Dutch retail electricity and gas markets, offers for two or three year fixed price contracts have become more common.

While short-term volatility may be less of an issue, volatility on the longer term may be looked upon less favourably. Some argue that liberalisation may lead to longer-run price or investment fluctuations, which may result in higher contract prices. A case in point might be the current longer-term price rises in the UK gas mar-

[32] The German EEX market has also a very high level of liquidity.

Graph 3.3: Daily spot prices at UK gas market (NBP) and Dutch electricity market (APX)



Source: Datastream.

ket, where faster than anticipated decline of indigenous production resulted in a sequence of several winters with tight supply-demand conditions (see Graph 3.4).

The UK system so far has been able to withstand this above-mentioned shock in terms of balancing supply and demand, as a result of price signals and a significant demand response. Before liberalisation, such conditions were less likely to happen as risks of over-investment were not only borne by the investor, but also by the consumer (who would pay a higher average price) as well as, where subsidisation was involved, also by the tax-payer. As a result, the larger margin of spare capacity (to be on the safe side) in the pre-liberalisation period tended to dampen such price fluctuations at the cost of higher average prices over the longer term.

The long-run average energy price fluctuations are comparable in magnitude to those in other commodity markets (e.g. oil, metals). A major difference with these markets is that electricity and, to a smaller extent, gas prices are of a more local nature: as a consequence of infrastructure capacity constraints, global arbitrage of prices cannot occur (see e.g. Graph 3.4 for differences between UK and US prices). Average price conditions across various local markets may diverge more significantly than in other commodity markets, creating larger fluctuations in relative competitiveness between regions, and potentially reducing liquidity of forward markets. These international price differences are likely to decrease as the gas market becomes more global. Consumers may deal with long-run price fluctuations through long-term fixed price contracts. However, the market for such longer term contracts (of many years' duration) features limited liquidity.

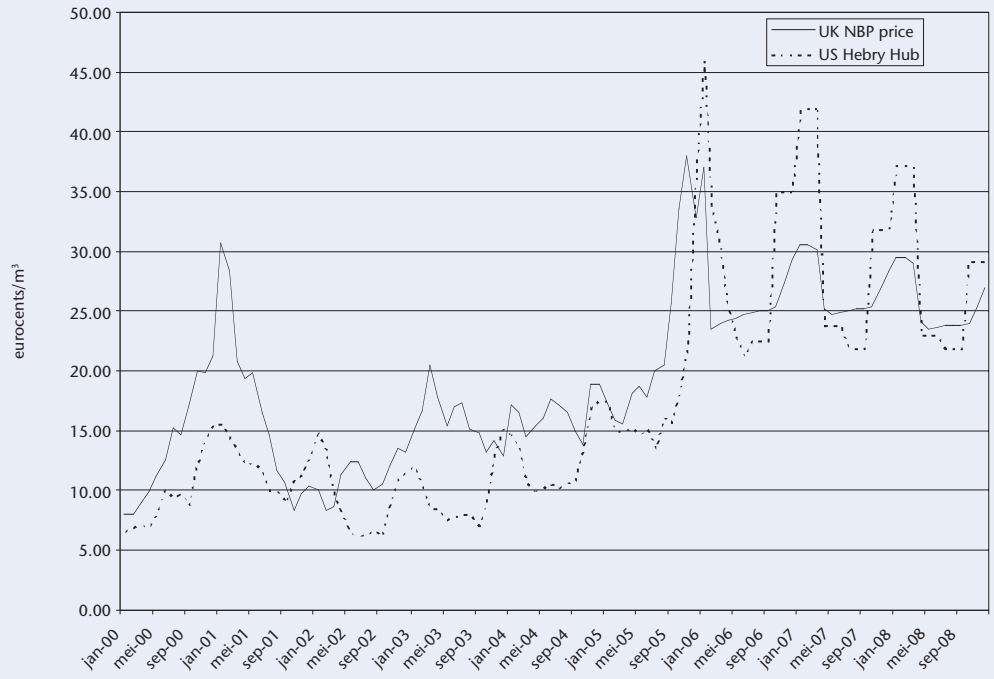
3.3.2.2. Balancing supply and demand

Shortages may occur in gas and power markets as a consequence of inadequacy of generation capacity, inefficient use of energy, outages in the transmission system, or local problems in distribution grids. One may furthermore distinguish between involuntary curtailments of consumers on the one hand and voluntary demand responses to price signals on the other.

Real physical shortages[33] have always been mainly restricted to problems in system management or distribution grids, and have not in general been caused by insufficient production capacity. A well-known

[33] In power markets, these would either be uncontrolled black-outs or controlled rotating black-outs or brown-outs (voltage reductions below normal operational limits) or forced interruption of industrial users.

Graph 3.4: Gas prices in US (Henry Hub) and UK (NBP), monthly average, 2000 – 2008, spot market prices until December 2005 / forward prices from January 2006 onward



Source: Datastream, European Spot Gas Markets (various issues).

exception might be the Californian power crisis, where indeed consumers did experience (controlled) forced disconnections. Even here, as explained in Bushnell (2004), this appeared not so much a consequence of insufficient capacity, but rather of insolvability of the utility firms.

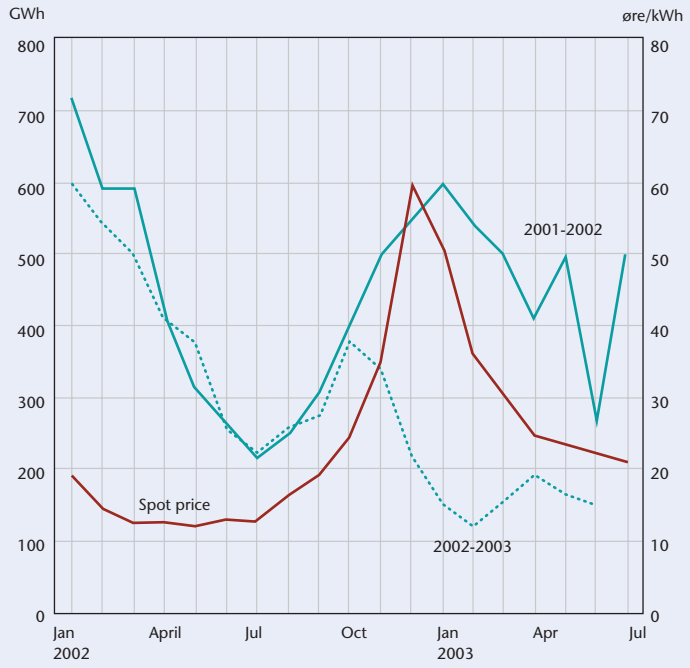
On the demand side of the market, on the other hand, responses to high energy prices (such as closing of production activities in other sectors of the economy have been more widespread: liberalised markets do generate market prices where consumers decide to reduce their energy use. In the UK gas market, for instance, demand response over the high priced winter 05/06 was significant. Regulator Ofgem estimated this as up to 10% of total gas consumption; the majority of this came about by electricity producers switching to other fuels. Energy intensive firms (e.g. in the ceramics and paper industries) shut down during large parts of winter. Also in the US, higher gas prices have led to the de-location of some of the more energy intensive consumers (e.g. fertilizer production, see Fertilizer Institute, 2005). In the Norwegian market, in the 2002-2003 Winter, price spikes emerged, provoking significant demand response, even from domestic consumers, who were generally on short-term contracts and were therefore soon confronted with the price rise. As a result the market coped remarkably well in preserving supply-demand balance (Bye, 2003; see graph 3.5).

Apart from actual experience of incidents where economic shortages appeared, one may also investigate whether risks of supply shortages have increased since liberalisation. One indicator of this is the evolution of spare electricity generation capacity after liberalisation. Declining capacity margins make the system more susceptible to incidental supply shortage. In the EU-15, the growth in electricity demand over the last two decades has slightly outpaced growth in capacity: average utilisation of capacity increased by 7% (see also Graph 3.1). Focussing on individual technologies, it appears that the average spare capacity margin [34] on nuclear and conventional capacity has decreased (with utilisation rates increasing by over 10% for each) (Eurostat). When looking at the last 5 years, this trend is even more apparent.

However, the lower margins of spare capacity in EU-15 have to be viewed in the perspective of increased power trade among countries. In addition, allocation of rights to use interconnection capacity has become more flexible and swifter response of power flows to short-run local supply or demand

[34] Defined as the ratio of available capacity from these technologies and annual output.

Graph 3.5: Effect of Norwegian 2002-2003 price spike (red line) on electricity consumption by the boiler market



Source: Bye (2003)

changes is now possible. As a result, with better pooling of national spare capacity margins (diversification), similar levels of security may be attained with lower spare capacity margins. It is also generally acknowledged that the level of spare capacity typical of the pre-liberalisation period was inefficiently high and often one of the key motivations for market opening in the first place.

Another indicator of risks of supply shocks is the level of diversification of supplies. More diversity of supplies leads to pooling of risks of interruption of supplies from individual sources. If alternatives are equally reliable[35], and shocks are uncorrelated, diversification will lead to lower aggregate risk. In electricity generation, one often looks at diversity of technology and fuel. Gas-fuelled production, and wind energy have grown significantly, at the expense of nuclear and, mostly, coal (see Graph 3.6). Given the traditionally high shares of the latter two fuels, diversification seems to have increased. This is indeed confirmed by analysis of diversity indices in the UK (see Grubb et al., 2006), but may differ across countries.

In gas, diversification is often associated with geographic sources of gas. Currently, imports of gas into Europe come predominantly from Russia, Algeria and Norway (IEA, 2004A). As indigenous European production will decline over the next decade, the reliance on imports will only increase. Risks can be related both to (political and technical) production risks and to transit and facility risks, which may increase as transit routes become longer. The importance (and risk) of dependence on specific facilities is exemplified by the 1998 Longford incident in Victoria, Australia, where domestic and business consumers' supplies were cut during two weeks, in the wake of an explosion at the Longford gas processing plant. All supplies depended on this plant (NERA, 2002). Such dependence of large volumes of gas on single pieces of infrastructure is not uncommon (and often indeed motivated by cost efficiencies). For example, for the UK, NERA (2002) and Stern (2003) point to the importance of the Bacton gas terminal in delivering gas to the country. Experience in recent winters demonstrates the sensitivity of the British gas market to the unavailability of the Rough storage facility, which accounts for some 80% of UK storage capacity.

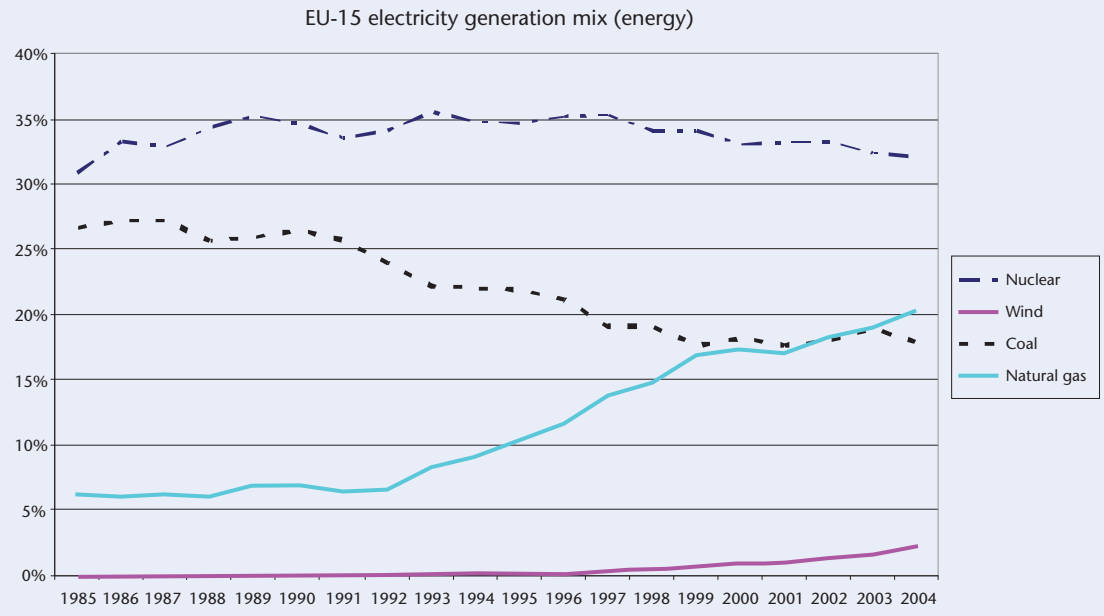
It is not obvious whether liberalisation leads to more or less diversification. Generation portfolios in the traditional systems may have been biased towards some technologies (e.g. as a result of coal subsidisation in the UK before liberalisation), while liberalised markets may focus on different technologies. The Longford incident in Australia was attributed to the monopolistic status of the gas sector.

3.3.2.3. Reliability of networks

The reliability of the electricity system is intimately connected with security of the transmission system.

[35] Risks of different technologies do obviously differ in practice. Gas, for instance, is generally viewed to be more vulnerable to political risk.

Graph 3.6: Contribution of various technologies to total generation



Source: Eurostat.

Indeed, all major power failures of recent years did not originate from inadequacy of generation capacity, but were a consequence of failures of system operations. System operators are in charge of balancing electricity demand and supply over the network. Failure to do so results, firstly, in overloaded transmission lines, and soon afterwards, in loss of equipment that may send the system into a cascade of failing components and loss of power over large areas. Well known examples are the 2003 black-outs in the Eastern US and Canada, leaving 50 million people disconnected for up to 4 days, and in Italy, leaving citizens without power for a day.

IEA (2005B) provides some evidence indicating that the frequency and extent of (smaller) North-American outages may have increased since the early 90s. Secondly, IEA also notes that larger blackouts occur mostly when systems operate close to their security limits. EU-15 cross-border trade volume has increased by 4% per annum over the last decade, compared to a 2% increase in generation (Eurostat). As a result of liberalisation and increased trade, many interconnections between European countries are congested a large part of the time (UCTE, 2005).

Another reason for strain on transmission capacity may be the higher share of intermittent generation (in particular, wind) in Europe. The more erratic supply patterns resulting from these energy sources cause larger short-turn variation in transmission flows across European networks, and hence place greater strains on reliability. A near-incident jeopardizing stability of the Belgian power grid as a result of German wind production is an example of this (UCTE, 2005).

The impact of liberalisation on the distribution sector is mainly through stronger requirements on unbundling and regulation in the member states. A stronger focus on efficiency as a result of increased regulatory incentives might impact on distribution grid quality, though much depends on the form of regulation. Figures on outages in the UK grid do not show significant increases of distribution disruptions, while outages as a result of planned maintenance have decreased (see CPB, 2004).

3.3.3. Performance of energy markets in delivering an efficient level of supply

From a welfare economic point of view, the question of an optimum level of supply security can be rephrased as whether the market succeeds in achieving efficient balancing of supply and demand in the short run, and efficient levels of investment in the long run. Efficiency requires that prices fluctuate to reflect changing supply and demand conditions. This may lead to substantial price variations over time. The high prices in peak periods are required to recover the investments. In these periods, furthermore, demand responds to the high price levels, as energy users reduce their consumption of energy. Security of supply interpreted in terms of short- and long-run efficiency may therefore be at odds with some of the concepts of supply security analysed above.

Since security of supply is itself costly, the optimal cost-benefit evaluation may well involve lower levels of supply security than were enforced by central planners in the past or is currently imposed through public-service obligations. In this approach, policy measures are called for when markets may fail to achieve a given level of security.

An evident reason for intervention in energy markets hinges on the fact that small consumers are not aware of (real-time) electricity prices and many consumers do not have the opportunity to react to short-lived price rises by reducing their demand. The potential failure to balance the system as a result of such demand rigidities might lead to system collapse, imposing an externality on all users. System security is therefore a public good. In practice, the adopted solution to this failure is that responsibility for balancing the system and making decisions on curtailing consumption is assigned to a system operator. In fact, the Transmission System Operators have to procure expensive idle reserve capacity for peaks. This decision is taken, not by the market but set out in regulations, standards etc., therefore liberalisation has no direct effect here.

Uncertainty over peak prices is sometimes mentioned as an impediment to efficient levels of investments on the grounds that producers would not invest if they perceive the revenues to be too risky. However it can also be argued that companies invest in order to avoid the risk of having to purchasing energy for their needs from these volatile markets.

Market failures may occur if prices in periods of price spikes do not adequately reflect the value of energy. This may result from ill-designed real-time (balancing) markets, or balancing mechanisms, but also for instance from (investors' anticipation of) interventions by governments or system operators in mitigating temporary price rises (e.g. Bushnell, 2005). As Joskow (2005) points out, especially under scarcity conditions, prices will be extremely sensitive to the system operator's discretionary actions.

Incompleteness of markets can also result in sub-optimal behaviour. If markets, in particular for long-term contracts, are not sufficiently liquid, optimal transactions may fail to take place. Reasons for insufficient long-term contracting may arise from transaction costs, but also from inadequate design of retail mar-

kets. If consumers favour contracting with financially unreliable retailers since they are not exposed to the imbalance costs in the event of the retailer's bankruptcy [36], insufficient contracting may result (Bushnell, 2005).

Do markets deliver suboptimal diversity? Again, when risks of certain sources or technologies translate into adequate price risk exposure to those contracting from these sources, market parties internalise those risks. An exception might occur if supply interruptions are exploited to achieve political goals. In addition, there is an obvious public good aspect involved in trade relations and international frameworks of property rights: foreign policy affects costs and risks of international supplies.

As to technology choice, there is, finally, a clear environmental externality. Neuhoff et al. (2005) argue that in the presence of market power, base load plants (i.e. the low marginal cost plants producing cross all hours of the day) or intermittent generation benefit less from exercise of market power than peak plants. The equilibrium mix of technologies may therefore be distorted under market power.

Regarding transmission and distribution, optimal regulation should incorporate incentives for internalising reliability of the grids. A difficulty in transmission grid regulation in particular is that local grids' security is intimately connected to operations in adjacent grids (that will typically be regulated by different regulators). This creates moral hazard where operators can shift responsibilities to adjacent operators (see e.g. Glachant et al., 2004). In addition, benefits of investments spill over to other operators, and are sensitive to (imperfect) compensation mechanisms for transit flows.

3.3.4. Policy discussion

3.3.4.1. Allocation of rights and responsibilities

Crucial to efficient functioning of markets is clarity over rights and responsibilities. Firstly, both in electricity and gas markets, given the public-good character of system security the system has to be managed by an operator having the responsibility for keeping system balance. Under the balancing regime, market parties generally have rights to execute (balanced) transactions, but are charged for imbalances between input into the system, and off take from the system. The design of the balancing arrangements is critical in appropriately making market parties internalise the consequences of their decisions. In particular, efficiency requires that real-time prices reflect real-time value of electricity or gas, in order to give adequate incentives to participants to contribute to supply security. Transparency on system operator disconnection policy in case of real-time shortage, as well as pricing behaviour under these conditions, can signal that system operators will allow prices to reflect scarcity, and that governments will refrain from interfering in the market in these events, thus providing assurance to investors. The need for clear allocation of rights and responsibility is recognised in EU Law through the gas and electricity security of supply Directives.

3.3.4.2. Price and capacity regulation of wholesale markets

In some electricity markets, high prices reflecting scarcity are either not acceptable or a policy of non-intervention cannot be credibly committed to. Some governments have therefore capped wholesale or balancing prices at some maximum level. However, to keep the same incentives for investment, this often requires compensation of investors in the form of capacity payments (subsidies to generators related to installed or available generation capacity) or some form of capacity credits (where consumers have a regulatory obligation to contract with generators for having capacity available, which created a market for capacity separate from the market for energy). This dual structure with capacity markets and capped energy markets has been chosen in many regions in the United States.

Price caps are less common in Europe as there are several disadvantages including the necessity for detailed regulation and central planning of required capacity, as well as the muted incentives on market participants for providing system security in times of stress [37] (see e.g. Hogan, 2005). Although price caps are sometimes advocated as a device for market power mitigation, experience suggests that market power is often shifted to the capacity market instead as argued by Bushnell (2005) and Joskow et al. (2006).

Insofar as inadequate contracting (and inability of consumers to hedge against price volatility) is the cause of concern, measures may be taken to improve liquidity of contract markets. This may require regulation with regard to market transparency and regulatory endorsement of market places. Participation of retail firms in the long-term contract market may be encouraged, on the one hand, by avoiding regulation that provides consumers with opportunities to terminate supply contracts and switch to low (regu-

[36] However this risk is reduced since suppliers have to provide large financial guarantees to the TSO.

[37] It might also, in integrated systems, give perverse incentives to lean on the system and export power to regions not affected by the cap.

lated) default rates in times of high prices.[38] On the other hand, it also potentially requires regulation of retail firms to hedge their price risks. More draconian measures would be to force long-term (option) contracts on consumers (see e.g. Hogan, 2005), although Littlechild (2006) demonstrates that absence of such regulation may result in desired outcomes as well. Other measures may be to allow industrial consumers to collectively negotiate long-term contracts with producers, as e.g. occurs in France (Ministère de l'Economie, 2005) and the Netherlands (Electrabel Nieuwsbrief, 2005).

3.3.4.3. Encouraging liquidity of markets

Liquid spot and forward markets lower transaction costs and entry barriers for new players, and may hence contribute to reduction of market power. Government support, in terms of market transparency, may contribute to market liquidity. Liquid markets can also help solving potential hold-up problems in investments. As Honoré et al. (2004) point out, unlike many other multi-billion dollar projects in the gas sector, the Ormen Lange pipeline to the UK is not backed by long-term contracts, as liquid spot and forward markets reduce the volume risk.

3.3.4.4. Regulation of energy mix

In the electricity market, environmental (emissions) regulations tend to increase generation diversity (see Grubb et al. 2006) for projections of diversity in the UK under low carbon objectives). As interconnection increases diversity, existing policy goals setting minimum bounds on interconnection capacity may be beneficial. However, setting minimum bounds likely results in suboptimal investments, as the presence of information asymmetry makes it difficult for the regulator to determine the optimal level. Improving regulation on congestion management and investment would be preferable.

In the gas market, diversity is probably more important, in particular concerning geopolitical sources of gas. Restricting shares of imports from individual countries may be difficult to enforce in liquid markets (except by limiting pipeline capacity). The costs of such constraints would depend on the substituting supplies. In the long-run, this would presumably be increased imports of liquefied natural gas (LNG), shipped from diverse locations. Foreign policies could try and control geopolitical risks (CIEP, 2004) and reduction of transaction costs for other sources of gas (e.g. through coordination of sitting permits for transmission infrastructure) could be considered.

3.3.4.5. Investment in strategic stocks

The government could also intervene in markets by investing in electricity generation or gas storage. The major risk here is crowding out: private investors may decrease their investment by a similar amount of capacity, depending on the deployment criteria of the strategic reserves. If only used under contingencies, voluntary disconnection of consumers may well be a less costly alternative. Also, IEA (2004A) notes that gas stocks are much more costly than oil reserves. [39]

3.3.4.6. Optimal regulation of grids and system operators

The natural monopoly of transmission system operation and investment evidently requires regulation. In contrast to regulation of distribution grids, analysis of, and experience with regulation of transmission systems is still underdeveloped. A notable example that is often considered to be successful is the UK, where the independent system operator is regulated using a mix of cost of service and profit sharing mechanisms based on performance metrics, including indicators for quality (Joskow, 2005). Giving adequate incentives for inter-TSO transmission investment is a more difficult issue, however. Increasing transparency to stakeholders of system characteristics and computation of available capacities may be a useful step.

Vertical integration with generation is likely to create distorted incentives as system operators' decisions may have an important impact on generator profitability. Joskow (2005) argues that ownership unbundling is optimal.

Minimum quality standards are widely used by regulators to protect customers from quality decreases below a certain level. In particular for distribution networks, such a standard may require that the company has to pay a fine or may even loose its licence for violating this standard. Minimum quality standards are used, for example, in the UK (Ofgem, 2003).

Although minimum quality standards are effective in preventing the drop of quality below a certain level, they do not reward companies for the provision of a higher quality or for achieving a better price-to-quality ratio. There have been regulatory attempts to introduce these incentives by adjusting regulated tariffs with change in consumer interruption cost (e.g., in Norway and the Netherlands, see Langset

[38] If retailers are barred from writing binding long-term contracts with consumers (e.g. because regulation stipulates that consumers may switch to competing retailers at all times without a penalty, or at an administrative penalty that does not reflect the market value of the long-term contract), retailers will not be inclined to sell such long-term fixed price contracts.

[39] See also cost-benefit analyses in De Joode et al. (2004) and Mulder et al. (2005).

et al., 2001, and DTe 2002). By doing so, the regulator balances cost-reducing incentives with incentives for a better price-to-quality ratio.

3.4. Liberalisation and environment

3.4.1. Introduction

Electricity generation is a major source of environmental pollution. Emissions from burning fossil fuels to produce electricity contribute substantially to urban ozone and other air pollution, acid deposition, regional haze and visibility problems as well as the build up of greenhouse gas concentration in the earth's atmosphere. These environmental effects result from environmental externalities arising from a well known market failure due to a divergence between market prices and social costs associated with the production of energy. Clearly the extent of these distortions depends on the energy inputs. The consequences of such environmental pollution are human health problems, damages of ecosystems, crops, and building material, amenity losses, and global warming (cf. European Commission, 2003).

Against this background it is important to know how increased competition in the European electricity markets is likely to affect the size of the environmental impact. The answer to this question is not obvious because restructuring can affect the environmental performance of electricity generation in many different ways, some leading to increases of air pollution and global warming and some leading to decreases. The effect depends on four key factors: how liberalisation affects electricity consumption, how it affects fuel efficiency, how it changes the mix of technology to produce electricity, and how liberalisation affects voluntary environmental initiatives and the performance of environmental regulation. This section first discusses these issues based on theoretical literature (Brennan et al., 2002). Afterwards, some empirical findings are presented both from inside and outside the EU and the results of a game theoretic model on the EU electricity market are outlined.

Beforehand, it is important to note that in principle liberalisation does not lead to any change in total CO_2 emissions because they are capped by the European Emissions Trading Scheme (EU ETS). If the emission cap is fixed and liberalisation facilitates fuel efficiency and clean technologies, this will only lead to more available allowances that could be sold to other sectors also covered by the EU ETS. It is, however, possible that liberalisation results in a higher level of electricity consumption with equal CO_2 emissions (see 4.3).

3.4.2. Effects of liberalisation on environment

3.4.2.1. Electricity consumption

A primary motivation for more competition in the electricity market is the expectation that it will lead to increased market efficiency leading to lower electricity prices. If prices fall, the consumption of electricity and emissions from electricity generation can be expected to increase, though not by a large amount since electricity demand tends to be inelastic. Whether and how much electricity prices fall as a result of liberalisation depends on a number of factors. If, for instance, the new market is very competitive and therefore leads to more efficient production and more purchase options for all classes of consumers, this can result in significantly lower electricity prices. In the short term, prices may also fall because overcapacities that have been produced by regulation and subsidies may be abolished. Conversely, if the regulated utility is a low cost supplier relative to its neighbours, prices in this area can actually increase under competition. Prices may also be higher than they would have been under regulation due to mergers and strategic behaviour of the electricity suppliers, as is described in section 2 (see also Haas et al., 2000). Thus, liberalisation has to be accompanied by a strong enforcement of antitrust laws.

Liberalisation could also lead to greater use of real-time pricing of electricity, leading to higher prices during periods of peak electricity demand and lower prices during off-peak periods, increasing market efficiency. Consumers may decide to shift their electricity consuming activities to off-peak periods. As the baseload units in power generation rely on coal in many countries and produce more emissions than the peak units, the shift from peak to baseload could lead to higher emissions. In single countries that have a high share of nuclear power in the baseload generation such as France, the shift could lead to lower emissions. In these cases other problems like nuclear waste disposal or reactor accidents may become severer.

3.4.2.2. Fuel efficiency

Rate of return regulation, which was the leading regulation in the old days of electricity generation, was meant to cover generators' costs of production plus some fixed capital rent. This did not enhance investments into innovative energy efficient power plants. By contrast, after liberalisation, electricity generators economise on fuel use, as is seen in section 2, for example by improving their degree of energy cycle efficiency, because they have stronger incentives to reduce production costs. This is likely to lead to reductions in primary energy use and emissions per produced kWh.

3.4.2.3. Mix of generation technologies

Liberalisation can have different effects on the development of nuclear generation, coal-fired and gas-fired generation as well as generation based on renewable energy sources. For each technology the effect can be theoretically either positive or negative. For example more competition may on the one hand lead to an increased use of relatively cheap coal-fired generators. On the other hand, some older coal plants will require capital investments to extend their lives and the costs of these investments might not be recoverable in a competitive market. Increasing the output of these older plants will additionally increase their maintenance costs, potentially making them unprofitable and thus marking them for replacement by more efficient plants. The chances of renewables may be affected if, as expected, increased competition leads to lower electricity prices and no other instruments to promote renewables are in place. Conversely, liberalisation creates greater possibilities for differentiating purchase options that can provide a boost to renewables. Incumbents as well as new operators offer service packages featuring green electricity for which consumers are willing to pay a premium above the market price of conventional power (see also the section on dynamic efficiency).

In general, whether a certain technology penetrates the European electricity markets faster than it would have in the absence of liberalisation is an open question, for several reasons. Competitive markets are riskier for investors, so that the capital costs will be higher than under regulation and tend to yield lower levels of investment in new generation plants. Uncertainty about future developments of environmental regulation, available locations for new plants, primary energy prices, or costs of the required equipment may have investment-reducing effects as well (IEA, 2003).

3.4.2.4. Voluntary initiatives and environmental regulation

More competition in the electricity market changes the attitude of utilities regarding electricity conservation programs that help to slow the growth of electricity consumption (IEA, 2004B). To the extent that these programs are actually effective in reducing electricity demand, eliminating them would result in higher emission levels. Liberalisation of U.S. electricity for instance has contributed to the demise of many utility-sponsored conservation programs[40].

Voluntary commitments to reduce emissions are also less likely to be forthcoming in a more competitive market where electricity generators have a stronger incentive to keep costs low.

Greater competition may, at the same time, improve the generators' willingness to comply with some environmental regulations, provided that monitoring is effective and thus, complying doesn't create competitive disadvantages. In a more deregulated market, generators are more concerned about minimising costs, so that the incentives to install low cost abatement techniques or to switch to cleaner fuels due to taxes or emissions trading are stronger. The advantage of market based policies relative to command-and-control methods is greater in competitive than in regulated electricity markets. Market based policies are therefore seen as being more consistent with liberalisation.

3.4.2.5. Empirical evidence

As the process of liberalisation in many countries is still ongoing, the existing literature does not provide a comprehensive research on all effects. The following findings, however, present some impacts of liberalisation which have been observed so far. Pearson (2000) shows that liberalisation of the U.K. electricity market in 1989 was associated with a rapid decrease of both total emission of several key pollutants as well as emissions per unit of electricity generated. The main reason for this development was that coal was to a large extent replaced by gas. The author argues that this encouraged the then government to take a more proactive environmental stance than they would have otherwise done.

Several studies analyse the effects of the market liberalisation on energy efficiency and use of renewables in the U.K. They conclude that liberalisation coupled with other policies helps to enhance energy efficiency but is in itself insufficient (e.g. Eyre, 2000; Wohlgemuth, 2000). This result is confirmed by the development of the demand for green electricity after liberalisation of the German electricity market. Only 1.2% of the electricity consumers switched from conventional to green electricity due to higher prices and switching costs. Though this might have been due to wider problems with switching, this result suggests that the diffusion of renewable energy technologies may have to rely on additional promotion measures (Börner, 2002). Filippini et al. (2002) explore the consequences of the implementation of the proposal to deregulate the Swiss hydropower sector. They conclude that in the short run only a few producers would have financial difficulties to cover operational costs and that the majority of the firms would not reduce or shut down their activities. The prospects in

[40] "DSM programs have traditionally been used by electric utilities to assist customers in reducing their energy use and/or demand. The prime motivation for these programs has been to reduce the investment needed for new power generation, transmission, and distribution facilities. Impetus for implementing these programs frequently came from regulators, and costs for these programs are generally recovered from rate payers. However, in a more competitive utility market, experience in countries where retail competition is allowed indicates that price becomes paramount, and many utilities and large industrial customers view DSM programs as a cost they are unwilling to pay."(ACE3, 1996).

the long run would depend crucially on the long run market price and on the capability of the producers to innovate.

Eikeland (1998) compares the impacts of liberalisation of electricity markets on the environment in the U.K. and Norway. The short-term effects were different due to different initial situations. Compared to the environmental improvement after liberalisation in the U.K. due to an intensified use of natural gas instead of coal, the impacts in Norway have been more complex. In Norway, nearly all electricity had historically been generated by hydro. Shortly after the reform in 1990, a temporary stop in new development of hydro projects occurred, leading to short-term environmental improvements, because the abolition of politically set prices and the area franchise system revealed excessive supply capacity. More fundamental changes came because the reform led to increased power trade between Norway, Sweden, Finland, and Denmark, coupling the Norwegian hydro-based electricity systems with thermal-based systems relying on coal, gas, and nuclear power. Whether or not the trade has led to a net decrease in environmental damages in the whole area is not clear. With respect to the long-term environmental impacts, the patterns seem to have been quite similar in both countries. The new electricity legislation allocated the responsibility for environmental challenges to the state (regulator), industry, and consumers.

Focussing on the climate change problem, Eikeland (1998) ascertains that after liberalisation regulators and industries had lower incentives to promote energy efficiency and renewables due to other overriding interests. Consumers were still relatively passive. He emphasised however, that the Swedish example of labelling green electricity led to a massive demand for green electricity, pushing the liberalised market towards an improved environmental performance.

Fabrizio et al. (2006) examine whether liberalisation of the U.S. electricity market has increased the productive efficiency on the plant level. They find that investor-owned utility (IOU) plants in restructuring regimes reduced their labour and non-fuel operating costs by 3 to 5% relative to IOU plants in states that did not restructure their electricity market. The utilities in the restructuring regimes have therefore a greater potential to reduce electricity prices which could in principle lead to a high level of electricity consumption. The authors also find little evidence of increases in fuel efficiency relative to plants in regulated markets, although the power of this test is limited due to a lack of data. Another US study, Bushnell et al. (2005), finds that fuel efficiency of divested plants improved by about 2%. Similar, though somewhat smaller, improvements were also observed at utility-owned plants in states that imposed more stringent regulation during the same time period.

Ringel (2003) takes a closer look at the first trends of the European electricity markets after liberalisation. The author states that the liberalisation does not only imply opportunities but also risks for the creation of a sustainable power sector. Many risks are due to market distortions caused by the delay in forming a fully functional single European market. In the short term, market liberalisation may create more risks than opportunities to the extent that lower end-user electricity prices increase the cost disadvantage of renewable energies and combined heat and power (CHP) plants. In the long run however, the efficiency gains of the sector and the appearance of new actors, such as new energy service suppliers, are likely to bring forth the opportunities and foster a transformation towards a sustainable electricity sector.

Kemfert et al. (2003) apply a game theoretic model to study the strategic behaviour of energy suppliers and their impacts on the environmental situation in the liberalised European electricity market. The effects on environment are ambiguous. Liberalisation leads, on the one hand, to an application of low cost technologies which are generally more damaging. On the other hand, in the Nordic countries that have an initially high share of renewable energy production technology, the share of environmentally friendly technologies is further increased.

3.4.2.6. Conclusion

According to both theoretical as well as empirical results, the impacts of liberalisation of the electricity markets on the environment are ambiguous. The overall effect on the environment consists of the various effects that liberalisation has on electricity consumption, mix of technologies, fuel efficiency, and the effectiveness of environmental regulations. According to the theoretical literature the single effects can be either positive or negative. The case studies of the UK and Norway show that the impacts also crucially depend on the initial situation in a country before liberalisation. The initial situations differ with regard to natural resources and geographical conditions, technological know-how, and requirements of the existing environmental regulation. Furthermore, the degree of market opening and the adjustment of environmental policy measures are crucial. For these reasons the impacts of liberalisation on the environment will differ across the Member States. Anyway, liberalisation is generally not opposed to environmental objectives and can strengthen the effect of market based environmental instruments.

3.4.3. Effects of the European Emissions Trading Scheme on Competition

3.4.3.1. Introduction

The European Emissions Trading Scheme (EU ETS) is by far the most important environmental policy measure affecting the European electricity market. It was launched at the beginning of 2005 to control CO_2 emissions of the power generation and heavy industry. The aim of emissions trading is to contribute to meeting the emissions reduction targets at least costs. The cap-and-trade mechanism makes sure that the emitters which reduce emissions are those for whom it is cheapest to do. The comment in the previous subsection on the positive interaction between market based regulation and liberalisation holds true for the EU ETS in particular. In a liberalised market firms minimise their costs including costs of CO_2 emissions. Comparing allowance price and marginal abatement costs a firm decides either to reduce emissions or to buy allowances. The market mechanism of the EU ETS therefore achieves the efficient distribution of emission allowances at least information requirements for the regulator, i.e. the regulator needs not to know the marginal abatement costs of the emitters.

According to the present rules, the initial allocation of allowance lies with the Member States with the European Commission having to assess and approve the plans against a set of criteria in the ETS directive. The discussion in this paper focuses on five design issues that affect the efficiency and effectiveness of the EU ETS and which have received considerable attention in the recent past (e.g. High Level Group on Competitiveness, Energy and the Environment 2006):

- Free allocation and insufficient competition;
- Allocation rules for new entrants and closures;
- Multi-period nature of allocation (updating);
- Non-harmonised allocation;
- ETS as part of a comprehensive policy mix (Hybrid allocation).

This section presents a short analysis of the consequences of these features. As the EU ETS has been started very recently the analysis is mainly based on the results of analytic and numerical simulation models but also contains a limited number of empirical results.

3.4.3.2. Free allocation and insufficient competition

The power companies like other participants have to reduce emissions and receive most of the emission allowances for free. Nevertheless facing a market price of permits constitutes opportunity costs for the firms. Opportunity costs are part of marginal costs so that passing on the emission opportunity costs is generally in line with economic theory. Given that electricity markets are still mainly regional, not fully liberalised with a rather inelastic demand, the power sector is able to pass on a relatively large share of the opportunity costs. Indeed, empirical and simulation model estimates for Germany and the Netherlands indicate that the share of CO_2 costs which passed on to consumers ranges from 60 to 100% depending on market and technology specific factors. Other sectors that also participate in the EU ETS do not have the possibility to pass on a similar share of the costs due to international competition. Depending on the input structure of the companies, they do not only face CO_2 costs but also higher production costs due to higher electricity prices. Many electricity intensive industries, such as the aluminium industry that compete internationally with their goods are put at a competitive disadvantage vis-à-vis industries from countries without comparable CO_2 control. More competition in the power sector could help to mitigate these distortions, though the disadvantage of internationally competing industries will to some extent persist[41].

Independent from passing on CO_2 costs, the problem of additional profits would be mitigated, if allowances were, at least partly, auctioned. Literature indicates that auctioning would lead to higher overall efficiency regarding the optimal level of output and emissions (cf. Böhringer and Lange, 2005). Furthermore, auctioning provides the possibility of generating revenues which could be used to reduce distortive taxes and create welfare gains (ref. Smith and Ross, 2002). Given that one aim of the EU ETS is the reduction of energy demand the rise of gross energy prices is unavoidable[42]. Without special provisions for internationally competing and particularly energy intensive companies higher energy prices lead to competitive distortions and carbon leakages because generally companies in competing markets are not subject to similar policies. Auctioning, however, provides an instrument to allow for the redistribution of additional profits to households and to cut existing energy taxes, if governments are willing to implement such redistribution.

3.4.3.3. Allocation rules for new entrants and closures

The EU ETS tends to increase the costs of entry for high carbon generators and therefore limits the number of potential competitors seeking to enter the

[41] Various factors may influence the competitiveness of these sectors, such as the availability of natural resources.

[42] Other policy measures than the ETS, aiming at comparable reductions of CO_2 emissions, would be less cost-effective and would have higher economic effects.

market. For this reason, most Member States reserve allowances for new entrants and thereby, facilitate competition. The promotion of competition, however, may come at a cost. If the allocation depends on technology used in the energy sector, i.e. carbon intensive technologies receive relatively more allowances, the choice for new power plants will be distorted away from CO_2 efficient plants towards more CO_2 intensive technologies. Although the overall emissions are capped the technology mix will then be inefficient. This effect would be mitigated at the margin if companies with permits sell them on to new, more efficient companies, or become more efficient themselves. In order to create efficient investment incentives the allocation should be based on output independent from technology. An alternative would be to auction allowances. More investments in CO_2 efficient technologies tends to lower allowance prices because less allowances are needed for the same level of electricity output.

With regard to closure, when allowances are allocated to incumbent generators, in some Member States it is required that the power station operates a minimum number of hours or produces a minimum number of MWh per year. An operator then will run the power station even if the marginal production costs exceed the wholesale price, as long as the loss is less then the value of his allowances. As a result, old and unprofitable power stations that otherwise might have been replaced by new build power plants could stay online (Neuhoff et al. 2005). The allowance price tends to be higher because these operators keep the allowances instead of closing down and selling the allowances. As both rules for newcomers and closures vary, the incentives for new entrants and operators of old and unprofitable power stations also vary between Member States. More harmonisation of rules across the EU is necessary, notably for new entrants and closure, including the possibility for using a benchmarking approach.

3.4.3.4. Multi-period nature of allocation (updating)

The allocation of allowances is presently largely based on historical emissions and follows a sequential process. Allocation plans are decided on for one trading period at a time with repeated negotiations about the allocation for the following periods. It is therefore likely that present emissions have an impact on the negotiations and therefore on future allocations. A grandfathering scheme of this type is likely to lead to dynamic inefficiencies. If electricity generators anticipate that their present behaviour affects future allowance allocations, the CO_2 efficiency incentives of the EU ETS will be reduced because any improvement may reduce future allocations. Analytical and simulation models show that this strategic behaviour results in higher CO_2 prices compared to one-off allocation (Neuhoff et al. 2006; Böhringer and Lange, 2003). A fixed reference date could avoid strategic behaviour because present day emission decisions would not affect future allowance allocations. Hhowever, this one-off allocation may appear problematic as it would ignore the intermediate technological change. Another possibility is to base allowance allocation on output or benchmarks. Output based allocation is independent from emissions and technology and would therefore avoid strategic behaviours and also create efficient investment incentives. Benchmarks compare existing technologies and define specified emissions levels (standards) for each technology. They could also help to avoid strategic behaviour but could lead to false investment incentives because they are not independent from technology, i.e. CO_2 intensive technologies may be favoured (see 4.3.3.). Due to technological innovations benchmarking has to be repeated regularly.

3.4.3.5. Non-harmonised allocation

The amount of national emission allowances is decided by the Member States subject to approval by the European Commission. They are, however, required to be on the pathway to their reduction targets from the Kyoto Protocol and the EU Burden Sharing Agreement, but have discretion over what share of their overall emissions reduction they plan to achieve in the EU ETS sectors, in the non-participating sectors, or through the flexible mechanisms of the Kyoto Protocol. Guidance has been provided by the European Commission. However, the Member States have discretion in allocating allowances to the participating sectors. As there is no harmonisation across countries, there is a real risk that differences in the assignment of free allowances to firms could distort competition. Böhringer and Lange (2004) show that it is in general impossible to obtain efficient CO_2 reductions when requiring 100% free allocation of allowances *and* non-discrimination of similar firms across countries. They propose a continuous increase of the auctioned ratio to promote harmonisation and efficiency in the longer run, leading the EU ETS to unfold its strength.

3.4.3.6. ETS as part of a comprehensive policy mix (Hybrid allocation)

The EU ETS covers almost half of all EU CO_2 emissions of which two-thirds are from power generation. The CO_2 emissions of the sectors not covered by the EU ETS are to be controlled by complementary policy measures. If the reduction targets from the Kyoto Protocol and the EU Burden Sharing Agreement are supposed to be reached mainly by national reduction efforts and not by using the international Kyoto

mechanisms, the allocation of allowances to the EU ETS sectors also determines the reduction obligation for the non-participating sectors. That is, a generous allocation to the energy intensive EU ETS sectors implies high reduction efforts for the other sectors and vice versa. Such a shift of the reduction burden can lead to substantial excess costs compared to a comprehensive emissions trading system covering all segments of the economy (Böhringer et al., 2005). Low carbon technology will, therefore, be less used and developed if efforts are concentrated in these sectors.

3.4.3.7. Conclusion

The analysis of the EU ETS allocation mechanisms shows that various provisions could create distortions of competition in the electricity market. This includes distortions between different participants, between participating and non-participating sectors within one country as well as between Member States. These issues are not being addressed in the context of the review of the EU ETS.

The EU ETS co-exists with the liberalisation process. The impacts on the electricity sector and the environment are therefore a result of their interaction. At this stage, the overall effect cannot be quantified There is, however, consensus that market-based regulations are clearly more compatible with a liberalised environment.

3.5. Summary and Conclusions

The European electricity and gas markets have been going through a process of liberalisation since the early 1990s. This process is changing the sector from a regulated structure of, predominantly, publicly owned monopolists controlling the entire supply chain, into a market where private and public generators and retailers compete on a regulated and unbundled system of transport infrastructure.

The change of incentives, resulting either from the introduction of competition or from more stringent regulation, has generally resulted in more cost-efficient operation. Although the reduced costs have to some extent been passed on to consumers, market behaviour raises concerns. Wholesale markets have turned out to be particularly vulnerable to market power, as a consequence of both legacy industry structure and the specific characteristics of electricity and gas. The viability of competition on retail markets, which relies on the willingness of smaller consumers to switch providers, is in most markets yet to be proved.

Evidence on effects on innovation indicates that a shift occurs in composition of R&D efforts: the companies' innovation focus moves away from technology innovation towards cost-reducing technologies and consumer services. While aggregate private spending appears to have diminished, the focus on efficiency-improving innovation seems to have increased. As a result, additional policy measures may be necessary to encourage fundamental energy research if the pre-liberalisation situation is to be restored.

Some policy responses that have been discussed usually centre on mechanisms to increase competition (e.g. through imposing requirements on dominant players). Full unbundling in transmission might be further encouraged as the resulting net benefits are widely acknowledged. Merger control at the EU level becomes all the more important as a more integrated EU market becomes the relevant market. Virtual Power Plants and long-term forward contracts can reduce the scope for strategic behaviour in the market. It is also argued that conditions for the compatibility of the latter with competition policy have to be clarified.

Also designs of mechanisms for cross-border trade have scope for improvement in order to better reap the benefits of integration of markets. Enhanced cooperation among TSOs and harmonisation of regulation should be further encouraged. In particular, current steps towards 'market coupling', a mechanism which allows for more efficient utilisation of available transport capacity between countries, may lead to improved gains from electricity trade. In this set-up, instead of auctioning interconnection capacity on individual borders to individual market participants, the allocation of transmission capacity on all borders in one region is jointly carried out, on the basis of the bids for supply and demand of energy on the power exchanges in the regions involved. In this way, energy markets and transmission markets are simultaneously cleared, taking into account the relations between flows on the different borders.

In assessing the effects of liberalisation on security of supply, care should be taken in defining the concept. A definition of security of supply that takes demand as exogenous has very different implications than a definition based on a competitive market whereby prices are allowed to move so as to ensure a balance between supply and demand. Both theory and evidence indicate that in liberalised markets, short-run prices are more volatile and reduction of demand to clear the market becomes of more importance than before liberalisation. While these effects are sometimes viewed as undesirable from the first perspective, the larger role of demand in clearing the markets is consistent with an increase in long-run efficiency.

Market failures leading to insufficient investment, can result from ineffective market design (or from the anticipation of intervention in prices under scarcity conditions), under which market prices fail to reflect the real value of energy. In regulated markets, devising mechanisms to foster efficient investments may be challenging, especially where (cross-border) transport capacity is concerned.

A very important issue is the need for clear allocation of rights and responsibilities of market players, especially during periods of scarcity. This may require regulation on market transparency. Further promoting the development of liquid markets where consumers can insure against price fluctuations is a necessary component of any policy for security of supply and this is stressed in Community legislation. In addition, a mechanism at EU level to better monitor demand and supply patterns on EU energy markets, identifying likely shortfalls in infrastructure, supply and storage would contribute to enhancing transparency on security of energy supply issues within the EU.

The impact of liberalisation on the environment is ambiguous. While reduction of prices would increase consumption of energy, increased fuel efficiency and shifts in technology mix, caused by increased competition, can reduce emissions. The latter effect is sensitive to the country-specific initial conditions and much would depend on what other policies are in place.

Liberalisation will strengthen the effects of market based environmental policy instruments. One major market based instrument is the European Emission Trading Scheme. The evidence indicates that liberalisation has resulted in stronger incentives for market actors to increase their operational efficiency. These efficiency gains, however, risk not always being passed on to consumers as a result of market power. If market design in energy markets[43] conflicts with policy goals, either because of design flaws or because of objectives that are incompatible with efficiency, the stronger response to incentives will lead to a higher risk of undesirable outcomes. A sustainable energy market must therefore design mechanisms that can provide long-term price signals encouraging the right production and transmission expansion investments necessary to meet reliability standards.

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Chapter 4:
The Regulatory Environment in the Context of the Strategy for Growth and Jobs

4.1. Introduction

Better Regulation is a key contributor towards achieving the objectives of the Lisbon Agenda of higher economic growth and more and better jobs. By removing unnecessary costs and obstacles, Better Regulation allows businesses to focus on their productive activities, to adapt to market changes and to innovate, thus enhancing aggregate productivity and competitiveness.

Box 1: Definition of Better Regulation

Better Regulation is 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 a high quality, i.e. it is concise, straightforward, used only when necessary and the burdens it imposes are proportionate to their aim.

The focus of this chapter is on product market regulation and its impact on the competitiveness of the Member States. One should, however, bear in mind that there are also regulations in other areas, most notably in labour and financial/capital markets, which can have a significant impact on economic performance.

This chapter reviews theoretical and empirical economic literature on the effects of product market regulation on economic performance. The regulatory measures as announced in the National Reform Programmes (NRPs) and progress that has been made since are assessed against the current situation in the Member States and with regard to their adequacy. While the systematic measurement of administrative costs of regulation has so far only been done in a small number of Member States, an assessment is made of the likely combined impact on GDP of achieving a concrete reduction target across the EU.

The next section of the chapter explores the channels through which product market regulation can affect economic performance. The focus is largely on how regulations can impact on the underlying causes of productivity. The section includes a review of empirical evidence regarding the impact of product market reforms on productivity and employment. Section three of this chapter provides an assessment of the quality of the current regulatory environment in EU Member States. Section four considers the country-specific plans for improving the regulatory environment as outlined in Member States' NRPs and actions that have been taken since. A tentative assessment of their likely impact on competitiveness is also provided. Section 5 concludes.

4.2. Product market reforms[44] and economic performance: theory and evidence

Part of the EUs response to a changing and more integrated global economy, with more intense com-

[44] "Product market reforms are microeconomic reforms that aim to improve the framework conditions in which business operate". They include: the opening of markets by reducing tariffs or barriers to entry; the reduction of publicinvolvement in the economy and generally by creating a more business-friendlyenvironment. Seehttp://ec.europa.eu/economy_finance/publications/european_economy/the_eu_economy_review2004_en.htm or http://ec.europa.eu/economy_finance/publications/economic_papers/2004/ecp218en.pdf

petitive pressures, rests on remaining competitive at the top end, or high value added range, of markets and on increasing productivity growth. The latter is particularly important for long-term economic performance, which is to a large extent determined by an economy's ability to increase output per worker (or per hour worked). Productivity growth allows economic growth to continue when other sources, e.g. increasing labour market participation, have been exhausted. Because an increase in productive efficiency results in lower unit costs (provided costs of inputs do not rise), any improvement in productivity over that achieved by competitors represents a gain in price competitiveness. Bad or excessive regulation is likely to drag down economic growth and macroeconomic performance, more generally, by impacting on one or more of the major productivity determinants such as competition, R&D and innovation, the development of human capital, technology, the allocation of resources within the firm or entrepreneurial dynamism.

As mentioned above, regulations can be found in labour, capital and product markets. The emphasis in this chapter is predominantly on product market regulations, which includes legal and other requirements for staring a business; licences and permits; and rules for trade and investment.

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. 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. For instance, regulations can be used to boost consumer confidence by specifying certain standards that products must have. Without product specifications that ensure, for example, product safety (e.g. children's toys) consumers might find it extremely difficult to tell whether a product is of a sufficient quality, and therefore safe to use. This information problem could lead to higher search costs for consumers, make it more difficult for new market entrants to signal the quality of their products and reduce competition, thus increasing the opportunity for rent-seeking of established incumbents and the risk of higher prices for consumers.

Establishing standards can also prevent market fragmentation. In sectors that are fast moving and experience the introduction of new products, such as ICT, standards contribute to ensuring adequate market size, a key incentive for R&D and innovation to take place. Patents provide another key incentive for innovations by ensuring that the returns of a newly developed product or an invention go to the person or business that has developed it. This is necessary, for a given period of time, to allow for early stage investments to be recouped and to ensure an adequate rate of return on new products.

Finally, it should not be forgotten tat the EU Single Market was created with the use of regulations. It is also a very good illustration of how regulations can open markets, challenge monopolies and foster competition.

Bearing in mind these positive contributions regulations can make to competition, innovation or entrepreneurial activity, all of which are amongst the main drivers of productivity, the following paragraphs give an overview of the detrimental effects unnecessarily stringent levels of regulation can have on economic performance and employment. Indeed, while regulations should aim to serve a clearly defined purpose, such as fostering competition or increasing economic welfare, they also have the potential to do harm if not devised and implemented carefully and updated when necessary.

When examining the economic effects of regulation a distinction can be made between the direct effects on the allocation of resources through influencing the use of inputs and the volume and price of outputs, and the effects that are due to changes in production technology (for surveys, see Griffith and Harrison (2004) or Schiantarelli (2005)). If prices are regulated in an industry that used to be considered a natural monopoly, such as the utilities or trains, firms are often constrained with regard to price competition and may instead compete on things such as quality of service. Although there are good reasons for having some form of price regulations, particularly in the initial phases of utility deregulation in order to improve efficiency (e.g. RPI-X) and to prevent market domination, unnecessary use of this type of regulation has implications for investment decisions and for the internal allocation of resources. Extensive use of such interventionist forms of regulation on an economy-wide scale can disable the price mechanism as a signal for allocating resources and result in an inefficient overall allocation of economic resources.

In cases in which regulations unnecessarily hinder market entry, e.g. due to administrative burdens on start ups or licence and permit systems that lead to access costs for market entrants, either monetary or in terms of time spent, the threat to incumbent firms from new entrants is reduced. This can change their price-setting behaviour and production decisions.

Furthermore, inefficient regulation can add costs to the operations of existing companies by, for example, making understanding and complying with existing laws unnecessarily difficult, so that firms spend valuable time fulfilling their legal obligations when that time could be more purposefully dedicated to core business activities.

Another channel through which regulation can affect productivity and competitiveness is via its impact on production technology and on the ability of firms to develop and market new products. This can be done, for instance, by interfering directly with the choice of technology instead of targeting its possible undesired outcomes.

4.2.1. Empirical findings

Empirical research generally supports the notion that improving regulation has positive effects on economic performance[45]. Box 2 presents in a summary fashion the main findings from a number of papers focusing on product market reform.

[45] Empirically there are a number of difficulties in studying the effects of regulation, both in terms of measurement and methodological issues. Depending on whether regulation overall or some specific measure is studied, an index can be constructed or events such as changes in regulatory regimes can be used to provide natural experiments. Different countries and industries usually have numerous unobservable or at least immeasurable characteristics that may have significant effect on the outcomes but cannot be controlled for in empirical studies. This presents a considerable challenge to producing evidence on the effects of regulation. As regulation often impacts economic performance through its effects on competition, measurements of competition are also often needed, but cannot fully capture the effects of competition. Measurements such as the Lerner index (the ratio of the difference between price and marginal cost and the price) or mark-ups have been employed for this purpose. The total welfare effects of regulation are difficult to quantify as the externalities, or the true utility that individuals derive from goods, cannot be measured precisely. In contrast, the productive capacity and efficiency of the economy can be measured by various measures of productivity. However, it is not generally possible to measure separately the effects of regulation on the different forms of efficiency or productive capacity which were discussed above. Finally, increases in employment (and reductions in unemployment) are also significant measures of success of economic reforms as one of the main aims of European economic policies is to reduce unemployment rates and one of the main goals of the Lisbon agenda is to create jobs in Europe.

Box 2: Effects of product market reforms (PMR): findings from empirical research

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

European Commission 2003

Moving to US levels of regulation as measured by the Fraser index would lead to:
- a labour productivity growth rate increase of 0.15 percentage points in the long run

Nicoletti and Scarpetta 2005

Regulatory reforms aligning the overall regulatory stance with that of the most liberal OECD country could induce
- An increase the annual rate of MFP growth in continental EU by between 0.4 and 1.1% over 10 years.

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 percent 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 increases labour productivity growth by 0.7% (2-year lag) Reduction

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).

PMR 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.

Reduction in administrative costs

Tang and Verveij 2004

A reduction of 25% in administrative burdens in the EU would lead to:
– A real GDP level increase of 1% in the short run
– A real GDP level increase of 1.4% in the long run.

Product market regulation can also influence R&D and innovation. Bassanini and Ernst (2002) investigate the effect of the OECD indicators of product market regulation (see section three of this paper) on industry R&D intensity. Their cross-country evidence suggests that product market reforms improving the regulatory environment could have positive effects on innovation. They also conclude that labour market regulation could have a positive effect on innovation.

Griffiths, Harrison, Simpson (2006) study the pro-competitive impact of product market reforms on innovation in the EU and find that generally more competition increases R&D investment. However, their findings also suggest that competition seems to increase mainly innovative activities of incumbents rather than that of new entrants. Their data consists of country-industry level observations of economic performance.

Moreover, regulation of product markets has implications for investment behaviour and thus the amount of capital available, even if financial markets themselves are unregulated. Alesina et al (2005) point out that there are various channels through which regulation can affect investment: it changes the mark-up on prices and the costs of expanding capacity, it can impact on the rate of return and it can influence ownership.

Internal Commission research suggests that there is a significant negative relationship between per capita GDP growth and levels of product market regulation as captured by the OECDs product market regulation indicator, when controlling for other relevant variables. [46]

The OECD has carried out several studies on the links between regulation and productivity, employment and economic growth. Nicoletti and Scarpetta (2003, 2005A) analyse the possible links between product market regulation and total factor productivity growth in the OECD area over the past two decades. This was a period during which the differences in prod-

[46] The regression analysis estimates the impact on per capita GDP growth of changes in the aggregate OECD PMR indicator. The analysis controls for other relevant variables such as human capital, physical capital, and for catching up effects. Human capital is proxied by the average years of schooling in 2000 and physical capital by the investment-labour intensity. The catching up effect is controlled for by the GDP per capita level in the initial year. All these variables (except human capital) displayed the expected sign and were statistically significant. All variables are in logs except the PMR indicator.

uct market regulation between European countries widened for some time[47] despite market integration, EC competition policies and monetary union. Their results indicate that lower barriers to trade and competition in less regulated countries have increased the level and rate of growth of productivity by stimulating business investment and promoting innovation and technological catch-up. The regulation indicators used include OECD indicators of product market regulation and some other sectoral indicators of which longer times series are available. They find that the overall indicator of barriers to entrepreneurship, however, does not seem to be a significant explanatory variable for total factor productivity growth.

A more recent paper (Nicoletti and Scarpetta 2005B) analyses the effects of regulation on employment in OECD countries and takes into account labour market institutions and their interaction with product market regulation. They use indicators of overall product market regulation constructed from sectoral indicators, on gas, electricity, post, telecoms and various transport industries. More specifically, the stringency of regulation concerning barriers to entry, public ownership, vertical integration, market structure and price controls is assessed. They conclude that the employment-curbing effects of excessive product market regulation are magnified by labour market institutions that provide insiders with strong bargaining power.

Griffith and Harrison (2004) examine the effects of product market reforms on rents or mark-ups, as well as the effect of rents on employment, investment, labour productivity and R&D in a panel of European countries. They find that higher levels of employment and investment are associated with greater competition, especially in the service sector. The reforms Griffiths and Harrison focus on include changes to public procurement policies, privatizations, legal and administrative barriers to entry, barriers to trade and regulation and liberalisation of network industries. Griffith, Harrison and Macartney (2006) provide stronger evidence for OECD countries that regulatory reform increases employment and real wages.

Cincera and Galgau (2005) study the effect of product market reforms on firm entry and exit and the effect of entry and exit rates on macroeconomic performance. They find that the ease of starting a new business has a significant effect on entry and exit but they do not find any impact resulting from changes in time spent with government bureaucracy. Entry and exit rates themselves on the other hand have positive effects on labour productivity, while effects on output growth, employment and R&D were mixed.

Internal European Commission work has come to similar conclusions. The next graph shows the negative relationship between GDP per capita and the aggregate indicator "starting a business" from the World Bank Doing Business database. Results not reported here show that after controlling for relevant variables -human capital, physical capital, and R&D intensity- estimation results seem to indicate that if the average level of regulation as measured by the indicator improves by 10%, GDP per capita could increase by over half a percentage point.

4.2.2. The case of administrative costs

Administrative costs are defined as the costs incurred by enterprises, the voluntary sector, public authorities and citizens in meeting legal obligations to provide information on their action or production, either to public authorities or to private parties. They are different from compliance costs stemming from the intrinsic requirements of the legislation, such as investments in safer production processes or acquisition of less polluting technologies.

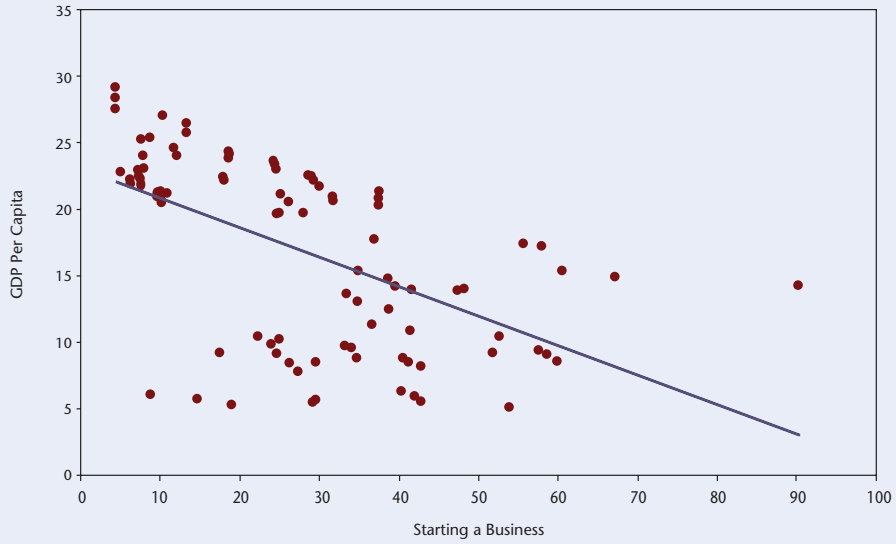
Kox (2005) presents estimates of the administrative costs that occur to the private sector as a direct result of compliance with regulation requirements as a result of national and EU level legislation, such as the time and effort in filling in forms. The estimated administrative costs relative to GDP are presented in Table 4.1.

Gelauff and Lejour (2005)[48] calculated that a 25% reduction of the administrative burden could eventually lead to an increase in the level of GDP of up to 1.5%. Internal Commission calculations (2006) based on the same methodology (but slightly different assumptions) produce a similar result and suggest that a 25% decrease in the administrative burden in EU-25 could raise GDP by 1.3% in the long run (or EUR 150bn). These predicted increases in GDP are increases in the level of GDP, meaning that once the reduction is achieved the overall GDP figure for the EU 25 will be up to 1.5% higher than if the reduction had not taken place. This gain is permanent insofar as if the administrative burden remains at the lower (75%) level, GDP will stay higher. However, the reduction does not affect the long-run growth rate of GDP. The potential GDP gains, in comparison to baseline GDP, are presented in Graph 4.2. They range from 0.5% in the UK and Sweden to 2.6% in Hungary, reflecting i.a. differences in the initial level of administrative costs.

[47] See also Section 4.3 below which shows that between 1998 and 2003 there was a notable degree of convergence in product market reform indicators between Member States.

[48] Gelauff, G.M.M. and A.M. Lejour (2005). Five Lisbon highlights: The economic impact of reaching these targets. CPB Document 104. CPB, The Hague.

Graph 4.1: The Ease of Starting a Business and Per Capita GDP



Note: GDP per capita is measured in 1000 Purchasing Power Standards (PPS). The Starting a Business indicator comprises the following sub-indicators from the World Bank "Doing Business" database: number of procedures, number of days, costs, and minimum capital requirement. The sample includes 31 countries for the period 2003-2005: Belgium, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Ireland, Italy, Latvia, Lithuania, Hungary, Austria, Netherlands, Poland, Portugal, Slovenia, Slovak Republic, Finland, Sweden, United Kingdom, Bulgaria, Croatia, Romania, Turkey, Switzerland, Norway, Iceland, United States, and Japan.

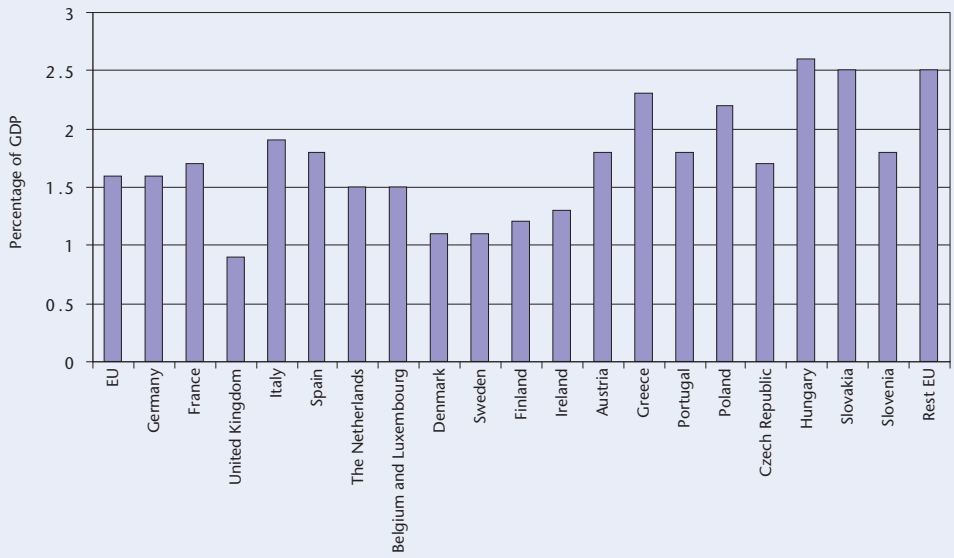
Source: Internal Commission work based on "Doing Business" World Bank database.

Table 4.1. Administrative costs by Member State

	Administrative cost share in GDP (in %) ([1])
Austria	4.6
Belgium/Luxembourg ([2])	2.8
Czech Republic	3.3
Germany	3.7
Denmark	1.9
Spain	4.6
Finland	1.5
France	3.7
Greece	6.8
Hungary	6.8
Ireland	2.4
Italy	4.6
Netherlands	3.7
Poland	5.0
Portugal	4.6
Baltic states, Malta and Cyprus ([2])	6.8
Slovakia	4.6
Slovenia	4.1
Sweden	1.5
United Kingdom	1.5
EU 25 ([2])	3.5

([1]) Based on Kox (2005): Intra-EU differences in regulation-caused administrative burden for companies. CPB Memorandum 136. CPB, The Hague.
([2]) Combined together. EU-25 figures are GDP-weighted averages.

Graph 4.2: Cumulative GDP effects by 2025 of a 25% reduction in administrative costs



Note: Based on Worldscan simulations, cumulative difference in % to the baseline in 2025.

Source: DG ENTR and CPB 2006.

In calculating this GDP increase it is assumed that one can achieve a 25% reduction of the administrative burden without affecting the benefits side of reporting requirements. Reducing double or triple reporting requirements by making better use of information technology or cutting obsolete reporting requirements that are of no use for further analysis or information gathering are examples of this kind. It is further assumed that by reducing the administrative burden employees have more time available that they will spend on productive activities, thus increasing labour efficiency.

Using the Commission calculations, if administrative costs are gradually reduced over a five year period, for example beginning in 2007, the level of GDP will be 1.1% higher by 2011. As more labour becomes available for productive activities, capital will have to adjust accordingly. By 2016 the capital accumulation process needed for matching the additional productive labour activities is completed, adding a further 0.2% to the level of GDP. Thus, according to these calculations GDP will be 1.3% higher in 2016 than it would be without the administrative cost reduction of 25%.

Finally, it should be pointed out that the evidence also shows that positive economic effects of any reforms may be dependent on labour market institutions and on supporting microeconomic policies such as those relating to education and training provision. At the firm level, skill shortages have been seen to be significant in hindering firms' performance (Stevens, 2005). This has been particularly pertinent in the absorption of technology, where complementary assets, including skilled labour and R&D, are seen as key facilitating inputs (Kneller and Stevens, 2005; Forth and Mason, 2005).

4.2.3. Summary

This section showed that economic research has identified several channels through which regulation affects economic growth and employment – the two main economic objectives of the Growth and Jobs Strategy. In the long run, economic growth is largely determined by productivity growth, and this section showed how regulations can have a positive as well as a negative impact on its underlying causes. Empirical evidence was cited showing that often where BR means more light touch regulation, one can expect a real improvement on productivity, growth and employment. Work carried out by the services of the Commission confirms earlier analysis regarding the expected effects of a 25% reduction of administrative costs on TFP and GDP levels.

4.3. An Assessment of the current Regulatory Environment in the EU

It is useful to relate any assessment of policy trends in EU Member States (see section 4.4) to the prevailing regulatory environment. However, such an analysis is complicated by the multitude of features that make up the regulatory environment and by the difficulty

of constructing, and hence the dearth of, indicators that depict the quality of the regulatory environment. Indicators measuring product market regulations exist but some of the most comprehensive and rigorously constructed indicators do not cover all EU Member States. Others are based on survey data and have a degree of subjectivity that may render them less useful for cross-country comparisons. This section looks at several indicators that relate to the regulatory environment in EU Member States, including indicators of the general regulatory environment, survey data of the business environment as well as specific data on the ease of starting a business. The indicators used here are produced by the OECD, the World Bank (WB), the Fraser Institute, and the International Institute for Management Development (IMD) (see Box 3).

Box 3: Indicators of regulatory intensity and the ease of doing business

The OECD has established indicators on product market regulation for 19[1] of the 25 current EU Member States (Conway et al 2005). The indicator values are mainly collected on the basis of questionnaires completed by the countries themselves. The questions are constructed so as to produce objective answers, for example, by asking whether a certain policy is in place, rather than trying to establish often subjective assessments of their quality. The indicators have a multi-level structure where aggregate indices are constructed from sub-indices by using weights derived from principal component analysis.

For the purposes of this chapter we have drawn mainly on the OECD higher level indicator *Barriers to Entrepreneurship* and particularly its component index on *Regulatory and Administrative Capacity*, which in turn is divided into C*ommunication and Simplification of Rules and Procedures*, *Licenses and Permits,* as well as *Administrative Burdens on Start-Ups* (see Annex Table 4.1 for the structure of the questionnaire and 4.2 for the values of EU Member States concerning administrative burdens on start-up businesses). We have also taken into account the OECD headline indicator for product market regulation (see Graph 4.3).

The Fraser Institute publishes indicators of economic freedom for every country in the world (Gwartney and Lawson 2005). Their indicators on administrative burden and bureaucracy on business activities can be used to proxy the regulatory environment. They are derived from the World Economic Forum Global competitiveness report (see Annex table 4.3 for the indicators used here). These indicators measure the quality of regulation as opposed to the total regulatory burden, and are based on questionnaires distributed to company executives. They therefore contain a considerable degree of subjective judgement and do show considerable variability over time. For each indicator, a higher score indicates a less restrictive regulatory environment.

The third source of information on the regulatory environment are the World Bank's (WB) "Doing Business" indicators relating to regulation and business conditions, which form part of a wider assessment of competitiveness (Annex Tables 4.4 and 4.5). These aim to provide an objective approach similar to that of the OECD survey but are not validated by the governments concerned. The data is obtained from local partners in the country concerned, based on standardised business cases. This means that, for example, in the case of administrative burdens on start ups, the size, the ownership and the number of employees of a company are pre-defined. Also, the "Doing Business" indicators are based on evidence collected exclusively in a country's most populous city. This method provides comparable data across countries; however, a case thus defined may not be representative of regulatory practices in a given country (see www.doingbusiness.org for methodological details). While keeping in mind their limitations, the World Bank indicators for the difficulty of doing business can still serve as a useful proxy for the quality of the overall regulatory environment.

This section also incorporates two survey-based indicators on the *intensity of regulation* and the *ease of doing business* produced by the International Institute for Management Development (IMD Yearbook 2006). These indicators are produced on the basis of questionnaires sent to business executives to obtain their opinion on "government efficiency". The responses underlying the *regulation intensity* index provide a numerical evaluation where a value of zero corresponds to regulation strongly restraining the ability of companies to compete and a value of ten corresponds to no such restraining effects. Similarly, the absence of *ease of doing business* corresponds to a value of zero, whereas the opposite evaluation corresponds to a value of 10 (see Annex Table 4.6).

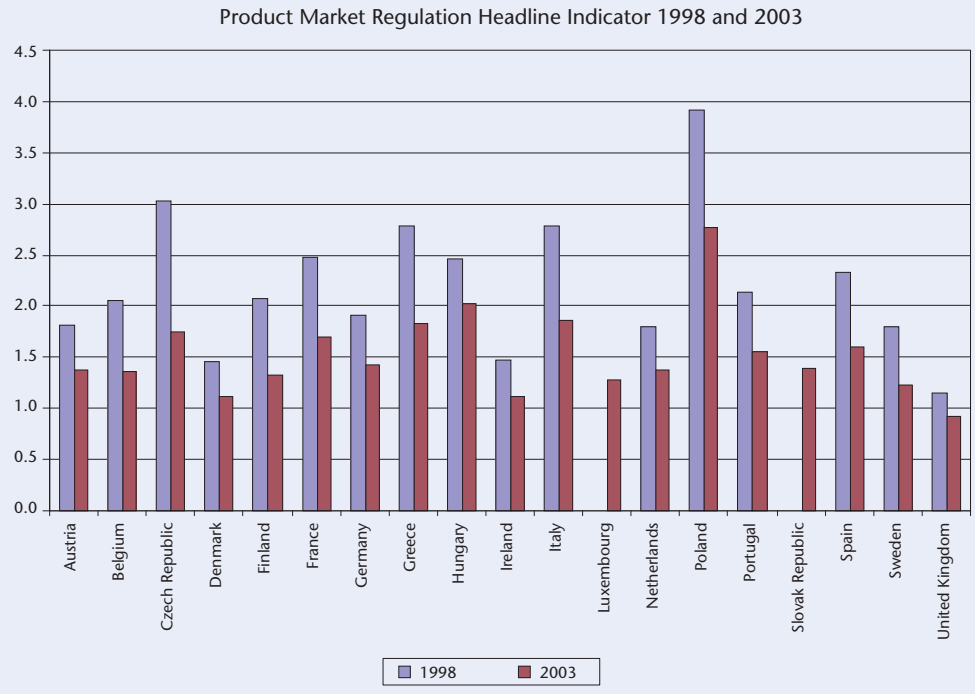
[1] Not covering Cyprus, Estonia, Malta, Latvia, Lithuania and Slovenia.

The OECD indicators on product market regulation provide an illustration of broad recent trends in the overall restrictiveness of the regulatory environment in the EU (see Graph 4.3). The broadest indicator for product market regulation, the OECD's PMR headline index, shows that all of the 19 EU Member States, for which this index is produced, have lowered the level of regulation between 1998 and 2003, on average by about 29%. A similar trend emerges for the component index measuring the level of regulation related to inward-oriented policies only, where regulation levels declined by about 25%. Apart from a general declining trend over that five-year interval, there is also a notable degree of convergence, as Member States with more restrictive regulatory environments in 1998 by and large made significantly greater progress than those which had already enjoyed a relatively less restrictive environment. There are however exceptions to this pattern of easing the overall restrictiveness at both ends of the spectrum of starting conditions.

The survey-based evidence provided by the Fraser Institute indicator relating to conditions for new businesses (see Graph 4.4 and column 1 in Annex Table 4.3) shows a trend between 2000 and 2003 that is different from the positive development captured by the OECD indicators. This is likely to reflect the higher subjectivity entailed in the index, which may lead to the business sentiment and the business cycle influencing the individual values, an explanation further supported by the relatively high degree of volatility over time. The picture is mixed with regard to the other two Fraser Institute indicators on time spent with government bureaucracy and on start ups (see Annex Table 4.3). These indicators are available for most EU Member States since 1995. The start-up indicator shows a clear improvement between 1995 and 2000, while registering a deterioration in many countries in 2003, which more than offset the earlier improvement on the 1995 level. A similar picture also emerges for the indicator on time spent with government bureaucracy. The subjective nature of the indicator could also be a factor behind its comparatively narrow range of values.

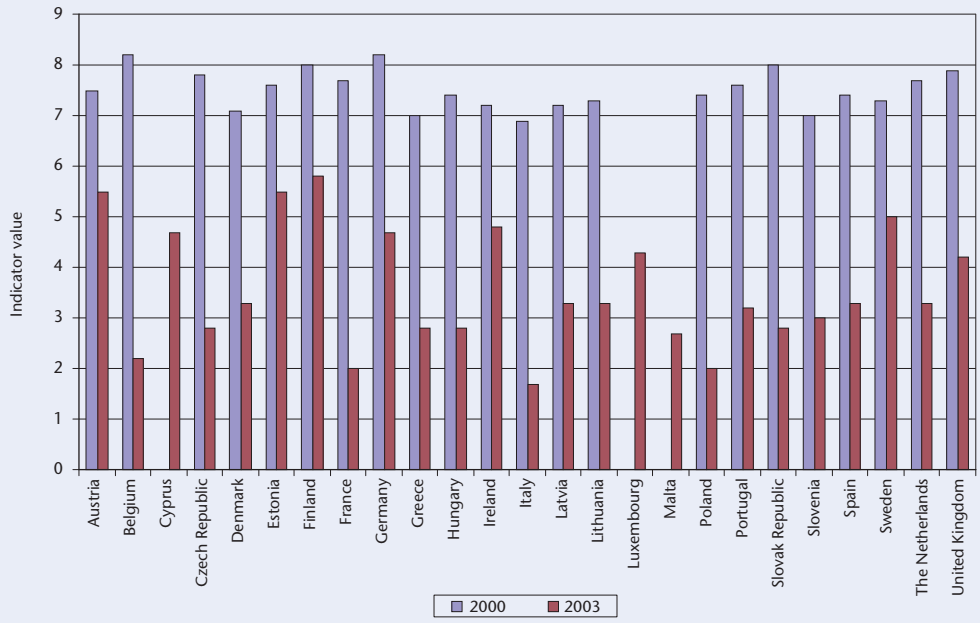
The survey-based IMD indicators on the ease of doing business and regulatory intensity include additional elements allowing a cross-country comparison (see Graph 4.5). The OECD product market regulation indicator has also been used to group Member States with different starting positions regarding their regulatory environment. One can differentiate one group of countries, which are found in most sets of indicators to display a low degree of restrictiveness in their regulatory environment, from another group, where the regulatory environment is generally found to be rather restrictive. Conway, Janod and Nicoletti (2003) have grouped the Czech Republic, Greece, Italy, France, Hungary and Spain to have a relatively restrictive regulatory environment, whereas Denmark, Ireland, and the United Kingdom are part of the group with a less restrictive regulatory environment. The third group

Graph 4.3: Levels of product market regulation in EU Member States



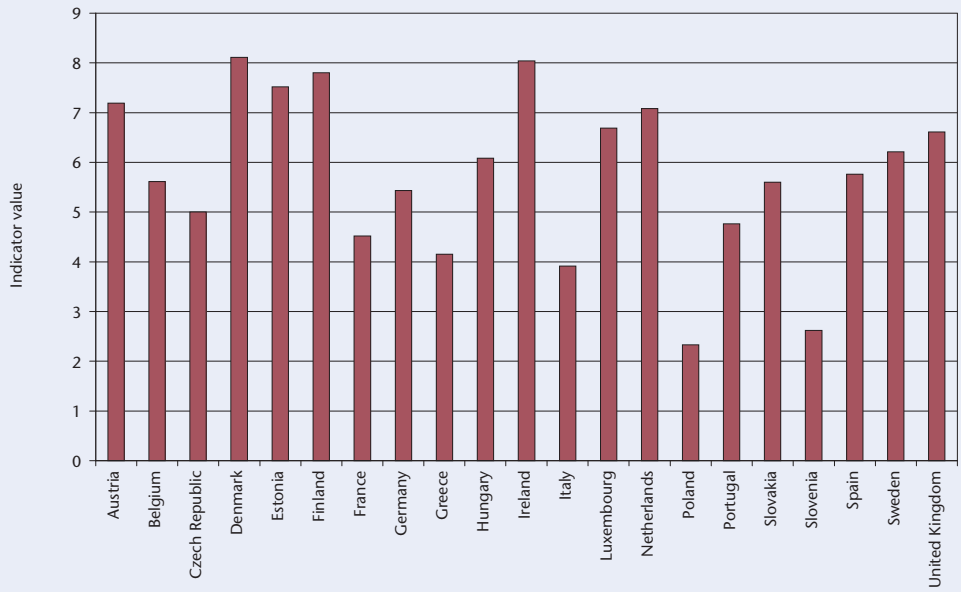
Source: OECD product market regulation indicator.

Graph 4.4: Administrative conditions for new businesses – Fraser Institute



Source: Gwartney and Lawson (2005)

Graph 4.5: IMD Indicator: Regulatory Intensity



Source: IMD Yearbook 2006.

of countries comprises all remaining Member States which are characterised by regulatory environments with a degree of restrictiveness that lies somewhere in the middle of the other two.

As the OECD indicators do not cover the entire EU membership, we have produced a grouping by taking into account the set of indicators presented in Box 3. While arriving at country rankings is not a straightforward exercise, given the differences in the indicators, one can still establish the two broad groupings of countries which are found in all or almost all indicators to display a high vs. low level of regulation or level of administrative and start-up costs. The group of countries with less restrictive regulatory environments would include Cyprus, Denmark, Estonia, Finland, Ire-

land, Luxemburg, the Netherlands and the UK, while the group of countries with a more restrictive regulatory environment comprises the Czech Republic, Greece, Italy, Lithuania, Poland, Portugal and Spain. All other EU Member countries would fall into the group displaying a degree of restrictiveness in the regulatory environment in-between these two groups.

Thus, while there is a widely acknowledged need in all EU-25 for measures to further improve the regulatory environment, there are some countries that stand to benefit more from their implementation, given their more restrictive regulatory environments as a starting point. Section 2 of this chapter established the potential negative impacts on entrepreneurship, competition, innovation, productivity and ultimately competitiveness and economic growth that excessively burdensome regulation may lead to. This section tried to give an overview of where Member States stand regarding their regulatory environments of product markets based on the best available indicators. The following section will take a look at recent policy trends and commitments made by Member States in their NRPs.

4.4. Policy action

The importance of improving the business environment through the application of Better Regulation measures has generally been recognised by Member States and at the EU-level.[49] At Community level, the Better Regulation system comprises systematic impact assessments for new legislation, improved stakeholder consultation, the screening of pending legislative proposals and a simplification programme for existing legislation, which includes the reduction of administrative costs. Work on setting targets for the reduction of administrative costs is under way.[50] Some Member States have already put in place their own fully developed Better Regulation systems, while others are in the process of doing so. The measures envisaged by Member States, both regarding Better Regulation as well as the business environment more generally (see Annex Tables 4.7 and 4.7 respectively), should ideally target existing problem areas of their current regulatory environments as broadly sketched out in section 3. Member States with relatively restrictive regulatory environments as identified above stand to reap the greatest benefits when applying the tools of Better Regulation. However, given that such improvements need to be sustained and guarded against backsliding, the institutional setup and the implementation of Better Regulation policies require continuous attention even in those countries that already have made considerable achievements in the area of Better regulation.

This section gives an overview of the measures in the area of Better Regulation and those related to it (e.g. e-government, one-stop shops) at the EU level and in the Member States. Based on the findings of section 3, it provides a tentative assessment of the likely adequacy of a full implementation of these envisaged reforms. The analysis of this section is based on last year's National Reform Programmes, the Spring European Council conclusions of March 2006, which contain commitments regarding the regulatory environment additional to those made in the NRPs[51], on information available to the Commission from the ongoing regulatory dialogue with Member States and on replies to questionnaires such as that on the Indicators of Regulatory Quality to which the majority of MS responded with detailed information. However, some Member States' reform efforts may not be captured in what follows, especially if they are not stated explicitly as part of their BR strategy. It must be noted also that the National Progress Reports on the state of NRP implementation presented in October 2006 could not be taken into account at the time of preparing this report.

4.4.1. Simplification of existing legislation

Simplification involves the screening of legislation with a view to making it more transparent and clear and preventing it from becoming obsolete or unnecessarily burdensome. In its October 2005 strategy for the simplification of the regulatory environment, the Commission developed a methodology for streamlining and modernizing the Community *acquis* and presented a simplification rolling programme of around 100 initiatives, covering more than 220 basic legal acts, which will be repealed, codified, recast or reviewed over the next three years. Approximately half of the 100 initiatives will be adopted by the end of this year.

Towards the end of 2006, the Commission plans to adopt a progress report on Simplification and Codification which will take stock of the progress that has been achieved since implementing the October 2005 simplification strategy (as requested by the Council), identify problems and propose remedial actions. Furthermore, the *simplification rolling programme* will be updated and further additional simplification initiatives will be identified on the basis of contributions received from stakeholders, as part of the previous exercise, and input collected during the preparatory process of the CLWP 2007. The document will also address the roles and responsibilities of Member States, the Council and the European Parliament in order to ensure that their efforts are complementary.

[49] Reference to Commission APR and 2006 Spring European Council conclusions.

[50] See subsectionon administrative costs below.

[51] Foreseen is the creation of one-stop shops for setting up a company, a reduction in the time taken for registering a business to less than one week by end-2007, a lowering of start-up fees, and the setup of a single contact point for hiring the first employee.

At Member State level, systematic simplification programmes are already in place in Belgium, Denmark, Germany, Ireland, Italy, The Netherlands, Slovenia, Sweden and the United Kingdom, while their introduction is planned by Estonia, and was recently introduced in Portugal (Annex Table 4.7). A number of Member States that do not have an explicit simplification programme in place nevertheless simplify the stock of existing legislation on an ad-hoc basis (Annex Table 4.7). The kinds of legislation targeted in simplification measures cover taxation, reporting requirements, fiscal measures, business start-ups, insolvency rules and consumer protection.

In the UK, the *Legislative & Regulatory Reform Bill* will be enacted in autumn 2006 to facilitate the removal of or amendments to unnecessary regulations. The UK is also a prime example of consulting systematically with stakeholders for adjusting the regulatory framework. France passed two simplification laws focusing on modernising public administration in 2003 and 2004. In Slovenia, the *Removal of Administrative Obstacles Programme* is currently being implemented and the Government has set up the *Council for an Economy-Friendly Administration* which will act as an 'anti-bureaucratic filter'. Slovenia will also introduce a system of strategic planning and managerial tools in the public administration. Latvia is implementing an *Action Plan for the Improvement of the Business Environment* (2005-2008). In the Slovak Republic a comprehensive review of barriers to business identifying inefficient processes is to be completed in 2006. Malta has set up a *Better Regulation Unit*, which will regularly monitor bureaucratic procedures and submit regular reports on how these procedures can be simplified.

In addition, various other initiatives aimed at improving the business environment are underway in all EU Member States. They include plain language programmes, e-Government activities and the introduction of one-stop shops (see Annex Table 4.8). Although these initiatives can produce significant improvements in the short term, they may be less effective in the long-term in the absence of a full simplification programme.

The introduction of one-stop shops for business registration is a stated commitment of the 2006 Spring European Council conclusions. The use of the **one-stop information points** is envisaged in 17 NRPs (AT, BE, CZ, DE, DK, EE, EL, ES, FI, FR, HU, IT, NL, PL, PT, SI, UK). By merging counters from different departments and promoting multi-task reception resources, business in general, and especially SMEs should benefit. In France, SMEs stand to benefit in particular from plans to introduce a one-stop tax system for SMEs. It is noteworthy that while every country seems to either already have one-stop-shops for obtaining information about requirements regarding licences and permits in place or plans to introduce them, a much smaller number of countries proposes to include one-stop-shops for issuing licenses and permits. That particular service seems to be only available in AT, FI, FR, EL, HU, IT, LU, PL, PT, SK, SP, SE.

Many NRPs consider the development and improvement of **Electronic Government systems** as an essential element for improving communication with the public and the business community and for simplifying bureaucratic procedures (EL, ES, FI, IT, SI). E-Government services are believed to have the added benefit of improving the efficiency and transparency of public administration. Finland, although a country that has already made most of public services available online, now aims to improve further the use of electronic data transfer between government services. ES, DK, LU and SI have the objective to set up e-government portals for public administration. In Denmark there is web portal where businesses can obtain all sorts of forms that are needed for reporting to public authorities (virk.dk). In Luxembourg, electronic assistance for companies in the industrial sector is being promoted. Portugal, which was identified as having a relatively restrictive regulatory environment, plans to create a Joint Knowledge Network for collecting and disseminating information on administrative modernization initiatives. Portugal also emphasizes the use of one stop shops in various areas. The UK Government has set up a new on-line portal where businesses and other stakeholders can submit proposals for simplification to which the government will respond within 90 working days. Italy aims to standardize the most important national public contact points for citizens and companies. Germany wants to undertake the largest e-government initiative in Europe this year by making all national, Internet-capable services available online. Several other countries (EL, IT, IE, LU, PT, SE, SK) intend to introduce a National System of Electronic public procurement (e-procurement) that will improve transparency and efficiency by making it possible for companies to to bid electronically for contracts. Cyprus wants to increase the overall awareness of the need for a well-designed and proportionate regulatory framework, while in Hungary, "plain language" programmes aim to make legislation more accessible. Belgium intends to provide tailor-made information to companies, especially for business start-ups, recognising that past measures for promoting entrepreneurship may not always have been offered or communicated in a 'business-friendly" manner. Moreover, Belgium has made significant progress in simplifying administrative requirements for citizens and business alike by cutting bureaucracy (reducing the Kafka index – www.kafka.be).

As shown in section 3, the administrative costs associated with **start-ups** vary widely across the EU. Belgium, Portugal, the Czech Republic, Estonia, Slovenia

and Latvia were amongst the countries that scored relatively poorly on administrative costs, particularly with regard to start-ups. Most of these countries present concrete reforms in their NRPs to address this situation. These include measures facilitating company registration, such as single contact points, amendments to the commercial codes and electronic tools. Portugal aims for company registration within one hour.

Several countries highlight in their NRPs the need to simplify businesses' relations with **tax administration** in order to reduce associated costs. Sweden aims to reduce such costs by 20% by 2010. The Czech Republic, which was identified by some of the indicators presented in Section 3 as having a relatively restrictive regulatory environment in 2005, is now taking action to modernise its tax administration to minimise the burden on taxpayers by increasing in capacity and performance of tax controls as well as e-communication between the administration and taxpayers. The implementation of electronic tax payments is planned in Germany and the Netherlands. In the Netherlands the new e-tax measures follow reforms in 2000 which already led to a reduction of taxation payment costs for companies and private households. Estonia and Ireland are creating simplified tax schemes for VAT. In the case of Ireland measures in this area will also reduce administrative costs for cross border trades. In Poland the procedures for business tax inspections have been streamlined and their duration has been reduced. While administrative costs associated with taxation are already low in France, the country placed a great focus on simplifying the tax system in its NRP, with the creation of the Large Business Directorate with a one-stop window for 24500 businesses, the gradual implementation of a one-stop tax contact system for SMEs, by improving the filing of tax returns and online payment options.

4.4.2. Measurement and reduction of administrative costs

As seen, regulations generally seek to achieve the delivery of objectives such as those relating to health and safety, consumer protection or the environment or to ensure the smooth operation of labour markets or tax system. However, as well as delivering benefits, they involve costs, some of which might be immaterial to their primary purpose. The reduction of such costs is an explicit objective for the majority of EU Member States and for the European Commission. The Commission will launch a large measurement study in 2007, to be preceded by a pilot project in 2006. The results of the latter, which will be reported in the November Better Regulation Communication package, will determine the Commission's action plan for reducing administrative costs (to be published in early 2007). In order to identify which policy areas should be a priority in the measurement and reduction of administrative requirements, the pilot project uses national measurements as a starting point. The project will draw extensively on the results of the four Member States that, at this stage, have already carried out their baseline measurement (the United Kingdom, the Netherlands, the Czech Republic and Denmark).

Most Member States use or plan to use the Standard Cost Model (SCM) when analysing or measuring the baseline of their administrative costs (AT, BE, CZ, DK, EE, FI, FR, DE, HU, IT, LT, NL, PL, PT, SE and UK). Four Member States have so far officially adopted concrete percentage targets to reduce their administrative costs (AT, CZ, DK, NL, SE) and another two are planning to do so (DE, UK)) Some of the efforts identified to support this exercise are mentioned above and relate to e-government, one-stop shops and central registration offices, all of which should simplify registration and administrative procedures for businesses and citizens alike.

4.4.3. Impact Assessments of new legislation

While simplification initiatives and the reduction of the administrative costs aim to improve the stock of existing legislation, Impact Assessments (IA) try to ensure that new legislation complies with the objectives of the Better Regulation agenda. The European Commission has recognised the importance of integrated impact assessments for a number of years. It published a revised set of IA guidelines in 2005 to further strengthen the way in which competitiveness aspects are taken into account while also reemphasising its commitment to taking full account of all economic, social and environmental impacts in order to analyse and be aware of synergies and trade-offs across these three pillars. Impact assessments allow policy makers to become aware of and to devise provisions for easing or mitigating potentially negative effects on groups that are particularly affected, e.g. SMEs. Earlier this year a specific methodology for assessing administrative burden was added to the guidelines. Since 2003 more than 160 IAs have been completed and an extensive evaluation study by external consultants on the Commission's IA system is currently ongoing. Its results will be available in early 2007.

Most Member States emphasise the importance of policy decisions being supported by some form of impact analysis but it is still only a minority of Member States that systematically assess all relevant impacts of their legislative proposals (AT, DK, DE, IE, NL, UK), while some other ones do so only partially or informally (BE, FI, FR, IT, LU, PT, SE). Although consultation of stakeholders becomes more and more an integral part of the impact assessment procedure, there is still significant room for improve-

ment when it comes to the involvement of all relevant stakeholders at an early stage, the use of various consultation methods and transparent procedures. At the moment, a minority of Member States have mandatory consultation processes in place (AT, DK, EE, FI, DE, IE, LT, PL, SI, SE, UK), albeit not all of them ensure that minimum consultation standards are applied across the board.

It should be noted that the existence of a formal requirement to carry out impact assessments has not proved to be a guarantee of impact assessment practice. On the other hand, impact assessment guidelines facilitate the introduction of an impact assessment system. Their implementation and enforcement differs widely across the EU-25, with some Member States, most notably the UK but also NL and IE, showing a better alignment of theory with practice. A number of Member States do not seem to have any guidelines nor are there any plans for making it obligatory to support new legislative proposals by IAs, while others have guidelines which in practice lack enforcement.

In the UK the guidelines for conducting regulatory IA were updated and strengthened already in 2004 and 2005 to address enforcement, compliance, and monitoring of new regulations, as well as their impact on public services. This has also brought the UK more in line with the Commission's integrated approach by now stipulating explicitly that economic, social and environmental impacts have to be taken into account. The UK's regulatory impact assessment (RIA) system is supported by an institutional set-up in which the Cabinet Office coordinates impact assessments across the government. In addition, the Better Regulation Executive and the National Audit Office fulfil the function of independent monitoring and evaluation of the UK government's Better Regulation and RIA record.

While the UK has the most advanced IA system in the EU, a number of other Member States are in the process of developing their own. In the Czech Republic for example, the introduction of impact assessments will take place via a pilot study in 2005 and 2006. From 2007 there will be an obligation for ministries and other central state administration bodies to carry out impact assessments for all draft acts. Malta is also planning to carry out RIA, but at present, these are carried out on an *ad hoc* basis by individual Ministries/Government institutions.

In Finland, a three-year programme has been launched in 2005 to support the assessment of the impacts of draft legislation on business. In Denmark, the compulsory assessment will be done by analysing the administrative implications of all bills on enterprises through business panels.

Cyprus and Estonia acknowledge that they currently do not have the expertise required for systematic impact assessments of economic, social and environmental consequences of regulations and administrative costs and take first steps to address this. However, the Cypriot NRP contains measures to raise awareness in the public sector, the business community and the House of Representatives of the importance of systematic impact assessments and measuring administrative costs, and of the related institutional framework and administrative capacity. In the case of Estonia, an *ex-ante* analysis of the impacts of legislation is to be developed in the medium term, starting with developing and testing a methodology by conducting field-related analysis.

4.4.4. Conclusions

A multitude of measures are being proposed in the NRPs and implemented across all EU-25 Member States to improve the regulatory and business environment through impact assessments, simplification of existing legislation, and the reduction of administrative costs. While these measures vary considerably in terms of their time-horizon, depth, degree of institutionalisation and likely effectiveness, most Member States do envisage one or more high-profile activities in the area of Better Regulation. In addition, Member States present measures with significant short-term effects on the business environment, such as one-stop shops.

The large differences observed between the measures proposed by individual Member States may be reflection of the different stages of Better Regulation implementation. Creating a fully fledged and integrated Better Regulation system requires widespread awareness on the part of government agencies as well as businesses, considerable administrative resources, and a continuous feedback through monitoring and evaluation. Instituting a complete Better Regulation system will therefore require different types of actions, depending on a Member State's starting point in the process. Those who are already advanced should continue to further improve their regulatory environments by using all BR tools while Member States at the beginning of the process may wish to raise awareness as an appropriate and necessary first step.

Naturally, for countries displaying a more restrictive regulatory environment, both the urgency of and the potential benefits associated with pushing ahead more strongly with the Better Regulation agenda in terms of the objectives of the Growth and Jobs Strategy are greater than for countries that have already attained an advanced stage. It is noteworthy in this context that among those Member States (Czech

Republic, Greece, Italy, Lithuania, Poland, Portugal, Spain) which were broadly categorised in section 3 as having relatively restrictive regulatory environments, most have implemented simplification measures on an ad hoc basis, such as one-stop shops and e-government, but do not sufficiently recognise the importance of stakeholder consultation. At the same time, a number of Member States which were listed among those with less restrictive regulatory environments (Cyprus, Denmark, Estonia, Finland, Ireland, Luxembourg, the Netherlands, the United Kingdom) are also found among those countries with measures in all or almost all elements of the Better Regulation agenda.

Annex Table 4.7 also shows that an increasing number of countries are implementing their own Impact Assessment systems, mirroring what is already taking place in the Commission and in a number of Member States. This should help ensure a higher quality of future regulation with regard to issues of importance for national and European competitiveness. There are however cases where resource constraints may impede and perhaps even prevent the implementation of systematic IAs with likely adverse consequences. Due to the long-term importance of IA systems there is some reason for concern that unless these resource issues are overcome, new legislation might be deprived of valuable information which could impede its quality.

4.5. Summary and Conclusions

This chapter began by taking a look at the transmission mechanisms through which Better Regulation measures can positively influence competitiveness, growth and employment. It was argued that there is theoretical and empirical evidence to suggest that Better Regulation initiatives impact positively on the drivers of productivity such as innovation, competition, entrepreneurship, skills and investment. Increases in productivity mean that more is produced with the same amount of inputs, or that the same is produced with less input. Both represent a gain in efficiency and should lead to an increase in the competitiveness of EU products on the world market and higher economic growth.

Section 2 a showed that economic research has identified several channels through which regulation affects economic growth and employment – the two main economic objectives of the Growth and Jobs Strategy. In the long run, economic growth is largely determined by productivity growth, and this section showed how regulations can have a positive as well as a negative impact on its underlying causes. Empirical evidence was cited showing that often where Better Regulation means more light touch regulation, one can expect a real improvement on productivity, growth and employment.

Section 3 provided an attempt of assessing the current regulatory environments of the EU-25 by drawing on available indicators. The imperfections and limits of assessing the regulatory environments based on these indicators, as well as their usefulness in terms of allowing for a broad categorisation of where MS stood were pointed out. Countries were grouped into three different categories: least restrictive, most restrictive and an intermediate category.

Section 4 looked at what MS proposed to do in their 2005 National Reform Programmes, complemented by information available to the Commission from other sources on the current state of play. It found that all MS have made commitments to establishing a better regulatory environment. Facilitating communication by expanding e-government services, one-stop-shops and plain language programmes are mentioned by the majority of MS in their NRPs and are being implemented, also by those Member States which were identified in Section 2 as having more restrictive regulatory environments. The absence of concrete simplification plans in some MS gives reason for some concern. Simplification is targeted at the existing stock of legislation and as such is backward looking. A systematic approach in the form of a plan or programme would signal the seriousness of intentions in this regard by, for example, publicly stating budget and resource allocations and would allow for greater outside scrutiny of the ongoing efforts.

The reduction of the administrative burden is clearly a priority for a number of MS and gaining momentum across the EU. This is encouraging as it also reflects what is happening at the EU level. Several countries have announced reduction targets. The European Council of June 2006 has stated that it should be possible to set similar targets at EU level and invited the Commission to make appropriate proposals by early 2007 in time for the next Spring European Council. It should also be noted that a small number of countries, most notably the UK, Denmark, the Netherlands and the Czech Republic have already carried out baseline measurements and that the Commission is currently engaged in carrying out a pilot project with a view to identifying policy areas where benefits can be reaped quickly. Further work in the coming year will be targeted inter alia at MS for laying the groundwork, such as baseline measurements, for achieving reduction targets. As this is an area where the full benefits can only materialise if the EU and MS levels cooperate, there are ample grounds for believing that real progress is already under way.

Systematic Impact Assessments are currently carried out in only a small minority of MS. While many countries stress the importance of IAs and have made some form of commitment to IAs, it is often unclear what sort of legislation will benefit from compulsory IAs, what the resource provisions are and how a supportive and conducive institutional set-up is going to be established. As IAs deal with new legislative proposals they are key to ensuring better regulatory environments for the future, any failure to establish systematic IAs as a fundamental part of law-making is likely to have a detrimental effect on the regulatory environment in the long run. Concerns about a lack of resources are a serious concern as they could impede the improvement of regulatory environments even when there is a genuine political desire and commitment to act. It is essential that resource constraints are overcome by, for example, proportionality tests that target existing limited resources to where proposals are likely to have significant impacts on the economy, the environment or in the social sphere.

It is encouraging to note that more and more countries are beginning to use IAs, albeit for now often in a non-systematic way, assessing some impact but not all or on an *ad hoc* basis. Some countries are in the process of conducting pilot phases with the aim of spreading out the use of IAs more widely on completion of their pilots. All in all, there is undoubtedly progress and more and more MS are beginning to use IAs in their national law-making processes. However, as it takes time to establish not only the culture of using IAs to inform new legislation, but also to acquire the skills base needed for producing them, it is likely that the real benefits are only going to materialise in a few years time.

In conclusion, it can be said that the commitments made in the NRPs by all MS and the progress that has already been made across the EU are encouraging but real challenges remain. Establishing a fully fledged Better Regulation system should be the medium to long-term objective of all Member States. Doing so in a sustained fashion will help provide better conditions for entrepreneurship, reductions in administrative costs and in barriers to market entry. Especially those Member States in a less positive starting position should make greater efforts to make progress towards establishing fully fledged Better Regulation systems in view of the benefits that can be expected.

An attempt at predicting, perhaps in quantitative terms, what the combined impact on the EU's competitiveness, jobs and economic growth will be is premature at this stage. Most of the real benefits are likely to be felt only in the long-term. The general process of Better Regulation is still in its early stages and its ultimate success will be influenced by many factors that cannot easily be accounted for. Much depends also on regulatory reform in the labour markets, which will have a strong impact on the economy. The rigor with which existing proposals will be implemented will also play an important role. Moreover, any resource constraints, which are likely to affect some countries more than others, will influence the final outcome. It is worth noting at this stage that MS and the Commission have recognised the need for action, are responding and thereby laying the foundation for better regulatory environments in the EU in the future. This provides a positive contribution to the long term prospects of the EU's competitiveness.

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Annex Table 4.1: OECD Product Market Regulation questionnaire: questions touching upon the quality of regulation

Source/Question number	Text of the question
Indicator: Use of command and control regulation	
Q 2.1.5	Are regulators required to assess alternative policy instruments (regulatory and non-regulatory before adopting a new regulation?
Q 2.1.6	Has guidance been issued on using alternatives to traditional regulation?
Indicator: Licenses and permits system	
Q 2.1.8	Is the "silence is consent" rule (i.e. that licenses are issued automatically if the licensing office has not acted by the end of the statutory response period) used at all?
Q 2.1.9	Are there single contact points ("one-stop shops") for getting information on notifications and licenses?
Q 2.1.10	Are there single contact points ("one-stop shops") for issuing or accepting notifications and licenses?
Indicator: Communication and simplification of rules and procedures	
Q 2.1.2	Are there systematic procedures for making regulations known and accessible to affected parties?
Q 2.1.3	Is there a general policy requiring «plain language drafting of regulation?
Q 2.1.4	Do affected parties have the right to appeal against adverse enforcement decisions in individual cases?
Q 2.2.2	Are there any inquiry points where affected or interested foreign parties can get information on the operation and enforcement of regulations?
Q 2.1.1	Does government policy impose specific requirements in relation to transparency/freedom of information government wide?
Q 2.1.11	Does the national government (all ministries and agencies) keep a complete count of the number of permits and licenses required?
Q 2.1.7	Is there an explicit programme to reduce the administrative burdens imposed by government on enterprises and/or citizens?
Q 2.1.12	Is there a programme underway to review and reduce the number of licenses and permits required by the national government?
Indicator: administrative burdens for corporations	
Q3.1.2a+Q3.1.2b	How many mandatory procedures would an entrepreneur have to complete to register a public limited company (pre-registration + registration)?
Q3.1.5	How many different public and private bodies would an entrepreneur need to contact to register a public limited company (pre-registration + registration)?

Q3.1.3	How many working days would it typically take an entrepreneur registering a public limited company to complete all mandatory procedures (pre-registration + registration)?
Q3.1.4	How much would it typically cost an entrepreneur registering a public limited company to complete all mandatory procedures (pre-registration + registration)?
Indicator: administrative burdens for sole proprietor firms	
Q3.1.2a+Q3.1.2b	How many mandatory procedures would an entrepreneur have to complete to register an individual enterprise (pre-registration + registration)?
Q3.1.5	How many different public and private bodies would an entrepreneur need to contact to register an individual enterprise (pre-registration + registration)?
Q3.1.3	How many working days would it typically take an entrepreneur registering an individual enterprise to complete all mandatory procedures (pre-registration + registration)?
Q3.1.4	How much it would typically cost an entrepreneur registering an individual enterprise to complete all mandatory procedures (pre-registration + registration)?

Annex Table 4.2: Responses to OECD product market regulation questionnaire questions on administrative burdens on start ups – corporations

	How many mandatory procedures would an entrepreneur have to complete to register a public limited company (pre-registration + registration)?	How many different public and private bodies would an entrepreneur need to contact to register a public limited company (pre-registration + registration)?	How many working days would it typically take an entrepreneur registering a public limited company to complete all mandatory procedures (pre-registration + registration)?	How much would it typically cost an entrepreneur registering a public limited company to complete all mandatory procedures (pre-registration + registration)?
AT	25	8	6	2232
BE	13	6	32	130
CZ	24	9	64	345
DE	13	6	30	1330
DK	10	2	18	0
EL	12	5	26	2400
ES	23	7	25	2090
FI	13	3	30	252
FR	22	6	29	290
HU	16	7	34	789
IE	9	2	16	71
IT	18	8	7	1750
LU	19	7	30	1175
NL	13	4	42	935
PL	28	6	90	
PT	8	6	11	605
SE	11	3	25	186
SK	15	8	15	722
UK	9	3	8	40

Source: Conway et al (2005).

Annex Table 4.3: Fraser Institute/World Economic Forum indicators of ease of starting business and time with government bureaucracy

Country	5Cii Administrative conditions and new businesses: administrative procedures are an important obstacle to starting a new business	5Ciii Time with government bureaucracy: senior management spends a substantial amount of time dealing with government bureaucracy	5Civ Starting a new business: starting a new business is generally easy
AT	5.5	6.0	5.5
BE	2.2	6.3	4.5
CY	4.7	6.5	6.5
CZ	2.8	6.3	3.8
DE	4.7	6.3	5.2
DK	3.3	6.5	6.2
EE	5.5	6.0	7.5
EL	2.8	5.5	3.7
ES	3.3	6.3	4.2
FI	5.8	6.3	7.7
FR	2.0	7.8	4.5
HU	2.8	8.3	6.7
IE	4.8	7.3	6.0
IT	1.7	7.3	3.8
LT	3.3	5.0	4.2
LU	4.3	6.5	7.0
LV	3.3	5.8	5.3
MT	2.7	6.0	5.2
NL	3.3	6.0	6.2
PL	2.0	5.5	3.8
PT	3.2	5.0	4.3
SE	5.0	6.5	7.3
SI	3.0	5.5	5.5
SK	2.8	6.8	6.0
UK	4.2	6.5	7.7

Source: Gwartney and Lawson (2005).

Annex Table 4.4: The World bank indicators of ease of starting business and dealing with licences

Country	Year	Starting a Business				Dealing with Licenses		
		Procedures (number)	Time (days)	Cost (% of income per capita)	Min. capital (% of income per capita)	Procedures (number)	Time (days)	Cost (% of income per capita)
AVERAGE	2005	7.4	27.5	8.9	46.0	15.9	191.0	81.5
AT	2005	9	29	5.7	61.5	14	195	81.6
BE	2005	4	34	11.1	13.5	15	184	64.1
CZ	2005	10	40	9.5	39	31	245	16.1
DE	2005	9	24	4.7	47.6	11	165	82.8
DK	2005	3	5	0	47	7	70	71.3
EE	2005	6	35	6.2	41.4	12	116	41.4
EL	2005	15	38	24.6	121.4	17	176	71.9
ES	2005	10	47	16.5	15.7	12	277	77.1
FI	2005	3	14	1.2	28	17	56	76.2
FR	2005	7	8	1.2	0	10	185	78.3
HU	2005	6	38	22.4	79.6	25	213	279.1
IE	2005	4	24	5.3	0	10	181	23.6
IT	2005	9	13	15.7	10.8	17	284	147.3
LT	2005	8	26	3.3	57.3	14	151	17.5
LV	2005	5	16	4.2	31.8	21	160	43.9
NL	2005	7	11	13	64.6	18	184	142.7
PL	2005	10	31	22.2	220.1	25	322	83.1
PT	2005	11	54	13.4	39.4	20	327	57.7
SE	2005	3	16	0.7	35	8	116	119.6
SI	2005	9	60	10.1	17	14	207	128.7
SK	2005	9	25	5.1	41	13	272	18
UK	2005	6	18	0.7	0	19	115	70.2

Source: http://www.doingbusiness.org.

Annex Table 4.5: World Bank indicators on administrative burden relating to registering property, paying taxes and trading across borders, 2005

	Registering property			Paying taxes		Trading across borders					
	Procedures (number)	Time (days)	Cost (% of property value)	Payments (number)	Time (hours)	Documents for export (number)	Signatures for export (number)	Time for export (days)	Documents for import (number)	Signatures for import (number)	Time for import (days)
AVERAGE	4.9	69.6	4.5	20.5	265.3	5.7	4	14.9	7.4	4.8	17.3
AT	3	32	4.5	20	272	4	2	8	5	3	9
BE	7	132	12.8	10	160	5	2	7	6	2	9
CZ	4	123	3	14	930	5	3	20	8	4	22
DE	4	41	4.1	32	105	4	1	6	4	1	6
DK	6	42	0.6	18	135	3	2	5	3	1	5
EE	4	65	0.5	11	104	5	2	12	5	5	14
EL	12	23	13.7	32	204	7	6	29	11	9	34
ES	3	25	7.2	7	56	4	3	9	5	3	10
FI	3	14	4	19	..	4	3	7	3	1	7
FR	9	183	6.5	29	72	7	3	22	13	3	23
HU	4	78	11	24	304	6	4	23	10	5	24
IE	5	38	10.3	8	76	5	5	14	4	5	15
IT	8	27	0.9	20	360	8	5	28	16	10	38
LT	3	3	0.8	13	162	5	5	6	12	4	17
LV	9	54	2	39	320	9	6	18	13	7	21
NL	2	2	6.2	22	700	5	3	7	4	1	8
PL	6	197	1.6	43	175	6	5	19	7	8	26
PT	5	83	7.4	7	328	6	4	18	7	5	18
SE	1	2	3	5	122	4	1	6	3	1	6
SI	6	391	2	29	272	9	7	20	11	9	24
SK	3	17	0.1	31	344	9	8	20	8	10	21
UK	2	21	4.1	8	..	5	5	16	4	5	16

Source: http://www.doingbusiness.org.

Annex Table 4.6: IMD Survey Indicators

	Regulation Intensity	Ease of Doing Business
Austria	6.87	7.19
Belgium	4.25	5.61
Czech Republic	6.29	5
Denmark	7.46	8.11
Estonia	6.93	7.52
Finland	7.48	7.8
France	3.68	4.52
Germany	3.98	5.43
Greece	5.03	4.15
Hungary	5.63	6.08
Ireland	6.43	8.04
Italy	4.14	3.91
Luxembourg	5.43	6.69
Netherlands	4.76	7.08
Poland	1.75	2.33
Portugal	4.95	4.76
Slovakia	5.78	5.6
Slovenia	4.12	2.62
Spain	4.26	5.76
Sweden	5.62	6.21
United Kingdom	4.09	6.61

Source: IMD World Competitiveness Yearbook 2006

Annex Table 4.7: Better Regulation actions in Member States[1]

	Explicit Better Regulation strategy	Existence of institutional structure dedicated to Better Regulation	Impact assessments	Consultation of stakeholders	Simplification	Administrative costs
Austria	Yes	Yes	Obligatory assessment of all relevant impacts	Obligatory consultation, guidelines exist	Ad-hoc simplification measures	Methodology: SCM Measurements: Planned baseline measurement to begin end 2006. Reduction target: 25% by 2010
Belgium	Yes	Partial (Administrative simplification)	Obligatory Kafka test on administrative burdens. Number of completed Kafka tests recorded	Not obligatory, guidelines exist	Simplification programme	Methodology: SCM. Measurements: Ad hoc. Reduction target: At federal level, nearly 130 laws & regulations were abolished or simplified, reducing admin costs for enterprises by 25% in comparison with 2003=drop of 1.7 billion EUR
Cyprus	No	No	No	Not obligatory	No	No
Czech Rep.	Planned	Yes	Ongoing pilot phase Planned: Obligatory assessment of all relevant impacts. Guidelines exist and are to be revised	Not obligatory Planned: Guidelines	Ad-hoc simplification measures	Methodology: SCM Measurements: In house baseline measurement Reduction target: Planned to be adopted by the govt by end 2007, at least 20%
Denmark	Yes, mainly admin. cost related	Yes	Obligatory assessment of all relevant impacts	Obligatory consultation, guidelines exist	Simplification programme	Methodology: SCM Measurements: Completed baseline with a 25% target. Planned 2nd round of measurements for an update to be completed in January 2007 Reduction target: Burden has been reduced by 5.1% since 2001 (deadline 2010)

[1] For the definition of indicators, please see explanatory notes below the table.

	Explicit Better Regulation strategy	Existence of institutional structure dedicated to Better Regulation	Impact assessments	Consultation of stakeholders	Simplification	Administrative costs
Estonia	Yes. Planned Action Plan in 2007	No	Obligatory assessment but no structured monitoring system exists	Obligatory consultation	Planned simplification programme	Methodology: SCM Measurements: Two pilot projects on VAT and wages were completed. Planned two new measurements in transport and implementation of structural funds
Finland	Yes	Partial (Impact Assessments)	Obligatory assessment of all relevant impacts but not enforced. Unification of existing guidelines and improvements of enforcement under work	Obligatory consultation	No	Methodology: SCM Measurements: Ongoing pilot on VAT.
France	Yes	Yes	Some impacts assessed	Not obligatory but guidelines exist	Ad-hoc simplification measures	Methodology: SCM Measurements: Partial measurements on selected legislation
Germany	Yes, mainly admin. cost related	Partial (Reducing bureaucracy)	Obligatory assessment of all relevant impacts	Obligatory consultation, guidelines exist	Simplification programme	Methodology: SCM Measurements: Is about to launch a large measurement of legislation. Target will be set 2007
Greece	Yes	No	No	Not obligatory	No	No
Hungary	No	Partial (Deregulation)	Obligatory to assess impacts but not enforced	Not obligatory	Ad-hoc simplification measures	Methodology: SCM Measurements: Ongoing sectoral measurements (VAT, EU funds).
Ireland	Yes	Yes	Obligatory assessment of all relevant impacts. Guidelines exist. Number of completed IAs recorded	Obligatory consultation, guidelines exist	Simplification programme	Focus on reducing admin burdens through simplification measures and e-government programme. Established a Business Regulation Forum which is conducting 2 pilot measurements to examine SCM methodology

	Explicit Better Regulation strategy	Existence of institutional structure dedicated to Better Regulation	Impact assessments	Consultation of stakeholders	Simplification	Administrative costs
Italy	Yes	Yes	Yes	Obligatory consultation for all simplification or better regulation measures; not obligatory in the other cases	Simplification programme	Methodology: SCM Measurements: Ongoing sectoral measurements
Latvia	No	No	Obligatory to assess impacts but not enforced	Not obligatory	Ad-hoc simplification measures	Methodology: Planned SCM
Lithuania	Planned	Planned	Obligatory guidelines exist but lack of systematic impact assessment	Obligatory consultation	No	Methodology: SCM
Luxembourg	No	Partial (Simplification/ Administrative costs)	Impact assessment sheets exist	Not obligatory	Ad-hoc simplification measures	Methodology: Planned SCM
Malta	Yes	No	No	Not obligatory	No	No
Netherlands	Yes	Partial (Administrative costs)	Obligatory assessment of all relevant impacts. Guidelines exist. Number of completed IAs recorded	Planned obligatory consultation	Simplification programme	Methodology: SCM Measurements: Baseline measurement carried out. Planned update of baseline. Reduction target: 12% of cost reduction out of 25% target already achieved (deadline 2007)

	Explicit Better Regulation strategy	Existence of institutional structure dedicated to Better Regulation	Impact assessments	Consultation of stakeholders	Simplification	Administrative costs
Poland	Yes	Yes	Obligatory to assess impacts but not enforced. Planned: IA guidelines	Obligatory consultation but not enforced. Guidelines exist.	Ad-hoc simplification measures	Methodology: SCM Measurements: Planned baseline measurement should start in 2008 at the latest
Portugal	Yes	Yes	Assessment of administrative burden only	Guidelines drafted but not yet implemented	Newly introduced simplification programme	Methodology: SCM
Slovakia	No	No	Obligatory to assess impacts but not enforced. No guidelines available. Planned: Improvement of the IA system	Not obligatory	No	No
Slovenia	Yes	No. Planned: An inter-ministerial group	Planned	Obligatory consultation	Simplification programme	No
Spain	Yes	Yes	Guidelines exist	Not obligatory	No	No
Sweden	No	No	Guidelines exist. Some impacts assessed. Planned: improvement of the IA system	Obligatory consultation but not enforced	Simplification programme	Methodology: SCM Measurements: Ongoing baseline measurement carried out with a step by step approach. Reduction target: Sectoral targets set

	Explicit Better Regulation strategy	Existence of institutional structure dedicated to Better Regulation	Impact assessments	Consultation of stakeholders	Simplification	Administrative costs
UK	Yes	Yes	Obligatory assessment of all relevant impacts. Number of completed IAs recorded	Obligatory consultation	Simplification programme	Methodology: SCM Measurements: Baseline measurement carried out. Targets planned

Source: Member States and Commission Services (information available to the Commission on 13 October 2006)Explanatory notes to the indicators used:

BR strategy
This column looks at whether an explicit comprehensive and intermeshed Better Regulation strategy or programme, encompassing all main Better Regulation tools is in place. It is compiled on the basis of whether a clear political commitment for regulatory reform establishing specific objectives, timetables and frameworks for implementation exists. Such a programme should encompass all levels of government and all policy areas, establish principles of good regulation, provide institutional structures for effective coordination, clarify responsibilities for assuring regulatory quality, create monitoring and enforcement mechanisms and ensure capacity to implement them.

Institutional structure dedicated to Better Regulation
This column assesses whether there is an institutional structure dedicated to implementing Better Regulation strategy. While its status, composition or size may vary according to the various institutional backgrounds in Member States, it should exercise such powers and have at its disposal sufficient resources so as to be able to implement and enforce Better Regulation strategy in its entirety and across the board.

Impact assessments
A functioning impact assessment system is characterised by combined sectoral effort in analysing economic, social and environmental impacts of a legislative proposal, considering alternatives to regulation if appropriate. Impact assessments are systematically carried out according to given principles and are subject to monitoring and quality check.

Consultation of stakeholders
Systematic consultation of stakeholders is based on clear, consistent and transparent consultation rules allowing for extensive stakeholder input throughout the regulatory process. It ensures that minimum consultation standards are applied across the board and consultation results are made public, which allows consulting all affected and potentially interested stakeholders in an accountable and transparent way.

Simplification
Simplification programme or plan, 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

Annex Table 4.8: Measure in the 2005 NRPs to improve the business environment

Country	Improving registering / permits / licences	One stop shops
AT	Not mentioned	Yes
BE	Use a central Crossroads Banks of Enterprises, which will reduce time needed to start business from 56 to 3 days.	Yes
CY	Not mentioned	Not mentioned
CZ	Facilitate incorporation to Commercial register, solve "double registration" problem.	Creating a system of central registration offices.
DE	Permits replaced by announcements or max period with default effect (Lander level).	Yes
DK	Registration property digitalised.	Information shops.
EE	Electronic tools for establishing companies (2008).	Yes
EL	Simplify licensing process for commercial business.	Yes, transforming Citizen's service centre info integrated transaction centre.
ES	Yes, to reduce requirements for presentation of documents.	Yes
FI	Yes, by discarding license and registration systems for private business.	Business Information System (2001) allow business registration in one form.
FR	Yes, by discarding license and registration systems for private businesses.	Yes, shortly also one-stop tax contact system.
HU	Yes, "notice period" to be introduced.	Single counter systems for better information.
IE	Not mentioned	Not mentioned
IT	Reform "tacit assent" and "start of activity notification".	Strengthen "single counters".
LT	Not mentioned	Not mentioned
LU	Yes, computerisation of business set-up procedures.	Not mentioned
LV	Improving Enterprise Register; Joint registration system of real estate transactions.	Not mentioned
MT	Not mentioned	Not mentioned
NL	Permit procedure more flexible.	Yes
PL	From 2007 single registration application will be submitted electronically time waiting for entry into register shortened.	Yes
PT	Simplification of notaries and registry acts, cutting red tape, on-line registration through internet revise license concession.	Yes, development of the "Company in one hour project".
SK	Not mentioned	Not mentioned
SI	Yes, establishing of central registers	It was introduced for sole trade sector from 2007 also to enterprises.
SE		Not mentioned
UK	Yes, based on greater sharing of data between regulators.	Yes

Source: DG Enterprise

Chapter 5:
The Financing of Innovation

5.1. Introduction

Innovation requires the commitment of resources, which in turn need to be financed. This chapter therefore focuses first on particular finance-related problems of innovation and the appropriate policy tools to deal with them. Public support can come in various forms: direct measures such as grants and loans, fiscal incentives for R&D, and risk capital measures. This chapter discusses good practice of government support, as supported by economic theory, and presents policy conclusions. These conclusions are then complemented by reviewing the innovation financing measures that member states put forward in the National Reform Programmes issued in October 2005.

The decision to invest in innovation depends on two critical factors:

- The incentives to commit resources for innovation, and
- The capacity to raise the necessary financial means.

Economic policy attempts to intervene in the firms' investment decisions because for both factors, the purely private allocation of resources suffers from certain deficiencies ('market failures'). This may cause private expenditures on innovation to be sub-optimal from the view of the society as a whole. First, the limited appropriability of new knowledge frequently causes private returns to fall short of social returns and thus leads to under-investment in innovation (Nelson, 1959; Arrow, 1962). Since this kind of market failure stems from distorted incentives, it applies irrespective of the actual financing capacity of the firm. Second, under-investment occurs when problems of asymmetric information in the capital markets (for instance when a bank has less information about the value of a certain project than the entrepreneur) undermine a firm's capacity to raise external funds required for financing its investment, even if its incentives were undistorted by external effects.

Analytically, both forms of market failure are independent causes of under-investment. In practice, however, they frequently interact with and reinforce each other. This is the case, for example, when the full appropriation of returns from an innovation depends on first-mover advantages. In the presence of asymmetric information, an innovative start-up company may lack the necessary external funds to expand its operations rapidly enough and thereby keep competitors at a comfortable distance. Conversely, external investors may be reluctant to provide funds because of uncertainty about the entrepreneur's ability to protect the returns from innovation against potential imitators.

The latest data from the Community Innovation Survey (European Commission, 2004A) put these problems in quantitative perspective. When asked about factors hampering innovation, 21% of all the firms in the sample argue that "innovation costs are too high," [52] while 15% complain about "excessive economic risks" and the "lack of appropriate sources of finance." In all three variables, the shares are generally higher for enterprises with innovation activity than for those without (Table 5.1). There is surprisingly little variation between sectors. For both manufacturing and services, the numbers are almost equal (numbers are not reported in the table). One exception is the utilities sector ("electricity, gas, and water supply"), which is the least affected sector. Perhaps this can be explained by the fact that utilities are often considered to belong to the public domain. Conversely, business services face the biggest finance-related barriers to innovation – probably due to their larger dependence on intangible assets, which makes it particularly difficult to access external sources of finance.

[52] For a meaningful interpretation, one might wish to add 'relative to the expected returns'.

Table 5.1: Finance-related hampering factors (share of firms considering them important, 1998 - 2000)

	Innovation costs too high	Excessive perceived economic risks	Lack of appropriate sources of finance
Total	21	15	15
Enterprises with innovation activity	24	17	19
Enterprises without innovation activity	19	14	13
Small enterprises	21	16	16
Medium-sized enterprises	19	13	13
Large enterprises	21	18	10

Source: European Commission (2004A).

Interestingly, a breakdown by firm size reveals relatively few differences with respect to the first two variables. Both small and large firms perceive the 'high cost of innovation' and 'excessive economic risks' to be obstacles of almost equal importance. However, access to appropriate sources of finance is a bigger problem among small (16%) than among medium-sized enterprises (13%), with large firms being the least affected (10%). Credit market problems are more pertinent to small firms because they can for instance offer less collateral.

Focussing on enterprises with innovation activity in the period from 1998 to 2000 (Table 5.2), the study found that the overall share of firms that received public financial support is 29%, with a pronounced discrimination in favour of industry (35%) as compared to services (19%). The observation that the share of companies receiving public financial support is higher for industry applies similarly to local and regional authorities, national governments and the European Union. The only exceptions are the EUs fourth and fifth Framework Programmes for RTD, which funded an equal share of firms in the services and the industrial sector.

Table 5.2: Share of innovators with public financial support

	Total	Industry	Services
	Proportion of enterprises with innovation activity that received financial support, EU, 1998-2000		
Received public financial support	29	35	19
From local or regional authorities	15	17	11
From central government	15	18	9
From European Union	7	8	5
From EUs 4th or 5th Framework Programmes for RTD	4	4	4

Source: European Commission (2004A).

Note: More than one source of public support is possible.

5.2. Under-investment because of appropriability problems

5.2.1. Missing markets for knowledge

The first factor determining the decision to invest in innovation refers to the incentives to commit resources to innovation activities. Briefly, the idea here is that under-investment in innovation originates from missing markets for knowledge, as private returns to innovation reaped by the company are below the social returns for society at large. Being a public good, knowledge has two critical properties that seriously impair its commercial value (Geroski, 1995). First, knowledge remains in circulation no matter how many people use it ('non-rivalry' of consumption). Second, as soon as knowledge is disclosed, it becomes difficult to enforce any payment ('non-excludability'). Consequently, many innovative firms face the following dilemma: How can they communicate the value of a new idea to a potential buyer without disclosing the idea itself? Innovative firms must therefore deliberately manage their knowledge flows in a way that maximises their private returns for a given innovation. Geroski (1995) lists a number of strategies for individual enterprises, among them use of intellectual property rights, secrecy, lead time and learning curve advantages, or embodied knowledge ('sell products, not ideas').

Depending on the particular technological and market characteristics, some strategies will be more effective than others, but overall, an innovative firm cannot expect to fully prevent the uncompensated diffusion of new knowledge. Frequently, competitors, suppliers, or customers reap part of the benefits of an innovation, even though they may have contributed little or nothing to it. The adequate policy response can rely on various instruments. One direct means is the strengthening of the appropriability conditions through an effective system of intellectual property rights. Another policy instrument is the public provision of basic research with little or no immediate commercial value, but the potential of creating positive externalities favouring industrial applications in the long run. This chapter is concerned with public interventions in the firms' investment decisions by means of a financial transfer changing the relative cost of innovation activities.

5.2.2. The principles of 'additionality'

The general objective of public financial aid to innovation is 'output additionality', which requires the generation of additional private and social returns through the subsidy. The overriding concern in policy design, however, is the question of leverage versus displacement effects, i.e. whether and how public subsidies affect private investments in innovation. In that regard, the basic criterion is 'input additionality', which means that private expenditures rise at least by an amount that is equal to the cost savings from the public subsidy. Positive leverage is achieved if private investments rise by more than the subsidy (for instance because the subsidy improves the bargaining power of the R&D department within an organisation, or because it is perceived as a quality signal by external investors in case of liquidity constraints). Conversely, if 'crowding-out' occurs, the subsidies displace (part of the) private investments that firms would have undertaken anyway. The foregone opportunity to direct the public resources towards a better use with positive leverage constitutes the social cost of policy failure. [53]

One must suspect that, in practice, these 'windfall gains' are quite common. First, public authorities are unlikely to deny their support precisely to the most promising innovation projects, which in turn are most likely to be undertaken anyway. David et al. (2000) mention two causes: (i) the pressures within public agencies for 'high success rates', and (ii) the pressure from vested interests, which generally increases with the size of prospective private pay-offs of an investment. Furthermore, even if public agencies had the power and will to deny the financing of the most successful innovating companies, one must acknowledge that in practice the principle of additionality remains extremely difficult to define and monitor at an operational level.

To reconcile theory with policy practice, one may derive some comfort from the consideration that even in the presence of 'windfall gains', where the public has little leverage on private expenditures for innovation, public subsidies may well 'reward' innovative companies for the positive externalities they generate. Alternatively, one may define different success criteria for a policy, where the objectives go beyond that of increasing the money spent on innovation, but instead address a desired change of behaviour. A typical example of 'behavioural additionality' is a grant that the firm receives depending on its participation in regional networks, cluster initiatives or some cooperation between science and business. The intention is to raise the social returns from investments in innovation by altering the behaviour of private firms through the subsidy.

[53] In addition to these micro-level effects, David et al. (2000) emphasise a macro-level displacement effect, which is due to the upward pressure on the prices for inputs to innovation, such as high-skilled R&D personnel.

5.2.3. Empirical trends

Public financial support to private investments in innovation comes in either of two different forms:

- The direct funding of a part of the targeted expenditures, or
- Fiscal incentives allowing companies to reduce their tax payments.

Graph 5.1 demonstrates that individual countries choose very different combinations of the two policy tools. On the vertical axis, the share of business expenditures on R&D funded by government is a relatively straightforward measure for the use of direct subsidies in innovation policy. Conversely, the OECD's B-index has become the standard tool to assess the relative generosity of fiscal incentives for research and development.[54] The generosity of the tax treatment increases along the horizontal axis of Graph 5.1. Each line connects the position of a particular country with respect to the two measures indicated by small dots for the year 1991 and large dots for the latest year available, i.e. 2003 for the share of government financed BERD and 2004 for the B-index. Following a convention by the OECD, one can distinguish four segments of countries with:

- *Strong direct funding and unfavourable tax treatment*: No country belonged to that quarter in 2003/2004 and only a few were located there in 1991 (e.g., Norway, the UK, and Italy);
- *Little direct funding and unfavourable tax treatment*: Interestingly, in 2003/2004, this particularly low profile of financial support for R&D applied to some of the technologically most successful European countries such as Finland and Sweden, where dynamic private expenditures appear to have outgrown the public subsidies for innovation;
- *Little direct funding and favourable tax treatment*: This quarter is where the majority of countries moved during the 1990s and where we also find the (unweighted) average of the EU-15;
- *Strong direct funding and favourable tax treatment*: This section of the chart is comprised of countries such as Italy, Spain, Norway, France, UK and the USA, which are all characterised by relatively generous public support to R&D.

Despite the overall variety in the policy mix of individual countries, we find a general trend of decreasing shares of government-financed business expenditures on R&D. The downward shift has been most pronounced in the United States (30% in 1981; 21% in 1991, and 10% in 2003) and in France (25%, 22%, and 11%, respectively). Most other countries experienced a similar development. For the EU-15 the respective shares declined from 19% in 1981 to about 13% in 1991 and finally 8% in the year 2003. For the EU-25 it declined from about 11% in 1995 to 8% in 2003. While the tax treatment of R&D expenditures became more generous during the same period, the relative importance of the two forms of innovation policies has thus dramatically shifted in favour of fiscal incentives and against direct funding instruments. This trend has the advantage that R&D support becomes more neutral with regard to technology area, although direct funding instruments will be the preferred strategy in case of areas with clearly identified knowledge spillovers.

5.2.4. Direct funding

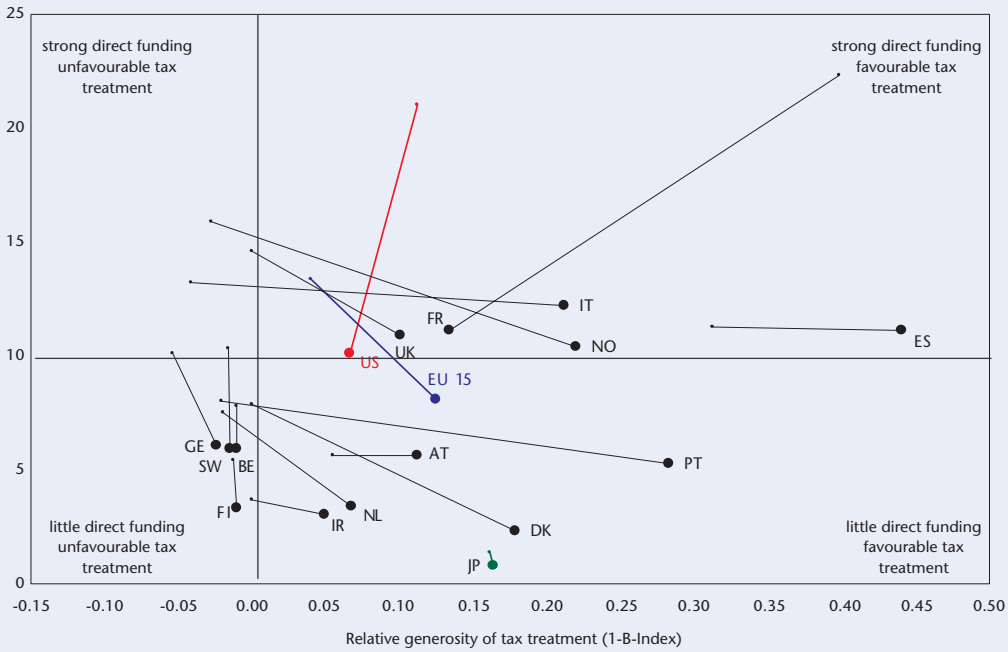
The most important difference between fiscal incentives and direct funding is that, by using direct funds, governments have more scope to make deliberate choices about which projects they want to support, whereas fiscal incentives generally leave that to the firms themselves. The higher degree of public intervention in private decision-making is the price that direct funding schemes pay for the opportunity to better discriminate between projects. The potential pay-off is the higher leverage by targeting public resources more narrowly, for instance, by targeting projects with particularly high externalities. However, direct subsidies may also target other social objectives, such as the support of small and medium-sized enterprises, start-up companies, regional cohesion, or other public 'missions' in the sense of priority concerns of the society at large. The typical tools are either grants or public loans at low interest rates. Sometimes loans are conditionally reimbursable (i.e. repayable only if the innovation is successful). The criteria for the selection of applications can be very diverse, as are the intensities and standards of monitoring and governance. The competitive allocation through calls is certainly the most transparent procedure and therefore desirable, but not universally applied.

In contrast to fiscal incentives, which naturally apply only to those levels of political governance that are empowered to make their own tax laws, any local, regional, national, supranational or even non-governmental[55] authority can in principle pay direct subsi-

[54] Warda (2001) defines the B-index as the ratio of the after-tax cost per unit of R&D expenditures to one minus the corporate income tax. The index takes the value 1 if all R&D expenditures are fully deductible in the current year; less than 1 when they are more than fully deductible; and greater than 1 in case the R&D expenditures are not fully deductible. An increasing index thus indicates a less generous tax treatment. The B-index is calculated with 90% current expenditures and 10% capital expenditures for all countries. The B-index does not discriminate between different definitions of innovation and according R&D expenditures, which may, however, seriously affect the overall scope and impact of the fiscal incentives.

[55] Trade unions, alumni networks, charities, environmentalist groups, etc.

Graph 5.1: Direct vs. indirect subsidies – small dots indicate a country's position in 1991, large dots in the latest year available (2003/ 2004)



Source: adapted and updated from OECD (2003A).

Note: (i) The B-index is defined as the income before tax needed to break even on one dollar of R&D outlay. See Warda (2001) for a detailed explanation. BERD means 'business expenditures on research and development'.

dies.[56] Furthermore, innovation policy is a fairly current issue (compared, for instance, to other fields such as industrial or competition policy). Parallel to the increasing awareness of the importance of innovation in the process of economic development, innovation policy has dramatically grown over the past decades, producing an ever-increasing number of agencies and initiatives, which have emerged in immediate response to newly perceived needs (Mowery, 1995). Consequently, there is a huge variety of programs providing direct funding of innovation activities.

To a certain degree, this diversity is also rooted in the heterogeneous nature of the sources of positive externalities of innovation as well as the variety of objectives and goals among different levels of governance and political territories. Nevertheless, there appears to be a growing concern about the fragmentation of too many different programmes operating at sub-optimal levels. In many instances, the consequence is a lack of transparency and coordination. The European Commission's 'TrendChart on Innovation' systematically collects and shares information on innovation policies in the EU member states, at the level of individual measures.

The major barrier for the attempted exchange of good practices in the area of direct financial aid to innovation activities is the lack of harmonised standards and tools for the evaluation of the manifold programmes and initiatives. This makes it difficult to compare their actual impact on private investment decisions and to derive principles of best practice. David et al. (2000) survey about 30 different evaluation studies, which primarily lead them to stress the diversity in the aims and scope of the programmes as well as the reported impacts. Referring to the criterion of 'input additionality', they draw the cautious but positive conclusion that "at this time, the econometric results obtained from careful studies at both the micro- and macro-levels tend to be running in favour of findings of complementarity between public and private R&D investments" (David et al., 2000, p. 500). A similar conclusion is reached in an earlier edition of the European Competitiveness Report (European Commission, 2004B).[57]

5.2.5. Fiscal incentives

Among fiscal incentives, several instruments can be distinguished. First, all OECD countries allow firms to directly deduct their current expenditures on R&D

[56] If permitted under European State aid rules and the relevant WTO provisions. In line with the State Aid Action Plan, the Commission intends to adopt a new Community Framework for State aid for Research, Development and Innovation before the end of 2006.

[57] Specifically, the presented econometric results suggest that a 1 Euro increase of R&D subsidies will generate an increase in total private R&D spending of about 1.4 euro.

from their taxable income, and many countries have similar provisions, for instance, for current expenditures on training or marketing activities. If one interprets these expenditures (as one should do) as investments in intangible assets generating income over a longer period, such provisions constitute a generous subsidy in form of accelerated depreciation. In addition to this immediate depreciation of current expenditures, a number of countries apply accelerated depreciation rules for R&D equipment; some countries even for buildings that are used for R&D.[58] Second, tax allowances offer firms the opportunity to deduct an additional percentage of their expenditures on innovation from their tax base. Third, tax credits allow firms to deduct a certain percentage of the targeted expenditures directly from their tax liabilities.

Since fiscal subsidy schemes typically relate to corporate income taxes, they can only raise the incentives for profitable firms. They have no impact, for instance, on high-tech start-ups making little or no profit because they have reinvested all their cash flow in order to grow fast and be among the first movers in their respective market. As a fourth instrument to remedy this situation, one can directly pay an innovation premium to those companies that have not earned a positive taxable income. One may also apply carry-forward or carry-backward rules, which allow carrying over the claim on certain benefits to a period where the firm is liable to pay taxes on its returns.

Finally, one may consider an alternative tax base, as in the case of the Netherlands, where an R&D rebate can be deducted from the employer's part of the wage tax and social security contribution of R&D-related personnel. The fiscal incentives thus apply to companies of all legal forms (including self-employed entrepreneurs) and directly link the cost reduction to the activities of the R&D department, which may effectively raise its bargaining power for the allocation of funds within the firm. In addition, this scheme offers special provisions for companies younger than 5 years and favours small and medium-sized enterprises through a nonlinear rate that decreases with certain thresholds of firm turnover and includes an upper limit on the total rebate.[59] The Dutch system has been repeatedly quoted as a best practice model (see, for example, Hutschenreiter, 2002). Interestingly, Belgium (wage tax exemption) and Spain (bonuses for social security contributions) have announced similar measures for research personnel in their National Reform Programmes (see section 4 below).

All these schemes implicitly assume that fiscal incentives have the power to influence the private decision to invest in innovation. However, the actual leverage depends on the price elasticity of investments, i.e. the extent to which a reduction of the cost due to the subsidy induces firms to spend more on the targeted class of expenditures. Hall and Van Reenen (2000) survey a considerable number of empirical studies that apply different methods and data sources and consequently produce very diverse results. The majority of later estimates, however, are broadly in line with a macro-panel study by Bloom, Griffith and Van Reenen (2002), who report that a 10% fall in the cost of R&D stimulates just over a 1% rise in the level of R&D in the short run, but about a 10% rise in the long run. In other words, fiscal incentives increase private expenditures on R&D by an amount that is equal to the loss in tax revenues. On average and in the long run, they therefore pass the basic criterion of 'input additionality', i.e. the public resources spent for the tax incentives do not displace private expenditures but constitute additional investments in innovation.

The actual impact of tax incentives in a particular country can vary considerably, depending on the precise design of its fiscal scheme. One critical choice, for example, is between the level and the increment of the targeted expenditures. Incremental schemes only subsidise expenditures above (an average of) the previous years and thus aim to reduce windfall gains. The goal is to raise the leverage of additional investments per unit of public subsidy. However, incremental schemes also have the disadvantage of greater complexity, which may cause additional distortions (e.g., with respect to the timing of investments) and raise the cost for compliance as well as administration.

The Commission will present a Communication later in 2006 with detailed guidance for the design and evaluation of generally applicable tax incentives for R&D.

5.2.6. Summary and policy conclusions

To summarise this subsection on incentive-related causes of under-investment in innovation, each of the two general policy tools has specific merits and weaknesses. The most important difference is that fiscal incentives leave the allocation of resources to the market, whereas in the case of direct subsidies, governments can be criticised for imposing their own priorities when selecting technologies and firms. Conversely, direct subsidies are the more flexible instrument if policy deliberately aims to address

[58] For further details, see OECD (2003A).

[59] CPB Netherlands Bureau for Economic Policy Analysis has done several studies on the impact of the Dutch R&D support programme on innovation activity. An overview can be found in Cornet et al. (2006). Empirical research suggests that one Euro spent by the government on this provision generates between 50 and 80 cents of additional R&D employment.

important social issues or clearly identified externalities (such as in case of health care, environmental protection, defence, etc.). In particular, direct measures can be better designed to target those areas where the gap between private and social returns is largest. In contrast, the majority of tax incentives depend on realised profits and thus tend to favour expenditures on innovations that are already close to the market. Additional spillovers might then be relatively weak as compared to more basic innovations that may also need a longer time to produce profits. Moreover, it is often argued that direct subsidies involve higher administrative costs for both government agencies and funded firms. One must also consider, however, that the higher administrative costs arise because of the more careful selection and monitoring of projects, which again should raise the efficiency of the public resources devoted to it.

The optimal combination of fiscal incentives and direct subsidies depends on the particular context, aims and priorities of national innovation policies. Even though a certain degree of harmonisation is desirable from the perspective of a European research area (i.e. to mitigate distortions in the international location of research activities), the diversity of systems among member states also offers an opportunity to learn how effective these instruments are in practice. However, this opportunity is currently lost, since little systematic data is collected and the occasional national evaluations of particular programs lack a comparable design and methodology (OECD, 2003A). There is certainly scope for a more systematic and comparable approach to evaluations.

From the above considerations, one may draw the following general guidelines for finance-related policies directed at the externality-induced under-investment in innovation:

Fiscal incentives should generally be designed such that they raise the private willingness to invest in innovation without further targeting certain technologies, sectors, or types of firms. In other words, they should comply with the general aim of "neutrality" of the tax system. Direct funding will be the preferred strategy in case of technologies with clearly identified and sizeable knowledge externalities.

- A major challenge is to extend the fiscal incentives to innovative businesses with a longer-term view on profits. One tool is the direct payment of an innovation premium for companies that do not make a profit. Rebates on wage tax and social security contributions of R&D-related personnel also seem to be an attractive, and spreading, approach.

- Even though some refined designs (e.g., the use of incremental expenditures) might raise the efficiency of the public funds used, their benefits must be critically assessed against the additional cost for compliance and administration as well as unintended distortions.

- The consolidation and streamlining of direct funding schemes should be a priority in order to increase the transparency and mutual coordination of the major public players within the national and regional systems of innovation.

Since the gap between private and social returns is generally presumed to be largest for technological innovations as defined in the OECD's Oslo Manual, financial support schemes typically target private expenditures on research and development (with some discretion in terms of how generously R&D is defined). There remains the issue of non-technological innovations[60], such as the introduction of new business practices, organisational models, etc. On one hand, and as long as there exists a clear cause of non-appropriability and positive spillovers, they could, in principle, be considered for public support but, on the other hand, difficulties would arise with respect to the precise definition of such innovations and with the establishment of effective rules for governance and, in particular, the discrimination between potential beneficiaries.

5.3. Under-investment because of capital market imperfections

5.3.1. The financing gap

The overall function of capital markets in the process of economic development is to channel financial resources to their most profitable uses. Since investment decisions are based on expectations about future returns, they rely on incomplete information about future outcomes and thus involve uncertainty. The financing decision is subject to two potential types of error. First, to finance projects that fail; and second, to deny financing to projects that would have been profitable. In that situation, the accurate selection of the capital market depends on two critical factors:

- The availability of *information*, and

- The ability to interpret it properly, i.e. *knowledge*.

In the ideal state of perfect capital markets, all projects are purely funded on their own merits, i.e. independent, for example, of the size of a firm, the availability of collateral or a firm's equity ratio. As

[60] Non technological innovations are covered by the latest version of the Oslo manual released by OECD and Eurostat.

riskier projects have to pay higher interest, markets can clear in equilibrium. In practice, however, interest rates are rarely used to discriminate between projects and businesses without sufficient collateral can face credit constraints. The reason is the problem of asymmetric information between the investor and the entrepreneur, which can lead to two types of behavioural reactions:

– '*Adverse selection*' is a problem of the proper identification of the quality of a project. The entrepreneur has better information about the expected cost and returns, but cannot credibly communicate it to the investor, who has difficulties to discriminate good projects from bad. The investor will then be reluctant to provide finance, or only at a higher interest rate. [61]

– '*Moral hazard*' is an incentive problem, where the entrepreneurs may change their behaviour at the cost of the investor. Examples are the reduction of own effort, growth beyond a firm's efficient scale, or increases in the risk profile of a project. When the costs of the required monitoring become too high, the investor prefers to deny the financing even though the project might otherwise have been profitable.

Some enterprises are more affected by restricted access to external finance than others are. For small enterprises, transaction costs (e.g. the costs of a proper risk assessment) can be very high relative to the required volume of finance. Additional problems arise for young (start-up) companies, because they typically have a lack of accumulated cash flow and collateral und usually do not have a record of accomplishment that may help to establish a good reputation among creditors. Furthermore, investors must take into account the statistical fact that many young enterprises fail. Finally, the burden of being a small and new company is further aggravated if external funds to finance innovation are needed:

– There is generally more uncertainty and asymmetry of information since, for instance, the need of expert knowledge to assess a financing project increases;

– More specifically, adverse selection increases as entrepreneurs are more reluctant to disclose information due to the confidential nature of innovation (fear of imitators);

– Moral hazard may also increase because the investor can hardly distinguish between the lack of entrepreneurial effort or the inherent risk of an innovation project as causes for failure;

– Innovative firms tend to have few tangible assets that can be used as collateral. Instead, they rely more on intangible assets residing in an innovative idea, such as highly qualified (but equally mobile) personnel or the 'present value of growth options'.

One must add, however, that companies regularly overcome these difficulties by continuously building up their leverage through accumulated cash flow and reputation, while financial intermediaries apply their experience and expert knowledge to assess and monitor financing projects. However, the lack of access to external finance is particularly prevalent when a highly innovative, small or medium-sized start-up company faces extraordinary growth opportunities. It is felt most urgently when an entrepreneur needs to expand rapidly in order to appropriate the returns from an innovation through the exploitation of first mover advantages. What follows from these considerations is that the 'financing gap' affects only a limited number of firms, but it is precisely those companies that bear the highest potential to drive economic development through radical innovations and technological change.

5.3.2. Innovation and the stylised 'pecking order' of corporate finance

The optimal/feasible capital structure typically changes over time with the increase of a firm's age and size (Berger and Udell, 1998; Myers, 2001). Due to the high degree of informational opacity and the associated problems of asymmetric information, young and small start-up companies initially rely mostly on 'insider funds', which primarily include the business founders' own savings and resources provided by their immediate social network of family members and friends. Other private individuals may invest as 'business angels', who typically have experience in running a business and may also support the new venture through their experience and network of commercial relationships. Moreover, a business angel's involvement in the venture may signal to other market participants (including financial institutions) that the firm has a solid business plan.[62]

Access to intermediated funds increases as the firms grow and successfully build up reputation and tangible assets. With a growing number of options availa-

[61] See Stiglitz and Weiss (1981).

[62] Inside knowledge about the market and immediate leverage through user-supplier relationships explain why trade credit is also an important non-intermediated source of finance during a firm's early stages of development. Other examples of financing sources for very small businesses are personal credit cards, home equity loans (entrepreneurs take a mortgage on their home), and factoring (someone buys a business' payables at a discount and collects the due bills instead). Such instruments indicate how desperate small business owners can become as their continued use drains a company's operating margin and makes it almost impossible to accumulate assets (Lupke, 2004).

ble, the conventional 'pecking order hypothesis' posits that firms prefer (i) internal finance from own cash flow and retained earnings over external finance; and (ii) issue debt before equity in case that the internal funds are exhausted. Internal finance is clearly the cheapest source simply because it avoids governance problems from asymmetric information. Debt finance is generally preferred among the sources of external finance because of lower issuing costs and the entrepreneur's preference to keep ownership and control. In contrast, external equity is generally considered as a financing source of last resort. Because of the high fixed cost of raising equity on the stock market and in case of difficulties to communicate (or reluctance to disclose) the value of its intangible assets, small and medium-sized enterprises typically turn to private equity and venture capital funds, while large companies tend to issue shares directly on the public market.

Empirical observations generally support the stylised pecking order hypothesis. For example, in a study of small and medium-sized enterprises in the German machinery sector, Harhoff et al. (2001) report that more than two thirds of the expenditures on product innovations have been raised through internal finance (cash flow), followed by bank finance and public subsidies. Only few SMEs in the German machinery sector have used equity finance.[63] Among external sources, the bigger importance of debt versus equity finance seems to reflect the general preference of owner-managers to preserve their independence and control of the company, the relatively tangible nature of assets in the machinery sector, and, more generally, the strength of relationship-based banking in Germany.

However, other studies focussing on highly innovative companies draw a different picture. In particular, the relatively recent emergence of private equity and venture capital markets offers new opportunities and might even lead to a partially 'reversed' pecking order for high-tech companies. For example, Hyytinen and Pajarinen (2003) come to this conclusion. In their study of the capital structure of more than 750 Finnish small and medium-sized enterprises, the principal owners are the single most important source of funds (29%), followed by trade credits (26% debt from "other institutions") and equity from other shareholders as well as debt from financial intermediaries (17% each). As technology-intensive sectors were oversampled, these numbers are not representative for the total economy. What makes this study particularly interesting, however, is the additional discrimination between innovative firms and others. By that comparison, the authors show that innovative companies generally exhibit a lower debt ratio and rely more on equity from the principal owner. Moreover, they find that venture capital is the most important source of external equity for the firms with the highest R&D intensity, while business angels are the major external source of equity for SMEs with rather low innovative activity.

To present another example, Hogan and Hutson (2005) have studied the capital structure of Irish software companies, where again self-financing accounts for the largest portion of investments (50%), followed by venture capital (28%), private investors (11%), and government grants (7%). Bank loans (4%) were by far the smallest source of finance in the total sample (and played no role at all for start-up companies that are less than 2 years old). The authors conclude that the entrepreneurs in their sample were willing to forfeit independence and control in order to pursue innovation and maximise the value of their company (for potential future selling). This finding might be explained through the particularly intangible nature of assets in the software sector (lack of collateral), the study's focus on new technology-based firms, and the existence of a relatively well-established private equity market in Ireland.

In short, while all studies uniformly point at the predominance of internal finance, the relative weight of external equity and debt appears to depend strongly on the degree of innovativeness of the activity concerned. Since debt finance is usually secured by assets, it is rarely available for high-tech start-ups until they have a proven product on the market. The longer that may last, the more collateral and financial rewards (interest, equity share) the firm has to offer to outside investors. Hall (2002, p. 45) therefore concludes her survey of the literature, stating that "there is solid evidence that debt is a disfavoured source of finance for R&D investment." This finally draws our attention towards private equity and venture capital, which specifically target enterprises that are most affected by these capital market imperfections.

5.3.3. Private equity and venture capital

Private equity refers to external finance by informal as well as institutional investors, to enterprises not traded on a stock market. Business angels are typical informal investors focussing on the earliest stages of development, when the required input is still comparatively small and the contribution of a wealthy individual with particular business experience has considerable leverage. The ideal targets are innovative companies, which provide the potential for fast growth and quick exit, for instance through the sale to a venture capital fund that enters at a later stage. Since business angels typically choose their invest-

[63] However, those who did made considerable use of it, covering on average 20% of the project cost.

ments among informal connections and local networks, no reliable records exist about their financial contribution. Other forms of private equity include, for instance, management buy-outs (MBOs) and management buy-ins (MBIs), which typically apply when established firms face some sort of crisis and need new capital to finance a radical restructuring of their operations.

Venture capital is a special form of institutional private equity. Gompers and Lerner (1999, p. 146) define it as "independent, professionally managed, dedicated pools of capital that focus on equity and equity-linked investments in privately held, high growth companies." Again, innovative companies are an ideal target as they promise the best opportunities for rapid growth and an accordingly profitable exit, for instance through an initial public offering (IPO) on the public equity markets. The typical business model encompasses the following characteristics:

– An intense commitment in terms of the selection and monitoring of projects;

– The focus on firms with high growth potential;

– Instead of paying out dividends, cash flow is entirely reinvested to raise the company value;

– Investments are of limited duration and returns are earned by exit (disbursement).

Typically, when taking a stake into an enterprise, venture capital funds also bring into it crucial managerial skills and guidance. This input, together with their expertise in the markets and the technologies in which they invest, contribute towards reducing thee information asymmetries referred to above.

While business angels have already been in place to finance, for instance, merchant adventurers of early centuries, or new manufacturing plants during the times of the industrial revolution, formal venture capital represents a recent institutional innovation, with the foundation of the American Research and Development Corporation (ARD) marking its official birth in the year 1946. Having gone through different phases of modest growth, extraordinary excitement, as well as bust, the US venture capital market has developed into an experienced and highly professional industry able to overcome part of the aforementioned governance problems from asymmetric information through its intense commitment and a complex set of specialised contractual tools. [64] Due to its high experience and specialisation, the US market has been particularly successful in channelling financial resources to venture capital investments, which on average amounted to 0.15% of GDP in the years from 1999 to 2002 (OECD, 2003B).

The institutional innovation of venture capital has increasingly diffused to other countries. In Europe, venture capital markets have gradually evolved since the middle of the 80s. According to data from the European Venture Capital Association (EVCA, 2006), institutional private equity and venture capital stayed at an extremely low level until the second half of the 90s, when it finally took off for a rapid expansion until the high-tech bubble burst in the years 2000 and 2001 (Graph 5.2). As new investments dropped sharply, fundraising has followed a modest pace until 2004. During those years, the overriding concern was to prove to investors that the business model of private equity and venture capital can indeed outperform alternative uses of the funds raised (see, e.g., Dantas Machado and Raade, 2006), while the cumulated difference between the new funds raised and those invested within the same year indicated sufficient liquidity in the market. [65]

In 2005, total funds raised were about €72 billion, with 10,915 companies receiving new investments that amounted to €47 billion. [66] On average, the share of total private equity investments in GDP amounted to 0.42%.

Another characteristic is the large disparity in the development of the private equity markets between European countries. In 2005, the share of private equity investments in GDP ranged from 1.33% in the United Kingdom and 1.06% in Sweden, followed at a distance by Denmark (0.51%), the Netherlands (0.47%) or France (0.43%) and countries such as Austria (0.06%) and Hungary (0.05%), the Czech Republic (0.02%), and finally Greece or the Slovak Republic with less than 0.01% at the bottom end of the distribution. Similarly, if one turns to the net difference between the private equity managed and invested in a particular country (Graph 5.3), the United Kingdom outperforms all other European countries. From 2001 to 2005, British funds managed approximately 8 billion euros more private equity per year than had been invested in the UK by all European countries taken together. [67] Their private equity industries thus

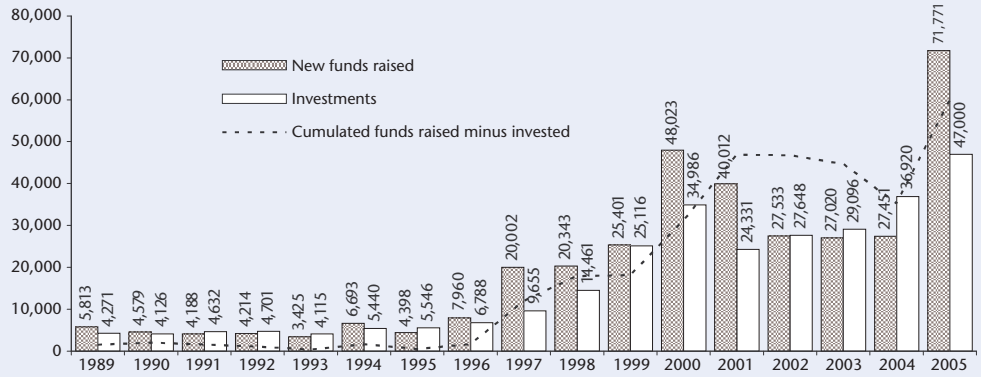
[64] For example, Schuman et al (2001) give an impressive account of the process of standardisation and routinisation of contracts that originated from the dense community level networks of entrepreneurs, specialised law firms and venture capitalists in California's Silicon Valley.

[65] However, to avoid misinterpretations, one must take into account the considerable time lag between the commitment of funds and their actual investment. To give an example, a venture fund with a limited life span of ten years may invest the capital that was initially committed at its beginning during the next five or six years of operations.

[66] European venture capital firms tend to make a large number of small investments, as opposed to the United States' strategy of making fewer larger investments. This fragmentation of venture capital investments in Europe could lead to reduced profitability of European venture capital; see also European Commission (2006).

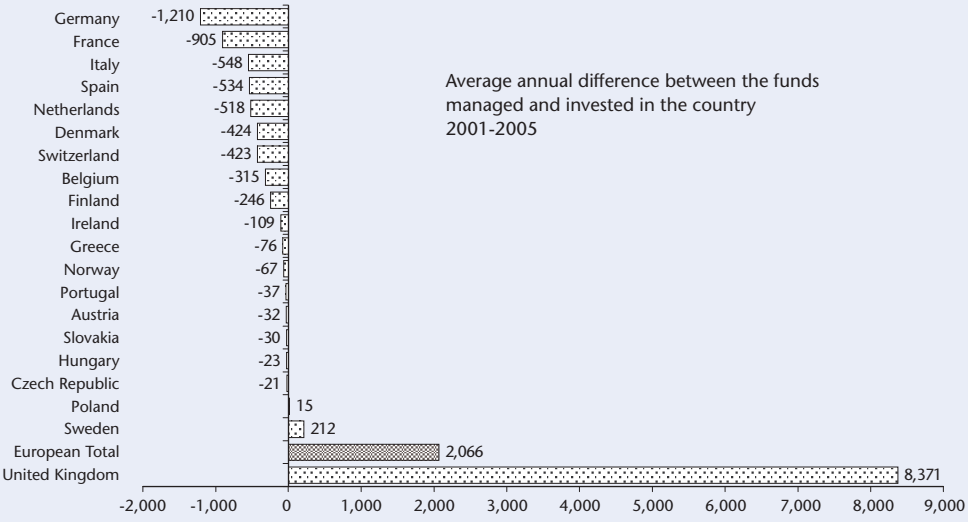
[67] Unfortunately, the data do not include private equity investments from non-European countries.

Graph 5.2: The evolution of European private equity and venture capital funds



Source: EVCA.

Graph 5.3: Net balance of private equity managed and invested in a country (2001 to 2005 in mill. €)



Source: EVCA.

helped to finance entrepreneurs in other countries with less developed markets, such as France, Italy, or Germany, all of which receive more private equity investments than are managed by the funds located in their own country.

It would be futile, however, to hope that this cross-national flow of investments could fully compensate for the lack of a developed local market. The reason is that the geographical spread of companies managing private equity is relatively restricted, precisely because of their intense commitment to the selection and monitoring of individual investments. Cross-border investments are therefore most likely to catch the 'big fish', many of them presumably later stage financing, whereas smaller companies in the seed and start-up stages still depend on the available local expertise.

A closer look at the stage distribution of private equity investments in Europe reveals that during the period between 2001 and 2005, on average 63% of the total funds were invested in buyouts and other later stage investments (Graph 5.4), with the majority going to the expansion stage and start-up companies, while seed financing received less than 1%. Since later stage financing consumes much more resources per investment than the others do, their

overall share in terms of companies funded drops accordingly, whereas firms in the expansion stage are the largest single recipients of private equity, followed by start-up companies. [68]

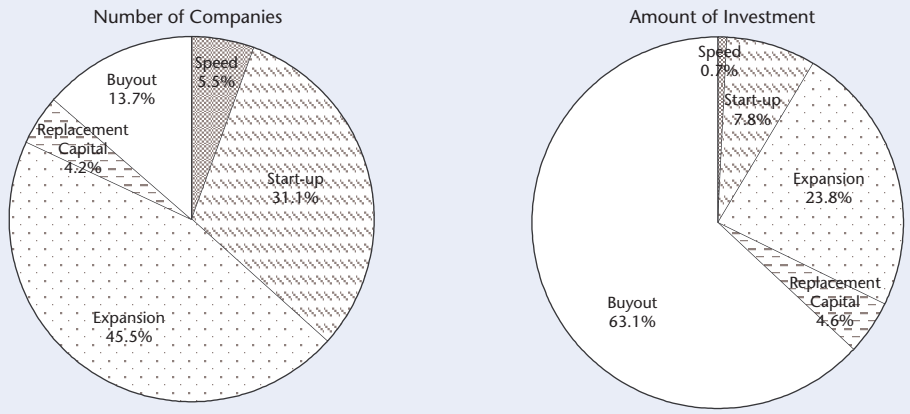
Turning to divestments and comparing the five-year averages for 1996 to 2000 with those for 2001 to 2005, the boom and bust period has left its traces (Graph 5.5). The shares of write-offs and of the residual category 'other means' (that is mostly comprised of sales to other financial institutions) have increased, while at the same time, the shares of new public offerings and trade sales have decreased. However, by 2005, the divestment by write-off was only at 4.7%, considerably below the share of exit by public offerings with 8.9%. Divestment by other means amounted to 63.8%, while trade sales accounted for 22.6%.

5.3.4. Summary and policy conclusions

Like other investments, innovation activities are predominantly financed by internal sources, i.e. from current cash flow and retained earnings. External finance is needed when investment opportunities are higher than a firm's self-financing capacity.

[68] Of similar interest, the overall share of high-tech investments is approximately 20% (five-year average from 2001 to 2005). This number stems from the subjective judgement by the PE/VC managers in the annual EVCA surveys. In the aftermath of the bursting high-tech bubble, it briefly dropped to 12.5% in 2002.

Graph 5.4: Stage distribution of investments 2001-2005



Source: EVCA.

Graph 5.5: Share of different exit channels in total amount divested

Source: EVCA.

Even then, large and established companies with a proven record of saleable products can easily turn to financial intermediaries or public equity markets in case the scope of new investments exhausts their self-financing capacity. The problem of a 'financing gap' due to capital market imperfections is a specific concern of young and small enterprises, particularly those that pursue an innovation and try to expand fast for the timely appropriation of its returns. These firms are most likely to miss an investment opportunity because of the lack of access to external finance if the following factors coincide:

- great opportunity (i.e. financing need),
- high risk for investors because of asymmetric information, and
- a lack of own cash flow or collateral.

In short, while positive externalities constitute a general rationale for public support, which is primarily conditioned on the merits of a particular project and not of the firm, the lack of access to finance calls for policies that specifically target a certain type of enterprise.[69] The central concern is to enable and foster the 'deal flow' from the early invention of novel ideas (for example, at a university lab) to business plans and their first application in a start-up company, and, eventually, to the subsequent growth and expansion of a new high-tech enterprise.[70] The initial volume and quality of such innovation activities depends on a multitude of factors that have already been discussed in earlier sections of this report. Examples are the intellectual property regime, networking, technology transfer between science and business, public investments in human capital formation and public research, and many more. At this point, we focus on finance-related measures.

In earlier reports, both the European Commission (2003A) and the OECD (2003B) have listed particular policy recommendations, which should not be repeated here. The following assortment selects the major lines of recommendable actions from the financing perspective, organised along the imaginary 'deal flow' from new ideas to profitable business applications:

- To begin at the earliest stages, public support should carry or share the cost of activities serving to match nascent entrepreneurs, e.g. from academic research, with commercial investors. The reason is that the transaction costs of incubator schemes, technology transfer platforms and other *'bridging-mechanisms'* are unlikely to be fully covered by commercial interest alone.

- On the investor side, *business angels* are particularly important for the earliest stages in the deal flow of small-sized investments. To them, a similar argument for subsidies to cover (part of) the transaction costs for networking and mentoring activities applies. As informal investors, business angel networks typically operate at the local level, while interlinkages with institutional investors of private equity and venture capital could be fostered through national or even European initiatives.

- Business angel *syndicates*, which pool their investments or operate as 'side funds' of institutional investors, and venture capital funds should be equally eligible for eventual tax and regulatory advantages.

- The direct provision of publicly financed venture capital should exclusively address the gap in early stage financing, and particularly focus on the area of seed investments, where private venture capital is extremely reluctant to enter. To avoid the frequent move of public initiatives towards the same segments as the private sector, a clear policy rationale and regular evaluations of compliance are necessary. Otherwise, public funds might crowd out private capital and thus inhibit the development of a mature and self-supporting venture capital industry. Of particular relevance in this context are the recently adopted by the European Commission new Guidelines on State aid to promote Risk Capital (European Commission, 2006B).

- The Commission's Risk Capital Action Plan, adopted in 1998 and gradually implemented up to 2003, was launched with the objective of eliminating persistent regulatory and administrative barriers, at Community and national levels, which may impede the creation of a truly single market in the risk capital area (European Commission, 2003B). Building on this, the Commission (Commission, 2006C) has recently announced a number of actions it will take to improve access to finance and invited the Member States to join it in promoting finance for innovative SMEs. Taken together such policies should allow the tripling of early stage venture capital investments by 2013.

- As a resourceful fund of funds investor, the EIF (European Investment Fund) not only provides capital, but also uses its expertise and leverage to promote quality and professional standards

[69] In popular discussions, it is sometimes argued that venture capital might be (come) a private sector alternative to public sector subsidies for R&D. The present discussion has clearly shown that this cannot be the case, since both address two very distinct sources of under-investment in innovation.

[70] An interesting initiative to encourage science-industry interaction while addressing the two types of market failures (knowledge spillovers and capital market imperfections) in an appropriate fashion is the Small Business Innovation Development Act implemented in the US. The programme provides pre-competitive financing (i.e. grants) to take R&D from the proof of concept stage to prototype. Thereafter, private financing should take over (see Canton et al. (2005) for an overview of this and other initiatives to promote knowledge transfer between science and industry).

of investment practices in the funds it invests ('behavioural additionality'). Funds with a clear focus on seed and start-up financing should get preferential treatment.

– The European Community has initiated a number of actions to provide risk finance at European level. Examples are the Competitiveness and Innovation Programme (CIP) and the Risk Sharing Finance Facility (RSFF). Also, to Joint European Resources for Micro to Medium Enterprises (JEREMIE) programme provides a way to use structural funds to improve access to finance for small businesses (see European Commission, 2006).

As the regulatory environment differs substantially between European Member States, the following recommendations on the specific framework conditions for the finance of private equity and venture capital will be of varying relevance to different countries:

– Quantitative restrictions on institutional investors (e.g. pension funds and insurance companies) should reflect the 'prudent' investor rule as practised; for example, in the US (i.e. individual high-risk investments can become acceptable within a diversified portfolio).

– The establishment of European standards for the regulation and taxation of private equity funds might foster tax transparency and ease cross border flows. National corporate and tax laws should adopt best practices from the most developed markets, for instance in the US and the UK, which obviate the double taxation of returns at the level of funds and investors. The benefits of mobility of venture capital have been clearly pointed out in a recent expert group report (European Commission 2006D). A main conclusion was that cross-border investments would be far more significant if funds did not encounter substantial administrative burdens and restrictions into cross-border deals or capital raising.

Alternative to the public provision of equity funds, public loan or equity *guarantee measures* offer an insurance against the failure of particular investments. As they more immediately address the underlying risk of an investment as a principal source of the financing gap, its potential leverage on private investments is considerable. Loan guarantees are well established in most countries, but mostly designed as horizontal measures for SMEs with little discrimination for the degree of innovation (European Commission, 2003A). Equity guarantees are a more recent development and either address individual investments or an equity funds portfolio. They are particularly favoured by countries that try to entice investors into venture capital markets that are little developed. However, guarantee schemes are afflicted by two major shortcomings: (i) the danger of increasing moral hazard by raising the risk profile of an investment or reducing one's effort to avert failure; and (ii) the problem of taking on the risk of investments that would have been undertaken anyway (windfall gains). The following design principles help to mitigate them:

– First, public guarantees, even if intended as a subsidy, should always require a risk premium that has to be paid by the investor because the fee helps to discriminate against investments that do not really need it.

– Second, investors should be obliged to carry part of the risk (i.e. the guarantee covers less than 100%) in order to maintain a minimum of individual exposure to the consequences of failure.

5.4. Innovation financing measures in the National Reform Programmes

The integrated guidelines adopted by the Council for the period 2005-2008 invite member states to *increase and improve investment in R&D, in particular by private business* (guideline 7) and to *facilitate all forms of innovation* (guideline 8). Financing is addressed in guideline 7, more particularly, by the invitation to *develop and make better use of incentives to leverage private R&D* and in guideline 8 by the invitation to focus on *better access to domestic and international finance*. Broadly speaking, these policy recommendations address, respectively, the appropriability problems analysed in section 2 and to the capital market imperfections analysed in section 3.

Member states addressed these issues extensively, often – but not always – giving considerable detail as to the measures they plan to launch, either new or in order to reinforce existing schemes. All member states refer to measures targeting at least one of the main modes of innovation financing (grants, tax incentives and venture capital) with many covering all three of them (see Table 5.3). A review of the NRPs confirms the empirical trends identified in subsections 5.2.3 and 5.3.3 above.

Fiscal measures are indeed more preferred than direct grants when Member States announce new measures. Twelve members states announce measures in both grant and fiscal scheme areas while only Estonia ignores them both. In certain cases the grant schemes serve more general purposes than supporting private research and innovation, such as promoting new investment in general, the modernisation of enterprises or their technological upgrade. In other

cases, they are rather narrowly defined, for instance targeting only collaborative projects.

There is considerable variation as concerns the way fiscal incentives are applied with all possible instruments presented in section 5.2.5 above being used by at least one member state. Most new measures announce din this area are of a qualitative nature (reorganisation, simplification) while for tax concessions many countries announce reinforcement of existing schemes or studying the introduction of new ones. By looking at which member states do not use or plan to use tax incentives, there appears a clear differentiation between old and new member states. In the first group one finds only Germany and Finland while in the second belong Cyprus, Latvia, Estonia, the Slovak Republic and Slovenia. The generally lower corporate taxation rates applying in new member states probably explain this difference.

Venture capital funds exist almost everywhere and the vast majority of member states refer to those in their NRPs. Here again, variation in the design of the measures is wide: establishment of new funds (e.g. Czech Republic, France, Germany, Greece, Latvia, Lithuania, Estonia, Italy, Poland, Slovenia, Portugal), restructuration and reinforcement of existing ones (Finland, France, Hungary, Ireland, Italy, Spain, Sweden, UK), measures to improve the framework conditions for further development of venture capital funds (Austria, UK) or the removal of unfavourable bias in the tax system against venture capital funds (Belgium, Finland). The provision of early stage finance (seed capital and investment in start ups) is addressed specifically in Finland, Germany, Ireland, Latvia, the Netherlands, Estonia, Hungary, Poland, Portugal, Spain, Sweden and Slovenia. Six member states (Czech Republic, Estonia, France, Spain, Portugal and the UK) announce measures targeting specifically Business Angels. In addition, France refers to the set up of a new segment of Euronext (Alternext) to facilitate the funding of innovative SMEs.

Financing innovation through credit institutions enjoys much less attention in the NRPs. Although measures to facilitate the access of SMEs to credit markets are much more common, only Germany, Italy and Spain include in their NRPs measures targeting loans for research and innovation projects. This points to a possible gap in policies supporting innovation financing since, as seen in section 5.3.2 above, debt remains a channel that many entrepreneurs prefer over equity.

In spite of the existence of cross-border venture capital flows as documented in section 5.3.3 above, it is surprising that only Finland refers in its NRP to the need to facilitate foreign venture capital inflows. This points to the existence of another possible policy gap, i.e. facilitating further the mobility of venture capital in Europe.

Finally, if the diversity of instruments is justified by the diversity of local situations, the complexity of support schemes clearly can be a hindering factor for enterprises seeking support, especially for new and small ones. Many member states announce the overhaul of their support schemes and the restructuration and modernisation of their venture capital industry. Others establish-or plan to establish- new funds and institutions, which will be added to existing ones. In many cases there seems to be a need for simpler schemes and more accessible instruments, as well as for flanking measures to raise awareness and disseminate information to possible recipients. On the other hand, diversity may be a source of peer policy learning and exchange of good practices, as has been the case in the area of early stage equity finance (Commission 2005).

5.5. Summary and conclusions

Innovation financing is an area where public intervention is justified by the existence of externalities that affect incentives to innovate and financial market imperfections that affect the channelling of resources to innovative projects. Public intervention typically uses instruments from one or more of the following types of measures: direct grants, fiscal incentives and measures to strengthen the provision off venture capital.

Over the last years, there has been a shift in favour of fiscal incentives and against direct funding, in terms of policy development. The National reform Programmes that member states issued in October 2005 confirm this trend. They also reflect the growing importance for public authorities of having a robust venture capital industry, by reporting ongoing; stepped up or new actions in almost all member states. A notable group of countries announce actions also for business angels. This said, little attention is paid, at least in the NRPs, to facilitating the mobility of venture capital. The same applies to debt financing of innovative projects, with only a small number of member states announcing measures to this respect.

The broad variety of schemes and instruments, as well as the frequently stated intention to overhaul and restructure them indicate that a lot of experimentation is going on. There is clearly scope for mutual learning and exchange of best practice, which would be much easier if evaluations of existing measures were more frequent, more systematic and more comparable. Also, sometimes a variety of instruments exists within national borders, mak-

Table 5.3: Innovation Finance Measures in the 2005 National Reform Programmes

Country	Grants	Tax incentives	Venture Capital	Other
AT	Harmonisation of subsidy guidelines, consolidation of programmes, co-ordination of instruments	Tax concessions for contract research by SMEs. Increased transparency and traceability of tax incentives.	Improvement of the framework conditions for venture-capital markets.	
BE	Not mentioned	Wage tax exemption for researchers.	Changes in corporate taxation so as to attenuate discrimination against venture capital and equity financing.	
CY	Funding of business-science collaborative projects. Grants for technological upgrading of SMEs.	Not mentioned	Not mentioned	
CZ	Grants to support business R&D and R&D collaboration of enterprises with public sector research institutions.	100 % reduction of R&D projects costs from the tax base.	In preparation, a risk capital fund with State participation targeting SMEs, spin-offs and start ups. Planned overhaul of framework conditions for Business Angels Networks.	
DK	Very limited.	150% deductions for R&D connected to public research institutions. Immediate deduction of research expenditures. Plans to grant three years of tax relief to innovative growth entrepreneurs from the time their enterprise starts generating a profit and they become tax liable.	Not mentioned	
DE	Many schemes aimed at SMEs, clusters and big .projects.	Not mentioned	New funding structure by the Federal Government to provide venture-capital funding for young technology companies. Set up of the High Tech Start-up Fund.	Low-interest loans to SMEs to implement innovative projects. Big projects (Galileo, electronic health card, fuel-cell technology, transrapid maglev track

Country	Grants	Tax incentives	Venture Capital	Other
EE	Not mentioned	Not mentioned	Development of a network of local business angels. Creation of the Estonian Development Fund.	
ES	Measures to reduce bureaucratic barriers and speed up access to subsidies.	Bonuses for social security contributions for research personnel.	Modernisation of Risk Capital legislation, continuation of fiscal benefits. Development of a National Network of Business Angels. Creation of the Capital-risk Fund of Funds to promote investment in projects at the seed and start-up stage.	Enlargement of the line of participative loans to innovative, technology-based companies. Systematic evaluation.
EL	Grants for investment and operational costs of collaborative research projects.	Tax relief: 100% deduction of R&D expenditure from gross income and further 50% deduction from net income.	Not mentioned	
FI	Main instrument used. Public funds made available to increase annually by 5-7% until 2010. Projects financed on a competitive basis.	There are no current plans to introduce tax concessions for investments in research and development.	Reform of venture capital funding for early stage business. Tax treatment of foreign venture capital investments revised. Operational and financial conditions are being created for the start-up of venture capital funds in service industries. New government investments in risk capital funds.	
FR	Funds made available through a reorganised system of agencies.	Tax (corporate, local, property and payroll) exemptions for young innovative business. Reinforcement of research tax credit scheme.	Creation of a Business Angel status. Modernisation of capital investment vehicles (venture capital mutual funds, venture capital companies, mutual funds for innovation, and local investment funds). Set-up of the new Alternext stock exchange.	
HU	Not mentioned	200% tax allowance for R&D	Modification of the law on venture capital. Increased presence of venture and seed capital fund delivered by the state.	

Country	Grants	Tax incentives	Venture Capital	Other
IE	Variety of grants linked to various stages and aspects of innovation.	Since 2004.	The State has actively engaged to develop the venture capital sector for higher risk investments and takes equity stakes in technology start-ups and through the early stage growth of companies. Revision of the Seed and Venture Capital Fund Scheme.	
IT	Various schemes, mainly targeting specific technologies.	Corporate income tax deductions, tax breaks for researchers returning to Italy, abolition of Italian regional production tax on innovation costs, limitation of IRPEF to 10% of income. Grant of tax breaks for labour costs of staff involved in R&D.	Refinancing and restructuration of the Technological Innovation Fund, and setting up a Fund for investment in risk capital of high-tech enterprises.	Reduced rate loans granted by the EIB in support of large-scale R&D projects.
LV	Support for the development of new products and technologies. Grants for concept and prototype developments of new products.	Not mentioned	Planned creation of risk capital funds for SMEs. Provision of seed capital through incubators.	
LT	Not mentioned	Not mentioned	Establishing venture capital funds is under consideration.	
LU	Better coordination of existing schemes.	Review of fiscal regime in favour of R&D investments and young innovative firms.	Not mentioned	
MT	Not mentioned	Progressive enhancement of existing tax incentives for r R&D.	Not mentioned	Introduction, of a loan guarantee scheme for start ups, particularly innovative ones.
NL	Target-oriented subsidies, innovation vouchers.	Reinforcement of the tax credit scheme for R&D.	Improved access to venture capital for and emerging companies.	
PL	Introduced by Act of 29 July 2005.	Introduced by Act of 29 July 2005.	Establishment of a National Capital Fund as a fund of venture capital funds.	Technological loans introduced by Act of 29 July 2005.

Country	Grants	Tax incentives	Venture Capital	Other
PT	Variety of schemes with different targets (innovative activities, modernisation, employment of researchers etc)	Reintroduction of tax benefits for business R&D.	Restructuration of the risk capital system in order to support launching of innovative projects. Drafting of a favourable legal framework for business angels and non-resident investors.	Subsidised loans as public support to research in companies.
SK	Not mentioned but intention to design a new comprehensive support scheme.	Not mentioned but intention to design a new comprehensive support scheme.	Consideration of creating a program of state participation in investments to private risk funds in order to lower risks. Modalities yet to be decided	
SI	Main instrument in use.	Planned: change tax policy and the system of financing research activity to encourage cooperation between research and the business sector, the creation of spin-offs and the employment of researchers in the business sector.	Reinforcement of the Slovenian Enterprise Fund. Support for the operation of risk capital funds and provision of start-up and seed capital.	
SE	Not mentioned	New tax credits for research in SMEs.	Reorganisation and reform of the public providers of risk capital to strengthen and simplify access to early stage finance.	
UK	Not mentioned	R&D tax credits	Government intends to establish a new public company to deliver capital funds and loan guarantees. Self-certification for business angels.	

Note: Please note that this table is not presenting an inventory of existing measures but only of those mentioned in the NRPs.

Source: DG Enterprise

ing necessary more systematic efforts to inform but also to make existing instruments simpler and more accessible.

In conclusion, it would appear that more efforts should be directed towards facilitating the provision of cross-border venture capital and the debt financing of innovative projects. The provision of early stage risk capital is being addressed in many countries; however, this clearly remains an area where more should be done. Also, evaluation and simplification of existing schemes should be carried out more systematically and mutual policy learning should continue.

The measures at Community and Member State level referred to in sections 5.3.4 and 5.4 above bear testimony to the efforts made to address the market failures discussed earlier in the chapter, i.e. the existence of positive externalities in innovative activities and of specific barriers for young and small enterprises to finance them. It must be clear thought that if these efforts are necessary, they are certainly not sufficient for achieving the more general objective of transforming the European economy into a more dynamic and knowledge-based one. Apart from setting up comprehensive research, development and innovation policies, this will take implementing also those reforms that will tone up economic activity in general, particularly in the areas of business environment, competition, education and labour markets.

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Chapter 6:
The "Lead Markets" approach to innovation policy

6.1. Introduction

The early adoption of a specific innovation by the market seems to be a necessary condition for international competitiveness. A country that lags behind scientifically can often not only catch up but also get ahead of the innovator when the domestic market is more willing to adopt a new technology. It is not inventions but the ability to turn inventions into commercially successful products that is a main determinant of the international technology gap between the USA and Europe (OECD 1968, 17).[71]

Time has shown, however, that even this conclusion might not be the whole story. Many countries adopted innovations or new technologies for the first time worldwide without any resultant competitive advantage. If other countries do not follow using the same innovation design, or technological trajectory, few exports result. In fact most innovations are still confined to local markets. Countries that are first to adopt an internationally successful innovation are often denoted as *lead markets* in order to signify that these countries do not just happen to be the first in line, but that they lead the international diffusion of innovation by triggering adoption of the new technology in other countries.

Up to now, the term 'lead markets' appears in the literature with varying meanings. In some cases, a lead market denotes the country where the innovation was first developed (e.g. Yip 1992, 43). Within multinational firms, a lead market sometimes refers to the country in which the subsidiary takes over responsibility as global coordinator of global marketing activities (Raffée and Kreutzer 1989, 50) or where a new product is first introduced in the fashion of a test market approach (Schröder 1996, 183). Most authors, however, have the most *basic definition of lead markets* in common: the market where an innovation is first widely used that later becomes successful internationally regardless of where that innovation was invented. The latter definition will also be used in this chapter.

Recently, the notion of lead markets has been increasingly used in innovation policy both at the EU level (see e.g. the Aho report, Aho et al. 2006) and in some Member States (for Germany see e.g. the workshop of the German Federal Ministry of Economics and Technology, BMWi 2002). There are at least two motivations behind this growing attention.

First, putting emphasis on lead markets promises to bridge the gap between the generation of new technologies and market success of innovations. In particular, the concept may seem to offer some new approaches to link the results of basic scientific research with the market-oriented application of new technology, by identifying factors that would make innovation policies more anticipatory of global trends.

Secondly, being a lead market may generate a number of competitive advantages for the country (see Box 6.1): firms may profit from increasing exports, foreign direct investment may be attracted, further research may be stimulated, or productivity gains may be realised earlier than in other countries. Ultimately, this may result in increasing employment and wealth.

In the remaining part of this chapter, three questions will be discussed:

– How has the concept of lead markets evolved, how may it be demarcated vis-à-vis other established concepts such as lead users and what are the constituting factors of a lead market?

– Is there a case for policy intervention in favour of lead markets i.e. is there a market failure and how may government intervention be justified?

[71] While and invention refers to a new idea, concept, design, etc., an innovation is an invention that has been put into practice.

Box 6.1: Advantages of being a Lead Market

Being a lead market for an innovation can create tremendous advantages for the country in question. In almost all successful cases documented, local companies, both locally-owned and local affiliates of multinational firms, have become major players in the world market.

Often, firms from lead markets were initially not leaders in the respective technology but acquired the technological knowledge from abroad in the wake of the domestic market dynamics. High quality requirements and, essentially, a close interaction between market and production ensure that large manufacturing capabilities are kept domestically. As a result, exports from lead markets are substantial, leading in some cases to very high export shares. Lead markets are frequently stable over a long time period covering several generations of products and innovation steps or even technologies (cellular phones in the Nordic countries, cameras in Japan, computers in the US, wind energy in Denmark).

Potential advantages of lead markets can be summarised as follows:

– An initial technological lag is closed rapidly and even turned into a technological lead based on superior productivity or market intelligence.

– Firms in the lead market become global market leaders.

– Exports are substantial.

– International competitiveness is often sustainable over decades as successive generations of products are adopted earlier.

– Lead markets are often characterised by a high degree of competition and lower prices for users.

– Lead markets regulatory keep larger manufacturing capacities at home in order to guarantee superior quality and allow for quick responses to varying local markets trends.

– Lead markets are attractive as an investment location for multinational firms which have to become insiders in the lead market. In particular, the influx of marketing and R&D functions ensure a large proportion of high skilled jobs.

– Through which mechanisms could governments' influence the creation of lead markets, and which pitfalls and drawbacks may such a policy approach involve?

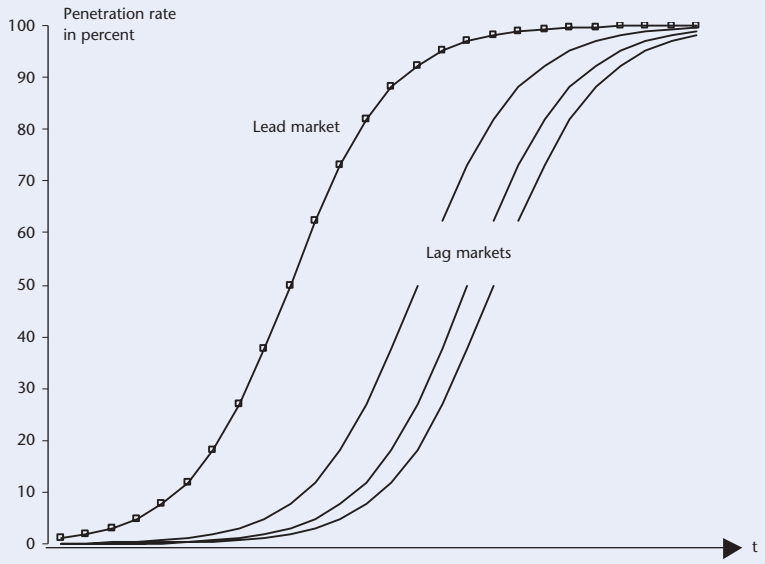
6.2. The Concept of Lead Markets

6.2.1. Market diffusion of innovations

In order to set the stage for our discussion of lead markets we first want to look at the process of market acceptance or market diffusion of an innovation. Every successful innovation introduced into the market needs some to time to reach saturation, i.e. until all potential users have adopted it. First, there is regularly the introduction phase in which only a small fraction of the market adopts the innovation and in which it is not clear to market participants whether the innovation is a success or a failure. A successful innovation then reaches a take-off point where the growth rate of sales increases dramatically and the number of users grows rapidly.[72] The time between market introduction and take-off varies, but usually spans several years (Tellis, Stremersch and Yin 2003; Gort and Klepper 1982). Most diffusion curves of innovations follow an S-shaped curve, for which there are various mathematical specifications (for an overview see Mahajan and Bass 1990). When we compare the diffusion curves of one specific innovation in several countries, a more or less distinct time lag between the curves can regularly be observed. Graph 6.1 shows a stylised depiction of this lead-lag pattern. In reality the curves often show different shapes but this generally does not affect the lag in diffusion between countries (see Graph 6.2 for the diffusion of the internet). The lead market is the country where the diffu-

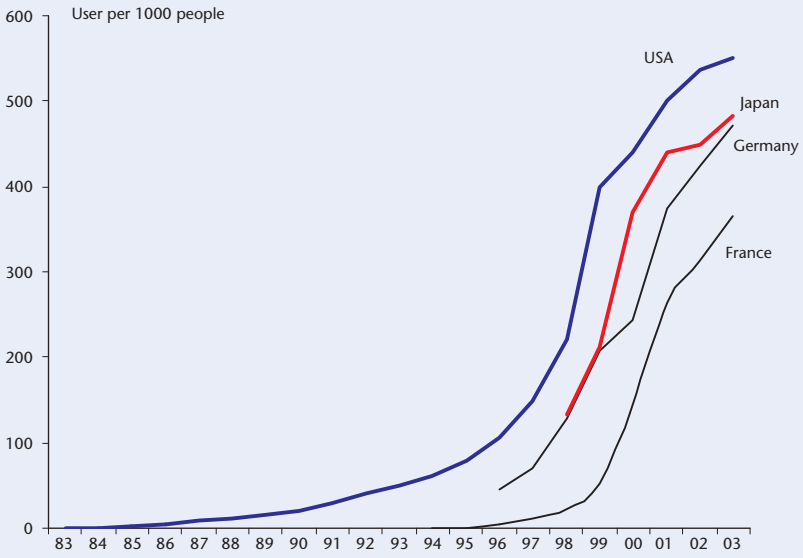
[72] Rogers (1995) locates the take-off phase between 10-25% of all potential adopters. Ever since Griliches (1957), it has been commonplace to calculate the diffusion lag of a country as the number of years from the time when an innovation is first adopted to the point when it reaches a 10% penetration level in the country. Golder and Tellis (1997) in contrast define the take-off when the sales growth rate reaches a certain threshold.

Graph 6.1: An international diffusion pattern of an innovation design



Source: ZEW.

Graph 6.2: Diffusion of Internet in selected countries



Source: ITU.

sion process of an innovation first took off (Kalish, Mahajan and Muller 1995; Kotabe and Helsen 1998). All other countries are lag markets.

This lead-lag market pattern or the lead market issue (without necessarily using this term) is discussed in different research fields: in marketing, in innovation economics, in R&D management and in international business. We identify four major strands of literature on lead markets:[73]

(i) Descriptive case studies on globally successful innovations,

[73] The term lead market is also sometimes used in international finance to denote a country that leads currency or equity market trends. This field, however, is not subject of this summary.

(ii) Statistical analyses of the international diffusion of innovations from a marketing perspective,

(iii) Studies on the market-linkage of R&D, and

(iv) Analyses of competing technologies and locational advantages.

These four approaches will be reviewed next.

6.2.2. Case studies on globally successful innovations

The question of why some countries have adopted an innovation earlier than other countries has been analysed in many in-depth case studies since the 1960s. Often, the aim of such studies was to identify successful policy instruments for the acceleration of technology diffusion or to pinpoint weaknesses in the national innovation system. Most case studies explore the adoption of process technologies from country to country. One of the most studied technologies is the oxygen steel making process (Maddala and Knight 1967; Poznanski 1983; Lynn 1982; Papajohn 1991). This case attracted much attention because the quick adoption of this new process in Japan was the foundation for the meteoric ascent of Japan as the leading steel making nation.

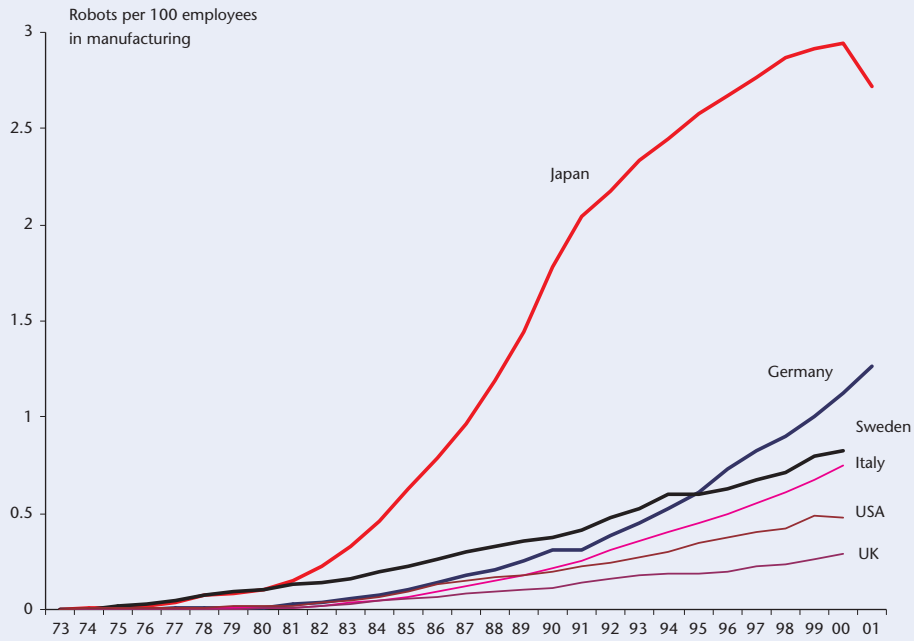
The employment of robots is another case where Japan has succeeded in creation a lead market (Flamm 1986; Mansfield 1989; see Graph 6.3). The US has been leading the way in one of the most influential technologies of 20th century, semiconductors, which Tilton (1971) examined in an important in-depth case study. However, the conclusions of these studies are highly situational, and it is almost impossible to draw general conclusions from single case studies.

6.2.3. Marketing studies on the international diffusion of innovations

Marketing scholars have attempted to find statistically significant explanatory variables for the international diffusion of innovations for a variety of product categories, mainly household appliances (Takeda and Jain 1991; Gatignon, Eliashberg and Robertson 1989; Kumar, Ganesh and Echambadi 1998; Tellis, Stremersch and Yin 2003). Such studies constitute a second strand of literature which attempts to explain international differences in the willingness of countries to adopt an innovation.

In the most comprehensive study covering 117 innovation diffusion processes in European countries, Tellis, Stremersch and Yin (2003) find that countries are characterised by different average lag times between the introduction of an innovation and take-off. For instance, the lag times in the Nordic countries, Switzerland and Germany are on average several years shorter than those in Southern Europe. Economic wealth is the most common significant explanatory variable for country lag-times; an argument that goes back to Vernon's international product life cycle.

Graph 6.3: International adoption of robots in manufacturing



Source: ITU.

However, a lack of comparable data has led this strand of literature to focus on cultural dimensions. Among the cultural dimensions a low degree of uncertainty avoidance (Lynn and Gelb 1996; Steenkamp, ter Hofstede and Wedel 1999; Gatignon, Eliashberg and Robertson 1989; Yeniyurt and Townsend 2003) and a strong need of achievement (Tellis, Stremersch and Yin 2003) are consistently found to be significantly associated with earlier adoption. Other factors that positively correlate with an earlier adoption of innovations are educational attainment and the media intensity.

6.2.4. Studies on the market-linkage of R&D

The third major strand of literature looks less at the adoption process and more at the generation of (radical) innovations (e.g. Jeannet 1986; Johannssen and Roehl 1994). In this perspective, lead markets are frontrunners of technical progress because they offer better opportunities to utilise new technologies. In lead markets, technical competencies meet with a clear need for new technological solutions (a 'need lead', see Gerybadze 1998), i.e. a particular technology derives a higher benefit for users than in other markets. For many new technologies, technology cycles and need cycles often do not run parallel. A technology breakthrough supposedly happens if both come together in one location. Liquid crystal displays may serve as an example in this respect (see Box 6.2).

The new argument here is that market conditions in the lead market in a particular industry entice local companies to adopt the new technology. The importance of this local interaction between customers and innovators has been stressed since the 1980s most notably by Lundvall (1988), Fagerberg (1992) and the proponents of 'national systems of innovation' (see Nelson 1993). The market interaction hypothesis re-emerged in studies in the 1990s that examined motives and strategies of international R&D activities of multinational firms (Gerybadze, Meyer-Krahmer and Reger 1997). At that time more and more foreign R&D facilities were located in science parks and R&D-intensive industry agglomerations as a form of technology sourcing (DeMeyer 1993; Neven and Siotis 1996; Anand and Kogut 1997; Perrino and Tipping 1990). However, it became clear that the region that is scientifically most advanced could easily lose its advantage if the regional market is not receptive enough.

6.2.5. Competing technologies and locational advantages

The fourth conceptual approach to lead markets emerged from studies on the management of multinational firms in a culturally and socio-economically diverse world market. Its main contribution is the introduction of the concept of competing technologies. For virtually all problems there are several technical solutions, innovations, and technologies on offer. Frequently, different countries prefer different technical solutions, depending on their specific market conditions. All these innovations or "innovation designs" compete on the world market. Multinational firms are the first who perceive regionally vary-

Box 6.2: Liquid Crystal Displays (LCD)

Recently, a worldwide frenzy has broken out to substitute the century old cathode ray tube in TV sets with flat screen technology. Japanese and Korean electronics firms are the main beneficiaries of this boom. Yet, the technology was originally pioneered by US and European universities as well as electronics and chemical companies which started an experimental use of liquid crystals and plasma for displays as early as the 1960s. Their market prospects remained bleak, and the technological lead moved to Japanese companies which perceived a much more promising market (Beise 2006; Kawamoto 2002; Gerybadze, Meyer-Krahmer and Reger 1997). There was a need for more sophisticated displays that could exhibit Japanese characters. This pushed the research towards larger displays resulting in active matrix technology. In Japan in the 1980s, LCDs were mass marketed in personal digital assistants (PDAs), video cameras and pocket TV sets. In contrast, a lack of civilian applications forced Western companies to resort to the military as a customer. Yet, military applications required such high quality standards and ruggedness that the LCD was quickly found to be inappropriate.

In the 1990s, the market shifted again. Laptops became more and more popular and Korean firms successfully jumped on this bandwagon. A European company set out to become the number one LCD screen producer in a Korean joint venture. By the end of the 1990s, price reductions of LCDs enabled their use in TV sets. As more than 75% of world sales of flat-screen TV sets went to the Japanese market in the years of the new millennium, Japanese manufacturers regained the lead in large LCD displays just before the market took off in the US and Europe.

Box 6.3: Lead markets versus lead users, pilot customers and pioneers

Lead markets are different from lead users, pilot customers or pioneers. While the concept of lead markets implies that an innovation has gained the affection of a whole market, denoted by a high or rapidly increasing penetration rate, the other concepts focus on the actors that are the first to generate, adopt or use a particular innovation. Usually, pioneers are denoted as the companies that first introduce an innovation into the market. Lead users and pilot customers (or launch customers) are the first users of an innovation.

A model that is often associated with the lead market approach is the lead user concept of Eric von Hippel (1986). In some publications the terms lead markets and lead users are used as equivalents. There are two reasons for this. One is that lead users are sometimes erroneously confused with launch customers, that is, the first customers for an innovation. The other reason is to underline the amalgamation of innovators and users in lead markets. In its original form, however, the term lead users refers to companies that innovate in order to use the innovations themselves instead of selling them, even though these innovations can be of benefit to other companies. The original focus of lead users is thus on their role as innovators not as launch customers for innovations. In contrast, the focus of lead markets is on the interaction between developers of innovations and users of innovations located in the same region.

Pilot customers are customers selected by companies that launch an innovation to be the first users of that innovation. They often receive special incentives such as heavily reduced price tags in order to stimulate the adoption of a new product. Pilot customers have to be followed by other market participants in order to constitute a lead market. For instance, British Airways and Air France were pilot customers of the supersonic jet airliner, the Concord. But since no other commercial airline adopted the Concord, there was no lead market.

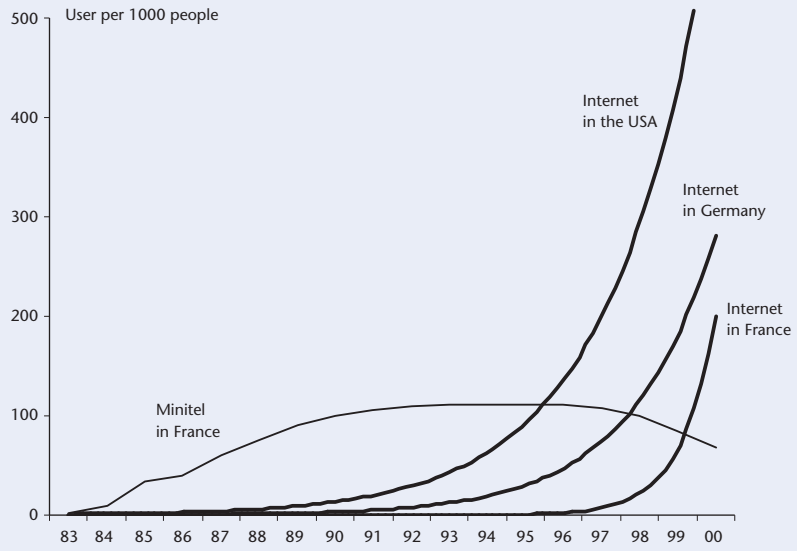
ing demand trends and are continuously struggling to reap global economies of scale by developing globally standardised products and processes. In their seminal work on multinational firms, Bartlett and Ghoshal (1990) envision the 'transnational' firm that is able to tap into the innovation opportunities in foreign markets and commercialise these local innovations worldwide. They cannot chase after every local innovation and thus have to carefully assess which innovations have the potential to become global successes. Bartlett and Ghoshal (1990) use the term lead markets in the context of the ability of these markets to stimulate global innovations. Lead markets are "the markets that provide the stimuli for most global products and processes of a multinational company" (Bartlett and Ghoshal 1990, 243). More particularly, lead markets exist, they suggest, because "local innovations in such markets become useful elsewhere as the environmental characteristics that stimulated such innovations diffuse to other locations" (Bartlett and Ghoshal 1990, 243).

This implies that early adoption of a new technology does not suffice as a competitive advantage. In some cases countries adopt a very innovative technology early on but later lose out to a rivalling technology that was preferred and adopted worldwide and gained global dominance. One example is the success and subsequent decline of the commercial online service Minitel in France (Graph 6.4). Although the service was adopted earlier and more widely than the Internet in France, it lost the struggle to become the globally dominant design of a network protocol to the latter.

The anticipation of a global environment by a local market has been suggested by Porter (1990) as well. In his seminal work on the competitive advantage of nations, Porter (1990) identified the demand side as an important cornerstone of the competitive advantage of a country besides supply factors. Porter suggests the following main attributes of home demand advantage: the composition, the size and growth of home demand, and the mechanism by which a nation's domestic preferences are transmitted to foreign markets. He identifies situations where countries favour rather idiosyncratic innovations that cannot be successfully commercialised internationally. Porter distinguishes between idiosyncratic demand and an "anticipatory" demand. The anticipatory demand gives a forecast of what will be needed worldwide in the future.

A new twist to the lead market model is provided by Lehrer and Schlegelmilch (2006) who suggests that two different markets play a role in the emergence of globally successful innovations: the market that demands the highest performance, (third strand of literature), and the market that leads the adoption of

Graph 6.4: Minitel and Internet penetration rates in France, the US and Germany



Source: ITU, Beise (2001).

the innovation (similar to the marketing approach). In a case study on business software, they observe that over time the actual lead market shifts from the market which demands high performance to the market that is leading the widespread adoption.

6.2.6. Lead market factors

Based on Porter's characterisation of idiosyncratic and anticipatory market conditions, Beise (2004) suggests a series of country-specific conditions that raise the chances of an international success of local innovations in the competition among different innovation specifications. These are grouped into five lead market factors:

- **Demand anticipation**: A country stays at the forefront of a global trend, leading the development of innovations that correspond to the trend.
- **Price advantage**: Domestic innovation designs become cheaper relative to foreign innovations.
- **Transfer**: Mobile customers, multinational firms or network effects increase demand for domestic innovations abroad.
- **Export orientation**: The market context enables domestic manufacturers to incorporate more foreign market preferences during the development of innovations.
- **Competition**: A high degree of domestic competition reveals latent preferences and discovers superior designs and new applications.

By *demand anticipation* we have in mind that users at the forefront of a global trend experience the changes earlier. The US market played the role of lead market for so long simply because per capita income was much higher than in any other country. As incomes increased elsewhere, American products became popular worldwide.

Many global innovation success stories are associated with international *price trends*. When the price of a good (or a factor that is used to produce a good) falls worldwide, this product might become successful internationally. This price reduction effect is the main argument of Levitt's (1983) famous 'globalisation of markets' hypothesis. He asserts that global producers 'attract customers who previously held local preferences and now capitulate to the attractions of lesser prices'. The price of one design decreases faster than that of the other when the lead market is larger in an early stage of the product life cycle, allowing manufacturers to exploit larger economies of scale. When economies of scale and learning effects are large, countries with a large internal market for a specific design have a lead market advantage. Scherer (1992) notes that when the fax machine was a market success in Japan, Japanese manufacturers were able to exploit economies of scale and lower the price to a level at which it became successful in Western countries.

In addition, some countries are characterised by their ability to influence or increase the incentives in other countries to adopt the same innovation. This can be denoted as a *transfer advantage*.

A country is more likely to internationalise its local innovation designs if local market conditions increase the *exportability* of innovation designs. Three factors can deliver this export advantage: the similarity of local market conditions to foreign market conditions, domestic demand that is sensitive to the problems and needs of foreign countries, and local participants that put pressure on companies to develop exportable products.

Last but not least, a high degree of *competition* raises the chances of local innovations becoming successful abroad as well (Nelson 1993; Porter 1990). In a country with a monopolistic producer or user, fewer alternative designs (or only one) are offered than in a country where several companies compete. Competitive markets are, therefore, more likely to discover latent needs and innovation designs preferred by consumers.

6.3. Lead Markets and Public Intervention

The competitive advantages that arise from being a lead market have raised the interest of policy makers who wish to leverage such lead market advantages to increase the competitiveness of their economy. Though there is no 'lead market policy' as such in any country, public policies have consistently attempted to link the development of new technologies with an early and broad adoption of these technologies. Many of these policies have been influenced directly or indirectly by the literature reviewed above. This is particularly true for diffusion-oriented technology policy that aims at accelerating the use of new production technologies, for policies that attempt to foster user-producer interaction in the development and diffusion of new technologies, such as cluster approaches and R&D co-operation schemes, or for mission-oriented technology policies that seek to create specific technologies and stimulate their rapid use in domestic markets. Many of these policies have explicit or implicit links to the concept of lead markets, and most of them apply various demand-oriented policy instruments (i.e. target users of technologies instead of producers).

This section will discuss the potential role of public policy in the development of lead markets, the set of policy instruments, as well as problems possibly arising from policy interventions.

6.3.1. Potential role for policy intervention

Traditionally, governments see their role in strengthening the stream of innovations generated in a country by supporting the creation of new knowledge and new technologies. This type of public intervention is well-founded on traditional market failure arguments. Under-investment in R&D occurs due to the public good character of knowledge (which is especially true for basic research, see Nelson 1959) and the positive externalities of new technologies due to knowledge spillovers (which also applies to applied research, see Arrow 1962). Moreover, information asymmetries in financial markets may lead to credit rationing for research projects. This provides further rationale for policy intervention to support innovation activities (see Stiglitz and Weiss 1981; Goodacre and Tonks 1995; also see chapter 5).

At first glance, the literature seems to be supportive to the idea of government intervention to create lead markets. Even Porter (1990) concludes that public procurement can play an important role in helping a technology become successful. The fact that lag markets later adopt global innovations at identical or even higher penetration levels than the lead markets is sometimes thought to imply that lag markets are burdened by an initial barrier that, once overcome, leads to a vibrant, self-sustainable market. Demand creation is then seen as policy to overcome this initial barrier and thus change the odds of a country undergoing a transition from lag to lead market.

However, the lead-lag market pattern is not specifically associated with market failure because failure to anticipate global trends does not, in itself, constitute a market failure. Case studies suggest that being a lag market, or generating idiosyncratic innovations can be reasonably induced by local market idiosyncrasies which are difficult to change. Well-known cases in point are the delay of the US steel industry to adopt the oxygen process in the 1950s and the failure of the French online service Minitel to become internationally successful. What certainly holds true is that markets in new technology are burdened by information asymmetries and uncertainty. But these problems affect all countries and generally do not explain the lead-lag market patterns.

The key issue here is whether policies in favour of supporting the emergence of lead markets address market failures or whether they are primarily guided by the policy goal to become a lead market in a certain technology, irrespective of any market imperfection. In particular, one has to ask whether being a lag market or adopting idiosyncratic innovations is associated with any type of malfunctioning of markets.

Whereas the traditional market failures and the corresponding reasons for government intervention do not apply to lead markets, lagging behind in technology adoption is typically considered to be undesirable. It therefore remains appropriate to analyse

how policymakers can contribute to developing framework conditions that stimulate the emergence of lead markets.

6.3.2. Potential instruments to stimulate the emergence of a lead market

In addition to a mix of policies aimed at encouraging innovation (which shall not be further discussed here; see also chapter 5), policies conducive to creating a lead market are often closely inter-linked with so-called demand-oriented innovation policies. These attempt to "induce innovations and/or speed up diffusion of innovations through increasing the demand for innovations, defining new functional requirement[s] for products and services or better articulating demand" (Edler 2006, 2). Instruments that are typically used by these policies are:

- Subsidies for manufacturers of innovations in order to reduce the price of a new product (and thus increase demand for it);
- Subsidies for users that lower their investment costs when adopting an innovation (e.g. tax credits);
- Public procurement, i.e. the demand of public authorities and utilities for newly developed innovative solutions that are ready for take-up (commercial procurement) or demand for not yet commercially available solutions that need to be developed (pre-commercial procurement) (Edler, Hommen, Papadokou, Rigby, Rolfstam, Tsipouri and Ruhland 2006; Geroski 1990; Edquist, Hommen and Tsipouri 2000);
- Regulation that favours a particular technical solution (for instance, the gas emission laws for automobile in the clean air act in the US were designed so that only vehicles with catalytic converters could match them, excluding all other technical solutions favoured initially in Europe);
- Setting standards for those parts of an innovative area that govern compatibility such as interfaces and protocols (Grindley 1995).

Building up on this set of demand-side innovation policy tools, lead market-relevant instruments may be summarised as follows (see Beise, Cleff, Rammer and Heneric 2002, 116ff):

- Demand-creating instruments, such as user subsidies, pre-commercial and commercial innovative public procurement that stimulate and aggregate the demand for innovative solutions, and regulations that favour the use of particular technologies;
- Demand-enabling policies, such as regulation that is open to new technical solutions, acceptance of new technologies by governmental agencies (e.g. electronic signature);
- Fast-follower approach to existing lead markets: innovations that are preferred in the lead market can even be adopted earlier (e.g. the catalytic converter in Japan).

Empirical evidence on the effectiveness of public policies that attempt to create lead markets or, more generally, on the relationship between national demand-side policies and the international success of innovations, is scarce. The empirical studies on the diffusion of innovations surveyed above do not include policy instruments, let alone compare different tools. Prominent examples that are given as proof for a successful demand-creating or articulation policy such as the Airbus or the European cellular mobile phone system are mostly not as persuasive as one might think. Indeed, the demand preferences in these examples were formed by profit-seeking companies, not by governments. For instance, the European GSM system was decisively shaped by the Nordic telecom companies that were already at that time exposed to domestic competition, whereas the politically motivated Franco-German proposal was not retained in the technical rounds of the standardisation committee (Beise 2001). Even the success of airbus was accredited to its design, which responded to a specific market demand in Europe that Boeing or McDonald-Douglas did not cover, and not necessarily to the political support for this company (Porter 1990). In other examples, through the use of pre-commercial procurement in the defence sector, public authorities have been successful in fostering the emergence of new lead markets (e.g. for GPS, the Internet). Experiences with demand-side policy often relate to personal safety, e.g. airbags (Mannering and Winston 1995), and environmental innovations such as unleaded gasoline (Stoneman and Battisti 1998), catalytic converters for motor vehicles (Jacob, Beise, Blazejczak, Edler, Haum, Jänicke, Löw, Petschow and Rennings 2005) and alternative energy generation (Beise and Rennings 2004).

6.3.3. Limitations and potential risks of lead market oriented policies

As we have discussed earlier, the notion of lead markets does not carry obvious implications for policy. Nonetheless, policy markers may want to develop framework conditions conducive to the emergence of lead markets. Direct government interventions might improve a certain attribute of local demand but such interventions are at the same time prone to negatively affect other factors that constitute a

lead market. For example, favouring a preferred technology hampers competition among innovation designs. Also, the dedication of a market to cost-cutting loosens when public subsidies are available. Finally, anticipation of global trends is hampered by a focus on the domestic market. The possible counterproductive effects of government intervention should be taken into account when considering the desirability of lead market policies. We will next discuss these limitations and potential risks in more detail.

6.3.3.1. Competition in product markets

Lack of standardisation can hold back the adoption of innovations. Setting of a standard in one market can reduce uncertainty in this market thus leading to early adoption. If, however, the government intervenes in order to speed up the standardisation process, the lead market role is weakened. One of the properties of the lead market is internal competition. Rivalry and the selection process of the market facilitate an economic solution that is more likely to be chosen worldwide. The reason for the success of the European cellular phone system GSM was not that there were no alternatives. The European cellular phone standard was shaped and selected by telecom companies that faced fierce competition in their home markets (Beise 2001). The selection of a particular innovation design or a technology by the government or other non-competitive agencies is normally a poor replacement for a competitive market solution. A lead market is characterised by smart, technically sophisticated, and profit-oriented users who are in fierce competition with each other.

In fact, government policies, frequently distort markets (Christensen 1997, 192). The risk of "backing the wrong horse" (Cowan 1991), that is, an innovation that other countries eventually shun, is considerable. In other countries, the choice of technology is made by markets and even if factors such as technical uncertainty are lowered as a result of government intervention, following a state-guided choice might not be enough to ensure that a market is competitive. For instance, the Chinese authorities' decision to build a high speed train connection is likely to be irrelevant in countries where the railways are privatised, because an investment decision of a private operator is based on profitability, not technological feasibility. Economic failure of a pilot project is likely to have a negative effect on the global appeal of a technology. As a consequence, it is recommended to create a functioning market wherever possible and let the market choose profitable solutions which are most likely to be followed by other markets.

6.3.3.2. Competition among innovation designs

Public intervention becomes even more problematic in the presence of internationally competing technologies. Public support programs for domestic industries might do more harm than good if they support an idiosyncratic innovation design that is not able to counter the competitive strength of the innovation in the lead market, but keeps the domestic market away from the coming global standard. Minitel actually held back Internet usage in France for a long time (DTI 1999, 28; OECD 1997). Local electronic manufacturers concentrated on the domestic technology while missing the world market potential for Internet servers and routers. In a situation when a strong lead market cannot be countered by public initiatives, a country is better off pursuing a fast follower strategy. Governmental policies and regulation could strengthen the orientation of local firms on the lead market. National technology policy can encourage cooperation between domestic firms and firms in the lead market. Regulation and public procurement should be open to or even be biased towards technological designs popular in the lead market. An example for this strategy is the Japanese telecom operator NTT. After the Japanese mobile telephone standards failed to be successful outside Japan, the Japanese operator participated in the development of the third generation mobile system in Europe and was the first to introduce the new joint standard in the Japanese market. This gave local mobile phone manufacturers a head start in commercialising the appropriate network technology and mobile phones.

6.3.3.3. Cost effectiveness of innovations

Government-driven technology development typically focuses on achieving certain quality criteria for new technologies in order to achieve a mission (military, space, health) while putting less emphasis on cost efficiency. Rovizzi and Thompson (1992) argue on the basis of the model of Bös and Peters (1988) that public monopolies may offer products at a higher quality level than the socially optimal quality. This is because the cost of achieving higher levels of quality is not fully taken into account, since for example state-owned firms have bureaucratic structures that would not be present in cost optimisation. Advocates of demand-oriented innovation policies that mobilise public procurement as an instrument to generate early demand for innovations might argue that willingness to pay a high price at an early stage of technology is an advantage of government agencies. While this eases market introduction, it may rule out cost-cutting efforts and efforts to design the innovation in a highly cost-efficient way from the beginning. Consequently, this may restrict the acceptance

by private customers, who have a higher price elasticity compared to public demand.

Today, examples of the US military as a crucial launch customer for new technologies that later lead to civilian applications are rather scarce and this traditional role of the military is generally contested as the requirements for military applications are rather dissimilar from those for civilian application (Mowery 1998; Dertouzos, Lester and Solow 1989). An example is plasma display technology in which the US military failed to support the spin-off of commercial applications (OTA 1995).

6.3.3.4. Anticipation of global trends

Global trends create pressure for reform of social structures that have worked in the past but now are in need of change. Vested interests and fear of change tend to slow down the necessary adaptations. Lead markets are characterised by the opposite: an anticipatory regime that not only welcomes change but even anticipates change and reacts early on. This can be the case because the trend is most advanced in the lead market country but also because the country is more sensitive to changes. For example, environmental issues are considered as more important in some countries than in others, not necessarily in those with the most severe environmental problems. The attempted sinking of an oil storage platform by the oil company Shell in the North Sea in 1995, for instance, met strong resistance in Germany, leading to a "greening" of Shell's German subsidiary and later Shell worldwide (Livesey 2001).

Governments could add to the idiosyncratic characteristics of a market via regulations or subsidies. For example, if oil prices are increasing world-wide, subsidising gasoline will only serve to shift a country away from the global trend and slow down the response to high oil prices.

6.3.3.5. Restricted exportability

Strong support by a national government can restrict exportability of innovations. National legislation and regulation tend to focus on domestic needs and the local environmental context. Policy typically promotes the adoption of technologies that fit the domestic context best regardless of the benefit for other countries. The telecommunications industry for example suffered for a long time from the idiosyncratic conditions set by national carriers that made it difficult to export equipment (Grupp 1990).

Other governments may interpret such adoption policies as an unfair strategic trade policy and may choose to counteract them by imposing restrictions on the domestic adoption of government-sponsored design, or sponsor their own design. For example the US and Japan resisted the adoption of European cellular phone systems for a long time. Faced with continuous technical isolation in the mobile phone industry, only Japan collaborated in the development of the third generation standard.

6.3.4. Towards a lead market oriented technology policy

Competitive advantage results from the commercialisation of new technologies, not from technological and scientific excellence alone. This does not necessarily imply that government has a well-defined role in the commercialisation process. In fact, government intervention in the market in favour of the adoption of specific technologies might even increase the barriers for a local innovation to become internationally successful. Anecdotal evidence suggests that lead markets are on average characterised by a lack of government intervention.

However, lead market models suggest that policy makers can improve upon the factors that render a

Box 6.4: A special case: Lead markets for environmental technologies

Subsidies and regulations are often used in the area of environmental innovations. A market failure argument that points out the private underinvestment in environmentally friendly innovations has kept this area relatively free of trade controversies. It can be argued, however, that the motivation of some of the public support programmes is partly related to industrial policy and lead market creation as well (Beise and Rennings 2005). Recently, the interest in the role of public procurement in supporting the adoption of a specific innovation design has risen (see Edquist, Hommen and Tsipouri 2000; Edler, Hommen, Papadokou, Rigby, Rolfstam, Tsipouri and Ruhland 2006). Public procurement is a considerable part of total demand, around 12 to 16 % in Europe (Edler 2006), and it can be used to push certain new technologies over the obstacles to their first commercial adoption. While public procurement might be able to raise the domestic stimuli for innovations (Geroski 1990), the more important question is whether this raises the chances of domestic innovations being successful abroad and therefore the country becoming a lead market. This question is pertinent because it is conceivable that demand-side policies reduce the exportability of innovations and may lead to trade disputes.

local market a lead market. Porter (1990) stresses that government specification "should be set with an eye to what will be valued in other advanced nations". By actively anticipating the requirements of foreign markets and reflecting them in national regulations, idiosyncratic country-specific innovations can be avoided. The Swedish telecommunications carrier, for example, accepted the global orientation of its domestic supplier Ericsson, which develops telecommunications equipment for export markets (Bartlett and Goshal 1989, 25; Pehrsson 1996, 104).

The discussion of possible limitations and risks of public intervention in Section 6.3.3 above lead to the identification of number of "success" factors that a lead market oriented policy should take into account. Accordingly, such a policy should try to:

- Incorporate foreign market needs and preferences of customers from abroad;
- Transfer domestic market preferences abroad;
- Lower the cost of production to a level that is sufficient to make an innovation attractive in other countries;
- Be neutral with regard to the choice of technology, i.e. the policy should allow for competition between competing innovations;
- Shift the country to the forefront of a global trend;
- Be compatible with policies designed to support the innovation process, i.e. policies to protect intellectual property, correct for knowledge spillovers, or combat credit market imperfections.

The literature describes anticipatory market regimes very vaguely and considerable research needs to be done in order to formulate anticipatory policies. However, one could argue that whenever global trends can be identified, governments can consider ways to shift the context of its local market towards the forefront of these trends instead of trying to ease or hold back the effect of the trends. Instead of focusing on how global trends that have negative effects can be slowed down or reversed, a lead market oriented policy takes the opposite road, embracing change and opening up technical solutions for coping with change. Anticipating foreign markets' needs can mean, for example, including them in national regulations and procurement. For instance, state-owned firms and government agencies can demand that firms develop exportable innovations instead of demanding innovations that fit the national context best. Promoting the export orientation of domestic firms can mean sponsoring a design that takes account of demand preferences abroad. Global trends can also be utilized to support the lead market role of a country. If a factor price or the price of a complementary good such as infrastructure is marked by a global trend, a government can try to increase the domestic price level of the factor or the complementary good by raising specific taxes (in the case of an increasing trend) or decrease the price by lowering taxes or giving subsidies (decreasing trend) and therefore push a country to the forefront of the trend.

A further lead market instrument is public procurement. Simply favouring the procurement of innovative technologies can lead to idiosyncratic innovations. Instead, public procurement can follow export oriented principles. Similar to the argument of anticipatory market context, it is essential to reflect domestic needs with international market conditions. This could include a public customer deliberately waiving requirements for specific quality or technical features that make it difficult to export the same product. Instead of creating extreme or generally uneconomical requirements, technical specifications should be adapted to the quality demands of the world market, facilitating the innovations' compatibility with the market context abroad.

Case studies point to an important transfer mechanism, namely policy diffusion (Kern et al. 2000, Jänicke 2005), as a means of stimulating the diffusion of a specific technology. If one country introduces a new regulation that induces innovations or spurs the adoption of a specific innovation design, this innovation design will be adopted by users in other countries as well, if other countries introduce this same regulation. Despite the fact that countries differ in conditions such as the gravity of environmental problems, and require different policy instruments, they often adopt the same regulations used by another country, even down to the wording (Bennett 1991, 222). Some countries "sacrifice...autonomy to avoid unnecessary cross-national divergence" (Bennett 1991, 227). As a result a country has a competitive advantage if it is more likely that policy makers follow this country than other countries.

In the context of EU policies, the creation of an internal market and technology adoption at the European level provides the economies of scale necessary for an innovation to compete successfully against innovations from the large national markets of the US and Japan. On the other hand, the high diversity of consumer preferences and market environments across the EU offers opportunities for experimentation, which will help to increase our understanding on what kind of policies, are the most effective.

6.3.5. Policies for lag markets

In lag market industries, it is more appropriate to use instruments that support the fast following of a lead

market instead of trying to convert a lag market into a lead market. Fast follower strategies would include supporting the early adoption of the technological designs of the lead market. This avoids the burden of idiosyncratic local designs.

In the end the more important question for technology policy might not be how to create lead markets but how to deal with a domestic lag market situation. It is interesting to note that Japan and Korea have often used a fast follower strategy toward the US market which paid off for them. A fast follower strategy means that governments and domestic companies are not focussing on the domestic market needs but on the market needs of a country that is expected to be the global frontrunner. Embracing the lead market role of a foreign country ensures that domestic industry is confronted with the coming global innovations context at a very early time. For instance, the introduction of the US clean air act in Japan a year before it came into being in the US itself, gave the domestic auto industry an invaluable head start (Beise, Blazejczak, Edler, Jacob, Jänicke, Loew, Petschow and Rennings 2003). And after a history of modest exports in the mobile phone industry, Japan has engaged in close cooperation with the most advanced region to develop the next generation of mobile phone system, UMTS or WCDMA.

6.4. Conclusions

The lead markets approach may help to understand the factors behind the global success of innovations and new technologies, especially in the case of competing innovation designs. It can be a powerful tool for innovation management in international firms that want to leverage market diversity for global innovations.

The lead markets approach is also relevant for governments. It can assist them in designing a more effective technology policy to facilitate the potential global success of domestic companies' innovation activities. In designing innovation policy (from funding programmes and public procurement to regulation and standard setting) the following issues should be considered: incorporation of foreign market needs and preferences of customers from abroad, transferring domestic market preferences abroad, putting emphasis on lowering costs of production, allowing competition among different innovation designs, and addressing global trends.

It is thus a critical point for any policy that attempts to support the emergence of a lead market to anticipate global markets, develop an innovation design that responds to these upcoming global needs and introduce cost advantages high enough to persuade other countries to follow. Policies that attempt to create demand for a particular innovation or to promote the early adoption of a particular new technology have little in common with the concept of lead markets, and they may even hamper a country's potential lead market role by backing the wrong horse.

In order to make the lead markets concept operational, the Commission has proposed in its recent Communication on Innovation[74] to, firstly consult stakeholders, in particular Technology Platforms and the Europe INNOVA Innovation Panels, to identify possible areas where a combination of supply and demand side policies may help the emergence of innovation-friendly markets and, secondly, to launch pilot lead markets initiatives in the most promising areas in 2007. Based on this experience, the Commission will prepare a comprehensive lead markets strategy.

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Chapter 7:
The competitiveness of the EU ICT sector

7.1. Introduction

Information and communication technologies have been playing an instrumental role in the fast transformation of the economies in the last twenty years. At the same time and as much as they contributed to changes in the other sectors that use the goods and services that collectively constitute ICT, through their vigorous and fast expansion, the ICT producing sectors have contributed to the structural change of the economy as a whole. Thirdly, the ICT sectors are themselves the place of continuous technological and structural change, in spite of the size that they have reached. The purpose of this chapter is to present an overview of recent developments of the EU ICT sector and its competitiveness and provide an outlook of challenges and opportunities in the medium term horizon.

The chapter is organised as follows. The sector and its sub-sectors are presented below. Section 2 presents the composition of the sector in terms of manufacturing and services industries and the type of goods and services that they produce[75], followed by an analysis of the sector's economic importance. Section three analyses the competitiveness of the EU ICT sector within the framework of increased globalisation, also discussing developments in intra-firm trade, foreign direct investment, the internationalisation of R&D activities and the localisation of ICT production.

The final part of this chapter is forward looking and attempts to analyse how the recent economic and technological developments in terms of digital convergence and globalisation impacts on the competitiveness of the EU ICT sector. The last part of that section elaborates on the consequent challenges for some selected segments of the EU ICT sector.

[75] A formal definition of the sector in terms of industrial classification is provided in the annex.

7.2. A profile of the ICT sector[76]

It is not always clear when discussions and analyses ICT refer to ICT as a product, a technology or a sector. One of the key characteristics of ICT as a *product* is its pervasiveness. ICT is an enabling technology and its products are used throughout the economy [Wintjes (2005)]. ICT is regarded as a general purpose *technology* with large spillover and network effects for the rest of the economy. The diffusion of new technologies such as ICT can change the existing type of goods and services and change the production processes and costs by facilitating process and product innovation, the diffusion and uptake of ICT changes both supply and demand for products. On the international level, ICT can speed up globalisation in both the ICT sector itself, as ICT services can be transported without costs, but also by allowing or facilitating the process of division of products into elements of products which can be produced in different locations according to comparative advantages [Meijers et. al (2005), European Commission (2005B), Koellinger (2006)].

The definition of the ICT sector provided in the annex does not accurately reflect the ongoing dynamic developments of the sector. A new classification from 2007 is being proposed which would

[76] This chapter uses data from different sources; EITO, Eurostat, OECD and Groningen Growth Development Centre (GGDC) and United Nations. The coverage of data varies over variables, countries and periods of time which is the reason why different aggregations of the Member States are presented in the chapter. Market data from EITO and trade data from United Nations provide the largest coverage over countries and contain also the most recent data. These data allow for presentations of EU-25. Industrial statistics are considerable less updated and also the coverage of data over variables and countries is less complete. The discussions of firm structure in the next section are based on Eurostat data from 2001 which is the most recent year which allows for analyses of firm size structure for EU-25. The most recent data for value added and employment in the ICT sector refers to 2003 and derives from OECD and GGDC. This data only covers 19 Member States. This data is used in the discussions of location and structure of the EU ICT sector and also in the comparisons with ICT sectors outside the EU. The discussions of the economic impacts of ICT are based on data from OECD and GGDC. Unfortunately, the data coverage only permits for a comparison of EU-15 with United States.

take into account new developments both in terms of products and technologies.[77] This chapter will discuss developments in the ICT sub sectors as presented in Table 7.1. The right column indicates some products that are produced by the firms in the sector.

The ICT sector is heterogeneous and complex; it comprises both manufacturing and service firms and many (especially the largest) ICT firms produce both goods and services, thus tearing down or at least blurring the border between manufacturing and services firms.[78] The heterogeneity is also apparent within ICT manufacturing and ICT services respectively. One aspect of the heterogeneity of ICT manufacturing is reflected in the vast variety of goods being produced by the different industries. Firms in the ICT sector produce intermediate goods, investment goods and consumer goods.

The complexity of the ICT sector can be illustrated by the inter-industry relationships between firms in the sector producing hardware, software and lately also contents. The increasing convergence of technologies allowing for example for bundled offering of Internet access, telephony and entertainment content is tearing down the walls between traditional market segments and changing old market structures.[79]

The ICT sector is to a large extent knowledge-intensive and is classified as a high-technology industry.[80] This classification can however be questioned as there is a large variety of ICT products of different qualities. Rapid technological progress in the sector reduces life cycles for many ICT products which mature and become standardised after a short period of time. Production is often knowledge-intensive in the early stage of a product's life cycle and dependent on

[77] The existing definition rests upon the consensus of the OECD countries in 1998. The definition is basedon ISIC Rev. 3. Annex Table 7.1 in the annex presents the industries and their classification according to both ISIC Rev. 3. and NACE Rev.1.

[78] Siemens and HP provide good examples of firms that offer both goods and services to their clients. See www.siemens.com and www.hp.com.

[79] See section four of this chapter for a more elaborated discussion of these developments.

[80] The classification of industries according to technology-intensities is based on R&D intensities (R&D expenditure relative value added). OECD (2005). *"Measuring Globalisation. OECD Economic Globalisation Indicators."* OECD, Paris.

Table 7.1. ICT industries and ICT products

ICT manufacturing	***Type of products***
Office machinery and computers	Typewriters, calculating machines, computers, printers, terminals
Insulated wire	Cables and fibre optic cables for transmission of telecommunication and video
Electronic valves and tubes	Television and camera tubes, semiconductors, printed circuits
Telecommunications equipments	Telephones, telephones sets, routers, switchers, television cameras
Radio and TV receivers	TVs and radios, VCRs, DVDs, CD players
Scientific instruments	Mathematical calculating instruments, oscilloscopes, radiation instruments
ICT services	***Type of products***
Telecommunications	Telephone communication, Internet provision, radio and TV provision
Computer and related activities	Hardware and software consultancy, data processing and database activities, maintenance and repair of computers

Source: See RAMON, Eurostat's Classification Server for a complete description of all the goods produced by the sector. A formal definition of the sector according to industrial classification and adopted by OECD and Eurostat is provided in the annex. http://ec.europa.eu/comm/eurostat/ramon/index.cfm?TargetUrl=DSP_PUB_WELC

access to human capital and facilities for R&D and innovation. Mature and standardised products are mass-produced in locations where access to cheap labour is more important. The ICT sector is nonetheless more innovative than the average industry and ICT firms patent more than firms in other sectors of the economy [Wintjes (2006)].

7.2.1. ICT market

Looking first at the ICT sector from the demand side, the EU ICT market amounted to 600 billion euros in 2005. Carrier services (fixed data services and fixed and mobile telephone services) accounted for the largest share of the market, 43% (see Graph 7.1). Even though the German market encountered the largest decline of all Member States in the beginning of the millennium, Germany is still the largest ICT market in EU. The ICT markets in the EU-15 countries accounted for 95% of the EU ICT market. The European ICT markets constitute around a third of the global ICT markets and the US and Japanese markets amount to 28 and 15% respectively leaving the remaining 24% of the total ICT market to the rest of the world. [81]

As will be discussed later in this chapter, consumption of ICT within the EU widely exceeds EU production of ICT goods which implies a large trade deficit. This is also the case, the trade deficit in 2005 amounted to some 60 billion euros.

[81] EITO (2006) p. 43.

7.2.2. Structure and location of the EU ICT sector

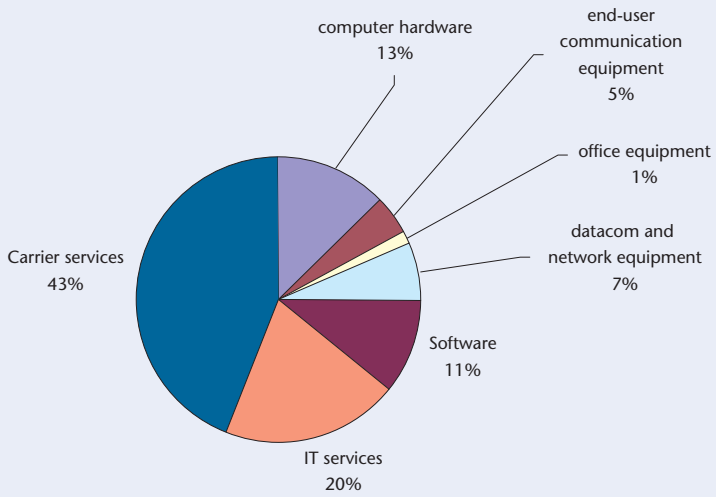
The remainder of this section will be devoted to a description of the sector from the supply side. According to the latest Eurostat statistics, the EU 25 ICT sector comprised approximately 600 000 enterprises in the year 2002, with 6.8 million persons employed and value added amounting to euros 450 billion. The ICT sector represented 3.4% of total European employment and value added by the ICT sector was equivalent to 4.5% of GDP. ICT services accounted for 70% of total ICT sector employment and 80% of ICT sector value added and for about 90% of the enterprises in the whole ICT sector.[82]

The ICT sector is heavily concentrated in most sub sectors. Large firms with more than 250 employees account for more than 60% of the employment and produce more than 70% of the value added in the sector.[83] Manufacture of telecommunications equipments is the most concentrated in ICT *manufacturing* and 80% of value added is produced by the largest firms (more than 250 employees) who employed 75% of all employees in the industry. Also the man-

[82] Eurostat New Cronos (2006). These statistics are provisional since statistics covering the ICT sector are unfortunately not available for all Member States after 2001 in Eurostat's database New Cronos. The data for 2002 and 2003 still contain many gaps for the different ICT subsectors and no aggregates for EU-25 are available. The EU-25 aggregates that are found in the annex table are not official but have just been calculated as sums of the individual Member States. The most recent updated and reliable statistics for the ICT sector are found in the database developed by the Groningen Growth Development Centre and will be used in the main text.

[83] Eurostat New Cronos, 2001 figures. See also Wintjes, R. (forthcoming 2006).

Graph 7.1: The European ICT market 2005 by products



Source: EITO (2006). Market values (percentages) represent end user spending. *Carrier services* include fixed and mobile telephone services and fixed data services. *ICT equipment* includes server systems, PCs and printers, fax machines and audio and video conferencing, office equipment and data and telecommunications networks. *Software products* include software and software infrastructure. *IT services* include consulting, implementation, operations management and support services. The Graph above includes data for Bulgaria, Norway, Romania and Switzerland.

ufacturing industries producing office machinery, electronic valves and tubes and radio and TV receivers are heavily concentrated. The relatively high level of concentration can be explained by the existence of high sunk costs and economies of scale [e-Business W@tch (2006)]. The concentration is less pronounced in the industries producing scientific instruments [European Commission (2005A)].

The services industry is considerably less concentrated than ICT manufacturing though there are large variations between ICT services industries. Telecommunications is the most heavily concentrated *services* sub sector where only 2% of the firms account for 95% of value added and 90% of the employees.[84] Old national former monopolies still have a large role in the telecommunications industry though they are increasingly being challenged by new firms. The developments in the sector have been driven by market liberalisation and deregulation in the 1990s followed by the entry of a large number of new network operators. Also the increasing convergence of platforms and technologies has opened up borders between different markets and resulted in increased competition from firms previously acting in other markets. One example is the transmission of voice over Internet (VoIP) which has been driven by increased broadband penetration.[85]

Computer services are considerable less concentrated than telecommunications services. Around 0.5% of the companies that employ more than 250 people produce around 45% of the value added and employ some 30% of the labour force in the industry. The lion share of value added (some 60%) is produced by SMEs. This industry hosts two thirds of all ICT firms and 90% of the ICT sector's micro firms are found in this industry.[86]

The most recent statistics for value added from OECD and GGDC for the ICT sector cover only 19 of the Member States According to Table 7.2 two thirds of the value added in the ICT sector is produced in the four largest countries: France, Germany, Italy and UK. Germany holds the largest share of ICT manufacturing production while the lion share of ICT services production is held by UK ICT services firms. This means also that the largest share of total EU ICT production takes place in UK since ICT services make out around 80% of total value added, 70% of employment and turnover and 90% of all enterprises in the ICT sector. Notable exceptions from this rule of ICT services dominance are Finland and Ireland where ICT manufacturing holds the major share of the total ICT sector.[87]

Belgium, Netherlands, Spain and Sweden produce relatively more of ICT *services* than what the sizes of the countries suggest.[88] The telecommunications services industry occupies around two thirds of total ICT services value added in Belgium, Netherlands and Spain while computer services carry a larger weight of ICT services value added in Sweden. Some of the new Member States like the Czech Republic and Poland also have relatively large ICT service industries. Telecommunications services it relatively the largest industry in the Czech Republic while the computer services industry plays a larger role in Poland.

7.2.3. Comparison of the industry composition with other regions

Comparisons of the EU ICT sector with some other countries are presented in Graphs 7.2 and 7.3 below. The Graphs present the size and composition of the ICT manufacturing and ICT services sectors respectively in terms of average shares of total manufacturing and market services value added between 2001 and 2003 for 19 Member States, Australia, Canada, USA, Japan, Korea, Norway and Taiwan.[89]

Graph 7.2 shows that both the composition and relative size of the ICT manufacturing industry vary over countries. ICT manufacturing industries in Ireland, Japan, Korea, Finland and Taiwan are relatively large with 15% or more of total manufacturing value added. On the lower part of the spectrum are Greece, Spain, Luxemburg, Australia and Portugal where less than 4% of total manufacturing value added accrues to ICT manufacturing.

Manufacturing of office machinery and computers and manufacturing of electronic valves and tubes are relatively large South-East Asian manufacturing sub sectors. Especially Taiwan has a large production in those industries. Other relatively large producers in these industries are located in Ireland with, respectively, 14 and 8% of the value added.

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[84] Eurostat New Cronos (2006).

[85] The proposed new NACE classification reflects this increased complexity of the sector and will include not only different technologies for transmitting voice but also means for transmitting different types of content.

[86] Eurostat New Cronos.

[87] Manufacture of telecommunications equipment is the largest ICT manufacturing subsector in Finland making up for almost 90% of total ICT manufacturing value added in 2003 while manufacturing of electronic valves and tubes are the largest ICT manufacturing subsectors in Malta. Manufacturing of office machinery and computers and electronic valves and tubes are the largest ICT manufacturing subsectors in Ireland.

[88] Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, www.ggdc.net.

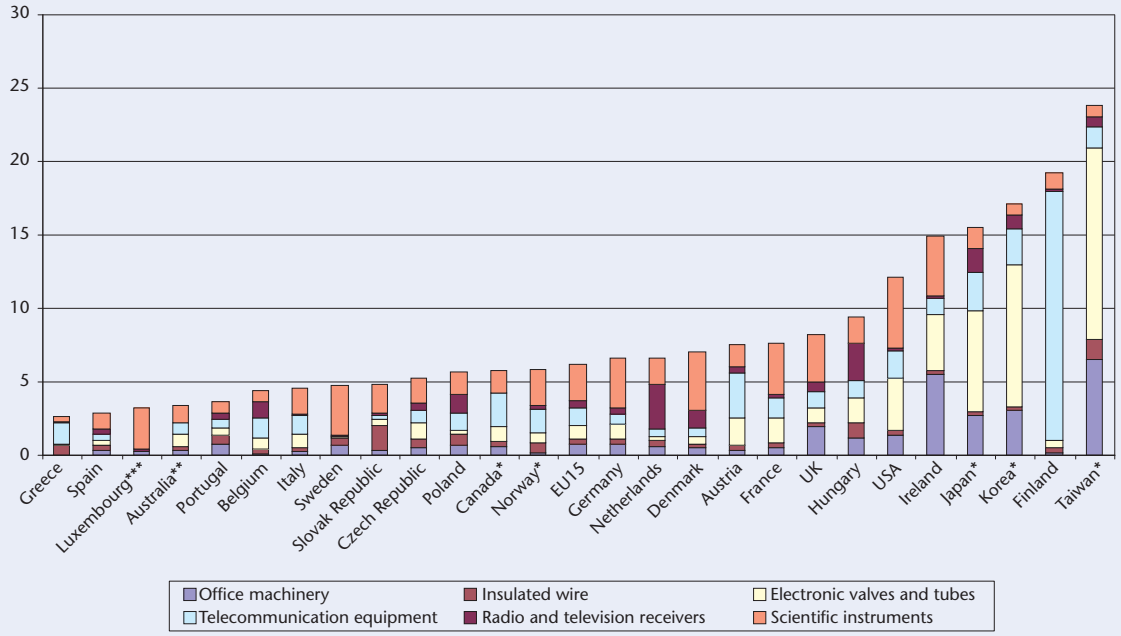
[89] An alternative would be to measure the size relative to the total economy. A presentation along such lines could however be blurred by the fast that the size of the public sector varies substantially between countries depending on whether consumption of education, health care and other expenditures for social security or welfare purposes are paid through taxes or are part of private consumption. Measuring the ICT sector relative to total manufacturing and market services therefore yields a more appropriate comparison. Since differences between Member States are smaller than compared countries outside the EU, a comparison of EU-19 ICT sectors relative the total economies is found in the annex.

Table 7.2: Location of EU ICT industries. Country share in EU19 ICT manufacturing and ICT services value added (%). Mean values 2001-2003

	ICT Manufacturing	ICT Services
Austria	3	2
Belgium	2	4
Denmark	1	1
Finland	5	2
France	14	16
Germany	27	17
Greece	0	1
Ireland	5	2
Italy	10	12
Luxembourg*	0	0
Netherlands	4	5
Portugal	1	1
Spain	3	6
Sweden	2	3
UK	16	20
Czech Republic	2	3
Hungary	2	1
Poland	3	3
Slovak Republic	1	1
Total	100	100

Note: ICT services include postal services. See also DG Enterprise and Industry (2005). Industry and location.
* Data for insulated wire, electronic valves and tubes and telecommunications equipment are not available.
Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, http://www.ggdc.net.

Graph 7.2: Size and composition of ICT manufacturing. (Average shares of total manufacturing value added 2001-2003, percent)



Notes: * 2000-2002 averages. ** Data for radio and television receivers is not available.
*** Data for insulated wire, electronic valves and tubes and telecommunications equipment are not available.

Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, http://www.ggdc.net.

The Netherlands has a relatively large production in the radio and television receivers, concentrating around a fifth of total EU value added in this segment (Phillips effect). The EU telecommunication equipments industry is especially important in Finland where some 25% of total EU value added in this industry is produced, with Nokia as the dominant player.

ICT services are relatively more important in the EU than in other parts of the world which can be seen in Graph 3. In eight Member States the ICT services share of total market services exceeds 10%. Two of the South-East Asian countries are found in the lower end of the spectrum. Telecommunications hold the largest shares of total ICT services value added in most countries while computer services are relatively more important in Belgium, Czech Republic, France, Ireland, Sweden and Slovakia.

Graphs 7.2 and 7.3 above imply that event though there remains a gap between the USA and the EU in terms of production of ICT manufacturing, production of EU ICT services is at least at par with US ICT services.

7.2.4. Economic Impact of ICT

The impact of ICT on the growth of the rest of the economy is usually thought of as being determined by ICT investment, the technological progress in the production of ICT goods and services in ICT producing industries and ICT usage.

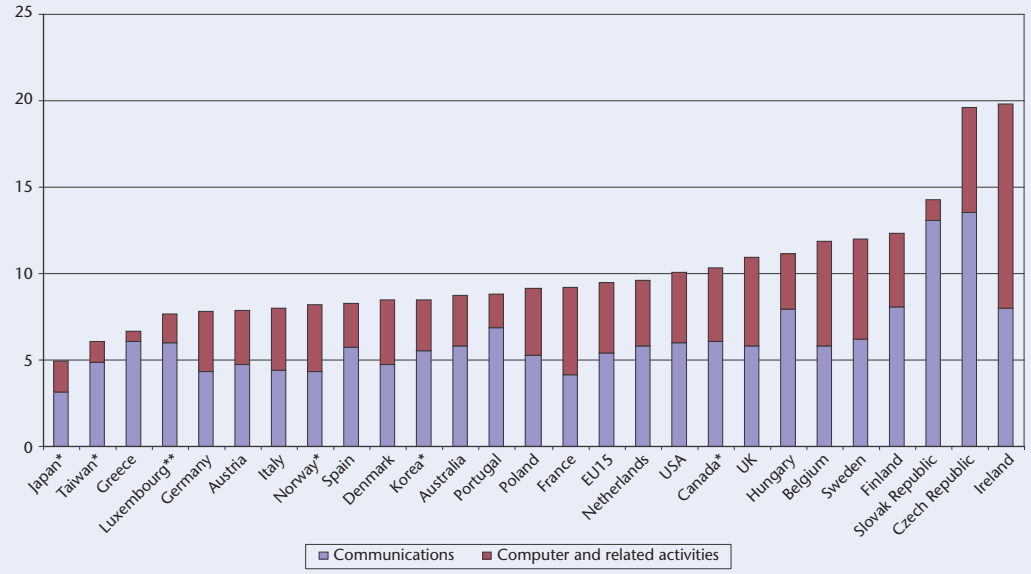
At the macro level, ICT investments increase labour productivity growth both by increasing the existing capital stock and by introducing new technologies in the production process.[90] Graph 7.4 below presents contributions of ICT capital to GDP per capita growth between 1995 and 2004. The largest contributions of ICT capital can be found in USA where 0.8 percentage points of GDP per capita growth can be attributed to ICT investments. ICT capital contribution for EU-15 amounted to 0.5 percentage points (or 32%) of GDP per capita growth of 1.54% between 1995 and 2004. The individual Member States display variations in GDP growth rates as well as in sources of growth.

Harbouring an ICT sector has proven to be important for growth since ICT production has been characterised by rapid technological progress and very strong demand. The technological progress has brought about falling relative prices which in combination with elastic demand leads to growing expenditure shares for ICT goods.[91] The economic importance for

[90] Pilat, D. (2006). "The Economic Impacts of ICT – Lessons Learned and Implications for Policy." Annex to i2010 High Level Group. The Economic Impact of ICT: evidence and questions. European Commission, March 2006.

[91] See for example the discussion in Pilat, D. (2003) and DeLong, J. B. & Summers, H. L. (2001).

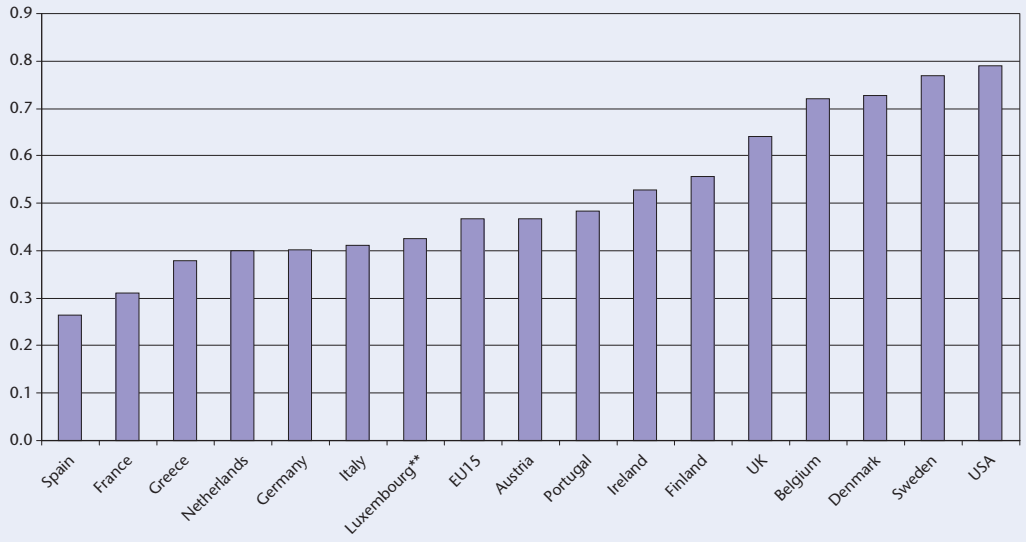
Graph 7.3: Size and composition of ICT services.
(Average shares of total market services value added 2001-2003, percent)



Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, http://www.ggdc.net.

Note: Communications includes postal services. Market services are defined as NACE G-K.

Graph 7.4: Contributions of ICT capital to GDP per capita growth 1995-2004 (percentage points)



Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, http://www.ggdc.net and own calculations.

a sector to the whole economy can be measured in terms of how much the sector contributes to aggregate labour productivity growth. The sector's contribution depends on the size of the sector and its productivity growth. The higher share of the economy held by the sector and the higher its productivity growth, the larger is the effect of the sector's productivity growth on aggregate productivity growth.

Table 7.3 summarises contributions from three major industry groups to market economy labour productivity growth in EU-15 and USA.[92] Even though most of the difference in market economy labour productivity growth can be attributed to market services, the differences between EU and USA in contributions from the ICT producing industries is also striking: the contribution in USA is more than twice as large as in EU. The larger contribution from ICT production in the US is primarly due to the larger share of US ICT producing industries relative to total output, though higher productivity growth rates in ICT manufacturing matter too.[93] Labour productivity growth in the EU15 ICT services is on par with the US ICT services.

The third channel for ICT impacts on the economy is through greater use of ICT throughout the economy. Firms and industries outside the ICT sector may increase their overall efficiency by using ICT more intensively in their business models. By introducing ICT, a certain amount of input factors such as capital and labour can be more efficiently combined and produce more output than before the introduction of ICT. In other words, total factor productivity growth may increase.[94] There may also be spill over effects of the use of ICT. In networks created or facilitated by ICT, benefits of ICT grow with the number of customers and firms connected to the networks. Wide industry adoption of ICT may therefore reduce transaction costs and give rise to a more efficient matching of supply and demand in many markets for goods and services. These effects may give rise to a higher overall total factor productivity growth [Pilat et.al. (2002)]. Even though these effects are difficult to measure, more and more firm-level studies show the positive impact of ICT use on firm performance [Pilat (2004)]. Australian experience shows that the use of computers has had a positive effect on total factor productivity growth in a number of industries and a number of studies on British firms have found significant returns to ICT investment.[95] Similarly a recent Swedish study found that the use of computers, ICT applications, networks and conducting busi-

[92] Market economy labour productivity growth excludes labour productivity growth in the public sector. The reason for exclusion is the substantial measurement problems of for example value added in the public sector. Production industries exclude the ICT sector. Reallocation is a residual picking up the effects on labour productivity growth from changes in industry structure.

[93] van Ark, B. & Inklaar, R. (2005).

[94] While labour productivity growth measures the part of growth in output that is not explained by greater use of labour to produce output, it does not take into account other factors of production such as capital. Total factor productivity growth measures aim to capture the increases also in for example capital, energy and knowledge.

[95] Gretton et. al. (2004) and Clayton (2005).

Table 7.3. Industry contributions to market economy labour productivity growth 2000-2003 (average annual percent)

	EU15	USA
Industry labour productivity growth	1.1	3.6
ICT production	0.5	1.1
Production industries	0.6	0.9
Market services	0.1	2.0
Reallocation	-0.1	-0.3

Source: van Ark, B. & Inklaar, R. (2005). "Catching Up or Getting Stuck? Europe's Troubles to Exploit ICTs' Productivity Potential." Research Memorandum GD-79. Groningen Growth Development Center, University of Groningen. September 2005.

ness over the Internet had a positive effect on firm-level total factor productivity.[96]

7.3. The competitiveness of the EU ICT sector

High-technology industries such as ICT play an increasingly important role in international trade. The growth of trade in high technology outpaces the growth of trade in other manufacturing goods and constitutes around 25% of total OECD trade [OECD (2005)]. Another strong emerging trend of international trade is the trade in intermediate products which has grown substantially since the mid 1980s. It is one of the main features characterising the increasing globalisation and is the result of new and more complex relationships between trade, foreign direct investment and international R&D activities.

These complex relationships are often the result of activities of multinational firms operating in different parts of the world. Direct investment flows of multinational enterprises (MNEs) and vertical specialisation in different stages of production has led to rapidly growing trade in intermediate inputs. Firms have chosen different ways to organise this and while some import from other firms, part of the intra industry trade (IIT-trade) takes place between different affiliated units of the same multi-national firm, intra-firm trade. The growth of this kind of trade reflects multi-national firms' search for more efficient production. Statistics also reveal that intra-firm trade in the ICT sector is relatively high and accounts for 68% of US ICT imports and 40% of US ICT exports in 2002 [OECD (2004)].

Investments and sourcing of production abroad are key elements in corporate competitive strategies. Globalisation also encompasses the increasing internationalisation of R&D activities performed by MNE's affiliate firms in different parts of the world. The internationalisation of R&D activities are driven by two major motives; adjusting products to local foreign marks and accessing superior knowledge in locations with large supplies of science and technology personnel and favourable systems of innovation [Meijers et. al.(2006)].

The globalisation of industry can thus be characterised by three main activities: international trade, foreign direct investments (FDI) and R&D activities [OECD (2004) and Meijers et. al (2006)]. The ICT sector is to a large extent contributing to the increased international specialisation by its production and services and is possibly the most internationalised industry sector [OECD (2004)]. The use of ICT has allowed for knowledge and information to be codified, standardised and digitalised enabling an in-depth specialisation and fragmentation of the production process. As a result the value-chain of production a product can be distributed over different countries according to comparative advantages in the production of the individual stages of production [Meijers et. al. (2006) and European Commission (2005B)].

7.3.1. Trade

A strong competitiveness position for an industry in any country ought to reflect itself in large market shares on domestic markets and export markets. This can be measured in several ways.[97] Competitiveness is measured below by revealed comparative advantages (RCA)[98] which relates the world market share for a certain industry to the world market share for total exports of the country [Balassa (1965)]. A value

[96] Hagén, H-O & Zeed, J. (2005).

[97] Maybe the most straightforward way is to measure the ICT manufacturing industries' shares of exports to a certain market. Measuring competitiveness by shares of world exports favours however large countries. A possible explanation to that can perhaps be found in that size seems to matter. There might be several reasons for this. Large countries have more resources in terms of capital, labour and other factors of production. Large countries also have larger domestic markets which mean that they are more able to exploit economies of scale.

[98] See the annex for a definition of RCA.

of RCA above 1 indicates that a specific country, relative to the world, tends to be specialized in exports in the ICT industry.[99]

Revealed Comparative Advantages for EU-25 and a number of other countries are presented in Graph 7.5. The Graph shows that the ICT manufacturing industries in the South-East Asian countries, especially those in Philippines, Malaysia and Singapore are the most competitive. The high RCA for the Philippines ICT manufacturing derives mainly from production of semiconductors while Malaysia, Singapore and Thailand have a more diversified ICT industry with significant production of also computers.[100] The EU-25 ICT manufacturing industry had a RCA's of 0.6 in both years indicating that on average the EU-25 is not specialized in exports of ICT goods.[101] Apart from the South-East Asian countries mentioned above, also Mexico and Japan were specialised in ICT exports in 2004. Japan managed to remain competitive despite the recession that hit the coutnry during the South-East Asian crisis. India is found at the lower part of the RCA spectrum. At first sight it might look peculiar that the Indian ICT manufacturing industry is not more competitive. The growth of the Indian ICT sector during the last decade or so has been concentrated in ICT services. *Individual* Member States that are specialised in ICT manufacturing are Estonia, Finland, Hungary, Ireland and Netherlands.[102]

Before the statistics on trade in *services* are presented, a word of caution should be raised. The intangible nature of services and the increasing number and complexity of means of delivery make trade in services more difficult to quantify than trade in goods. International trade in services require no physical package to cross borders, contains seldom any information on quantity and has no administrative system based on customs duty collecting measuring it. International services data, as opposed to goods trade data which rely predominantly on customs declarations, are collected through a variety of methods and sources such as business accounting and record-keeping systems, administrative sources, regular surveys of businesses as well as estimations by statistical agencies [Kirkegaard (2004)].[103] Statistics on trade in services are thus less available and less reliable than statistics on trade in goods.

Bearing these reservations in mind, the evidence suggests that EU seems to have comparative advantages in ICT services. Total EU shares of OECD

[99] A problem with this measure is that countries with a relatively small manufacturing industry can turn out to have high RCA's even though the ICT manufacturing industry only consists of a few firms. Examples of this are the South-East Asian countries, Philippines, Malaysia and Thailand but also Malta. The Maltese ICT manufacturing industry received the highest RCA. This is based on the existence of one large semiconductor firm, ST Microelectronics. Exports of semiconductors account for 60% of total manufacturing exports. European Commission (2006). European Economy, Issue 1, January 2006.

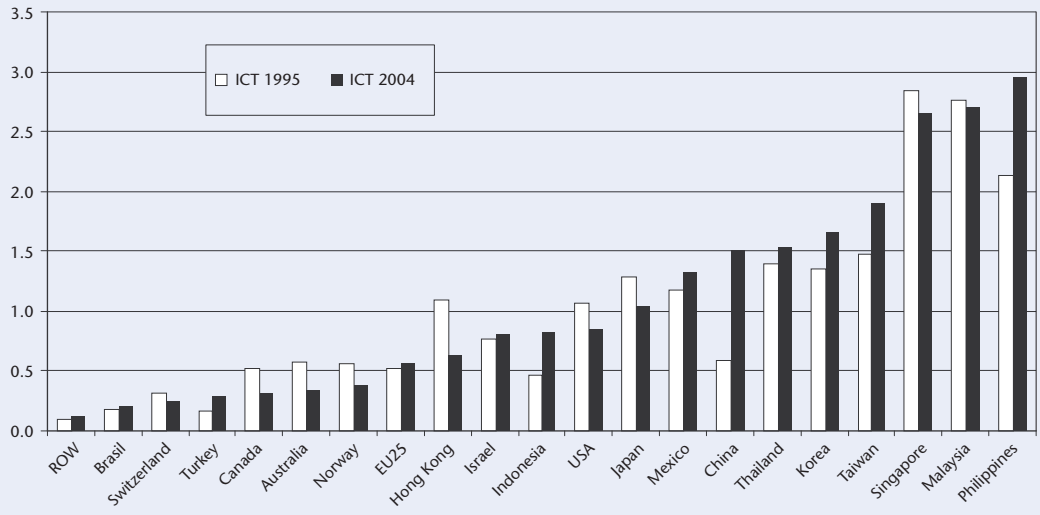
[100] International labour office (2005). http://www.logos-net.net/ilo/150_base/en/topic_n/t8_phi.htm.

[101] The RCA measure is calculated on the basis of extra EU trade.

[102] See the annex for individual Member States' RCA's.

[103] An often cited example of the difficulty to measure trade in services is the discrepancies in exports reported by India and imports reported from other countries. Kirkegaard (2004) and OECD (2004) contain examples and discussions of this discrepancy.

Graph 7.5: RCA's in the ICT manufacturing industries 1995 and 2004



Source: United Nations Comtrade (2006).

exports amounted to 70% of communication services and 80% of computer and information services. The Irish and US ICT service industries occupied the largest market shares in 2002. Together with UK and Germany, these countries shares of OECD exports amounted to 55%.

EU-25 has a trade deficit in ICT manufacturing while trade in ICT services shows a surplus [(European Commission 2005B)]. The trade balance for ICT manufacturing displayed a deficit of 55 billion euros in 2004 while exports of ICT services exceeded imports of ICT services with 9 billion euros (Meijers et al. 2006).

Further investigation of the trade performance of ICT *manufacturing* shows that even though the trade deficit is relatively large, *terms-of-trade* for ICT manufacturing goods have increased ever since 1996 [Meijers et. al. (2006)]. Most of the poor performance of ICT manufacturing trade seems to be rooted in products or parts of products where low-cost producers have a comparative advantage even though European Commission (2005B) notes that EU does not seem to have comparative advantages in the production of semiconductors which is usually regarded as a high-technology product. USA and Japan have also lost market shares which mainly have been captured by low-cost producers in South-East Asia [CEPII (2004), European Commission (2005B), Meijers et. al. (2006)]. Most of these market shares have been captured by China and other low-cost producers in South-East Asia.

Even though Chinese producers have gained more market shares than other producers in the last years, China has still its comparative advantages in low-technology industries and the Chinese comparative "disadvantage" in high-technology goods has actually increased over the last ten years [Schaaper (2004)]. The specialisation in low-technology production is also evident in the composition of Chinese ICT trade. China continues to import mainly electronic components (65% of imports in 2004) while the major part of ICT exports consist of computer & related equipment. In addition to satisfying domestic Chinese demand, electronic components are used to assemble computer & related, audio & video and telecommunications equipment and also consumer electronics. China has also significant trade deficits in trade with other high-technology ICT goods as integrated circuits, semiconductors and scientific instruments.[104]

Using disaggregated data on products Meijers et. al. (2006) show that EU-25 exported relatively expensive exports and imported relatively cheap goods between 1996 and 2004. Most of the imported products were computers, electronic parts, radio- and TV-sets and other consumer electronic goods where production is relatively standardised and prices are more important than quality for competition. The EU ICT manufacturing industry seems to be successful in relatively high-quality ICT products and Meijers et. al. (2006) show that the EU-25 ICT manufacturing trade recorded a surplus in trade with relatively more qualitative goods. Goods where EU-25 has a comparative advantage are electronic apparatus (Ireland and Netherlands) and scientific instruments (Germany and UK).[105] The export prices of EU-25 goods have risen quite substantially without an accompanying equally large increase of the trade deficit.[106] It is therefore likely that there are more products where quality competition is important and where the EU-25 ICT manufacturing industry is successful. Other ICT manufacturing industries where some EU-25 producers have comparative advantages can be found in the computer industry (Ireland and The Netherlands) and telecommunication equipments industry (Finland and Sweden).

The accession of the new Member States has resulted in an increased competitiveness of the ICT manufacturing industry as ICT producers in other countries have invested in these countries in order to take advantage of a relatively skilled labour force with considerably lower wages than in EU-15. Especially Czech Republic, Estonia, Hungary and Poland have received large inflows of FDI in both ICT manufacturing and ICT services industries. Estonian ICT manufacturing have comparative advantages in production of insulated wire, telecommunications equipments and radio and TV receivers and the Hungarian ICT manufacturing industry is competitive also in producing computers. Czech ICT manufacturing industry has comparative advantages in production of computers and insulated wire.[107]

The new member states' comparative advantages are still found in labour-intensive production. In a not too distant future one can expect that factors such as relatively high stocks of human capital and the proximity to EUs R&D networks will contribute to an upgrading of product quality and sophistication of ICT services in the new member states, thus reinforcing EUs comparative advantages in knowledge-intensive products.

It is obvious from the observations above that ICT products and parts of products cannot be regarded

[104] http://www.oecd.org/document/8/0,2340,en_2649_201185_35833096_1_1_1_1,00.html.

[105] Meijers et. al. (2006), p. 142. See also table A5 in the annex.

[106] Lack of data on a sufficiently disaggregated level precluded Meijers et al from further analysis of this subject.

[107] See table A5 in the annex.

as homogenous and that not all ICT goods are high technology goods.[108] ICT goods are differentiated and products of different qualities command different prices.[109] EU, USA and Japan have comparative advantages in goods or parts of products of relatively higher quality and prices than the emerging competitors from South-East Asia [CEPII 2005, Meijers et. al. (2006)]. The increased modularity of production process allows for a slicing of the value chain according to comparative advantages in different locations. Knowledge-intensive and relative expensive production such as chip design takes place in Europe and USA and relatively cheaper labour-intensive mass production takes place in Asia. Software design and systems design are located in European facilities but software coding is done in for example India [Meijers et. al. (2006)]. The fragmentation of the value added chain is reflected in the growing share of parts and components in world trade and has given rise to an increased re-organisation of production process at international level [CEPII (2004)].

In the beginning of a product's life-cycle, R&D expenditures constitute a relatively large share of its value added. The products are produced on a relative limited scale in this early stage and economies of scale are not significant in the production process. It is essential that the production of the product in this stage is located both close to the market and close to the supply of skilled labour, experts and specialised suppliers of key services for developing and marketing the product. *External* economies of scale are thus more important in this stage of the product cycle. Later in the life-cycle when products mature and production is characterised with high degrees of economies of scale cost deliberations become more important and the production can be re-located to low-cost countries. Transactions, communications and related costs become relatively smaller per unit of production when scale effects are present.

EU is more successful in trade in ICT *services* displaying a trade surplus which has kept growing since the mid 1990's.[110] Belgium, Ireland, Germany, the Netherlands, Sweden and UK are specialised in trade with communication services. Belgium, Ireland and UK are also relatively more successful in trade with computer services displaying positive RTB's.[111] This specialisation is also based on the ability of EU to produce services with relatively high quality and value added thus reinforcing the pattern that EU has comparative advantages in the production of knowledge intensive goods and services of high quality. Especially the production of software requires much human capital. East European countries are relatively well endowed with a high educated labour force with labour costs well below the EU-15 average. EU-15 software firms have reaped the benefits of this comparative advantage in Eastern Europe and invested in production facilities in the east European ICT sector. The trade effects of these investments are increasingly visible in Poland and the Czech Republic [Meijers et. al. (2006)].

While ICT and other manufacturing industries have imported (sourced) components from other parts of the world in many years, the international sourcing of ICT services is a rather new phenomenon. The relatively recent upswing of international sourcing of ICT services has been driven by rapid technological innovation and diffusion of information technology as well as rapid price declines in telecommunication prices. Also freer trade following liberalisation of trade in services and labour cost savings, especially in labour intensive service production such as call-centre type tasks and access to large pools of skilled English speaking labour outside the home country have contributed to these developments [Kirkegaard (2004)]. Therefore, services are now less constrained in terms of localisation than they used to be.

Re-locations of some ICT services to Asia from the EU and USA have received a lot of attention and spurred an often heated debate about the consequences for growth and employment in the EU and USA. The existing evidence and the discussion above indicates that most of the re-location of ICT services that has taken place applies to labour-intensive production such as call-centres and software coding while software development is still predominantly located in the EU.[112] This conclusion is reinforced by the observations that in-sourcing of knowledge-intensive elements of the value added chain from Asian firms to EU has taken place during the last years [Meijers et. al. (2006)].

7.3.2. FDI

Data on FDI by industry are scarce and often not very detailed. There is however some information for a limited number of countries for aggregates of manufacturing industries including ICT sectors [OECD (2004)]. The major recipients of FDI inflows in OECD to machinery, computers, radio and television and communications equipment industries in 2001 were the Netherlands, UK and France. Japan,

[108] OECD classifies manufacturing industries according to their skill/technology intensity. According to this classification all ICT industries but the manufacture of insulated wire is classified as high technology industries.

[109] Goods are differentiated in both horizontally and vertically. Horizontal differentiation refers to different variants of goods at the same stage of production while vertical differentiation refers to differences due to different stages of the production process.

[110] International Monetary Fund (2005). Balance of Payment Statistics, and OECD (2006) International trade in services.

[111] OECD (2006), International trade on services.

[112] See for example the report by GAO (2004).

UK, the Netherlands, France, Belgium and Luxembourg received large inflows of FDI in the telecommunications services industry during the same year. China and Hong Kong accounted for around 10% of total worldwide FDI inflows in 2002 thereby becoming the largest host countries.

The analyses of FDI in Meijers et al. (2006) corroborate the findings about ICT trade. The authors find that FDI is most present in relatively less knowledge intensive sectors with scale-intensive production and that inward and outward FDI flows are relatively well balanced. Insufficient coverage of data limits the analysis to a few EU countries and industries. Their analysis covers outward and inward FDI in the office and computer industry (ISIC30), radio, television and communication equipments industry (ISIC32), telecommunications services (ISIC 6420) and computer and related services (ISIC 72) between 1999 and 2002.

The largest outflows of FDI appear in the office and computer industry, radio and TV receivers industry and the telecommunications equipment industries with the Dutch ICT manufacturing industry as the largest investor in foreign markets. Also French and German industries are active in investing in foreign locations. Telecommunications services is the third largest ICT industry with respect to outward FDI and the UK industry is more internationalised than other EU telecommunications industries measured this way while the computer services industries in France and the Netherlands engage relatively more than the other countries' computer services in outward FDI [Meijers et. al. (2006)].

Outward FDI by manufacturers of radio, television and communication equipments as well as computer manufacturers appear to be driven by motives for locating production in low-cost locations. Eastern Europe has received relatively high shares of this FDI. The inward FDI in these sectors seem to be motivated by producers outside EU-25 searching for access to more advanced input factors and favourable conditions in general for more knowledge intense production of elements of these products. Outward FDI by telecommunications services is mainly driven by market-seeking motives [Meijers et. al. (2005)]. As flows with the exception of more scale intensive production are relatively well balanced it seems that EU offers an attractive location for production and development of knowledge intensive production.

7.3.3. R&D

R&D in locations outside the home country is mainly driven by two motives. The first motive is market oriented with the purpose of adjusting the products to the local needs and to provide development services for customers. The foreign market must be large enough to justify these kinds of R&D facilities since the establishment of these facilities is often associated with large sunk costs. Asset seeking or search for superior knowledge and/or to locate R&D establishments where framework conditions for R&D are favourable is another strong motive for internationalisation of R&D. Internationalisation of R&D is however not costless. It is often associated with large sunk costs due to capital-intensive equipment. Other important costs are associated with control and organisation of transfer and distribution of knowledge between various units and locations. Related costs are those associated with protection of vital knowledge for the innovating firm. Setting up foreign R&D may also incur costs if home based R&D loses scale advantages [Sanna-Randaccio & Veugelers (2003)].

By analysing triadic patent data, Meijers et al. find that most of the EU ICT research is located in EU and that no country invents more patent applications outside of the EU than inside.[113] Case studies of the R&D activities of ICT firms showed that the home country is the preferred location for R&D. Four European firms were analysed and the results showed that 75% of their research takes place within the EU. The increased internationalisation of R&D that takes place is mainly directed towards setting up facilities in USA and Japan. The location of R&D in other countries research seems to be more market oriented as the locations outside the Triad yielded only a few ICT patents. Thus, the increasing location of R&D facilities in China, India and Eastern Europe that has taken place during the last years is mainly driven by market seeking motives. The evidence suggests that firms prefer to carry out strategic R&D at home where costs of co-ordination and control are lower and where information about and access to skilled labour and systems of innovation is easier. This said, the increasing human capital endowments and low labour costs in China and India can make it increasingly attractive in the near future to locate there other types of R&D, aimed at benefiting from complementarities with their increasing share of production activities in ICT sectors as well as seeking access to the national systems of innovation.

7.3.4. Location of production

The globalisation has changed the landscape of ICT production. Increasing shares of both ICT manufacturing and services production take place in Asian countries. This is not only the result of new compet-

[113] Triadic patents are patens issued by the European Patent Office, the US Patent office and the Japanese patent office.

ing Asian firms but also the result of relocation of ICT production that previously took place in USA and EU. The changing landscape reflects changing comparative advantages and technological developments partly enabled by ICT which has facilitated a fragmentation of production processes allowing for a slicing of the value chain according to comparative advantages in different locations.

The changing location of ICT manufacturing production over time is illustrated in Graph 7.6 below. EU-15, Japan and USA accounted for more than 80% of world production in 1990. By 2002, their combined share had decreased with 25% (20 percentage points) to just above 60%.[114] The major parts of the shares lost by EU15, Japan and USA have been captured by China (12.2%) and other Asian countries most notably Korea (6.2%), Taiwan (4%), Malaysia (3.9%) and Singapore (3.7%) [OECD (2004)].

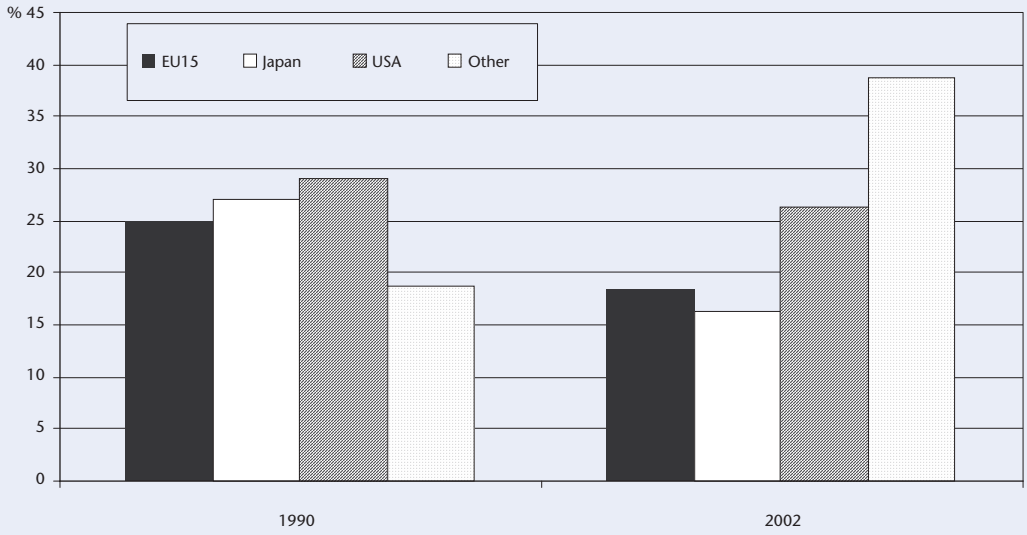
The analysis above has shown that most of the relocation that has taken place refers to products or parts of products which are mature and standardised and where production is labour intensive and subject to high degrees of economies of scale. Relative knowledge intensive activities tend to be located in EU. Strategic R&D is located at home close to the production of knowledge intensive products. EU has comparative advantages in knowledge intensive production due to better access to human capital and superior framework conditions for innovation and R&D.

Product cycles are however relatively short in ICT due to the rapid technological process in the sector. Products that may seem to be innovative today mature fast and can soon be mass produced in locations where unit cost is low and transportation costs as shares of total costs are negligible. Locations outside EU are an alternative for those products.

Meijers et. al. (2006) argue that degrees of knowledge-intensity and economies of scale are main determinants of the localisation of ICT products. The less knowledge-intensive production and the higher the degree of economies of scale, the easier it is to re-locate products or parts of products to low-cost locations. For example is packaged software under pressure to be re-located while, it is less likely that customised and own account software should be re-located. For knowledge-intensive IT services is proximity to the customers a strong complementary reason for location in the EU. Low-cost locations such as India are not the strongest alternative for this kind of production. It is instead the large US market which also offers access to highly qualified labour and favourable framework conditions for R&D that constitutes the strongest alternative

[114] The data is calculated in current US dollars and relative exchange rate changes will therefore have an effect on the shares of the different countries and regions.

Graph 7.6 Share of world ICT production accounted for by EU15, Japan, USA and other countries 1990 and 2002.



Source: OECD (2004) Information Technology Outlook 2004, OECD, Paris. Note: No data were available for Greece and Portugal in 1990. No data available for Luxembourg for any of the years. Largest shares held by other countries in 2001 were China, Korea, Taipei, Malaysia and Singapore.

to location in the EU.[115] Large parts of telecommunications services production are however subject to economies of scale and may be candidates for relocation to Asia.

High knowledge-intensity characteristics of products explains why EU is a preferred location for knowledge-intensive *manufacturing* production of scientific instruments and design of chips and other high-technology electronic components while the mass-production of chips has already to a large degree been re-located to low-cost locations.[116] The telecommunications equipments industry provides an example of how the value added chain of products is divided between different locations. Strong competition in the mobile communications market have forced American and European firms to subcontract the manufacturing of mobile handsets to Asian producers while most of the R&D activities are located in the home countries. Production of products in the later stages in the life cycles in the manufacturing industries office machinery and computers, radio and TV receivers and electronic valves and tubes is scale intensive and therefore candidates for a re-location to low-cost countries.

East European countries have appeared as a strong alternative to Asian location of ICT production as the East European countries have a relatively large supply of human capital at considerably lower wages than in EU-15. Especially successful have the ICT manufacturing industries in Estonia, Czech Republic, Hungary and Poland been and gained comparative advantages in the production of computers, insulated wire, telecommunications equipments and radio and TV receivers.

7.4. Challenges for the future competitiveness of the EU ICT sector

This section provides a picture of recent techno-economic developments triggered by digital convergence and globalisation, and discusses their expected impact on the competitiveness of the ICT sector over the longer term.

7.4.1. Defining trends of ICT cycle in its deployment phase[117]

Certain technologies emerge when certain economic and institutional conditions are met and in return, their adoption and deployment has a considerable impact on the economy and the society. In their deployment phase, it is the spread of new economic and social practices (whether in organizational structures or social interactions) that enable and sustain their production and use within a new socio-economic paradigm.

A new technology thus becomes embedded into current business operations as well as in new consumer goods and services, generating total factor productivity gains as well as consumer welfare. During this phase, the most important transformations tend to be institutional rather than technological.

There is little doubt that we are currently at the deployment phase of the information and communications technologies technological cycle.[118] It is considered as having begun with the microprocessor breakthrough and the general microprocessor expansion continues to form the backdrop to the technological developments, while bringing about institutional and societal innovations.[119]

A much-used measure for the current rate of technological change is the average period during which speed or capacity doubles or, more or less equivalently, the period when the device halves in price. For storage, networks, and computing power, these periods are around 12, 9, and 18 months, respectively.[120] The consequent technological evolutions are nevertheless more than permanent progressions of computing power, as we enter the stage of digital convergence.

Although it was noted as early as the early 80s[121] most observers agree that "real" digital convergence is taking off only now. EITO (2006) sees 2005 as Year One of the new scenario of global digital convergence, as the new paradigm of availability of any content, anywhere on any platform, closer to the reality. In its recent analyses ISTAG[122] (2006) also subscribes to this vision. Digital convergence implies several constitutive features[123]:

[115] SAP is an example of a firm which has R&D facilities in both the EU and USA. According to the case study in Meijers et al. (2006), the US share of knowledge-intensive activities may increase at the expense of SAP labs in the EU.

[116] Table A3 in the annex shows that the EU-25 ICT manufacturing industry has higher market shares in the scientific instruments industry than in any other ICT manufacturing industry.

[117] The broad theoretical framework we use is the concept of Techno-Economic Paradigm Shifts, a further development of the Kondratieff waves (Perez (2004)).

[118] See as well http://www.nicholasgcarr.com/digital_renderings/.

[119] We understand here institution in the widest sense possible, including laws and customs of social interactions (North (1991)).

[120] I.Foster, The Grid: A New Infrastructure for 21st Century Science, Physics Today, 2002

[121] The idea of digital convergence emerged with the MIT's Media Lab in 1978, as an overlap of computing, printing, and broadcasting.

[122] European Commission IST Advisory Group (ISTAG). ISTAG has been set up to advice the Commission on the overall strategy to be followed in carrying out the IST thematic priority and related activities of research as well as on the orientations with respect to the European Research Area by helping to stimulate the corresponding European research communities (http://cordis.europa.eu/istag.htm).

[123] FP 6 project BREAD (BROADBAND in Europe for All: A Multidisciplinary Approach) - Second report on the multi-technological analysis of the 'broadband for all' concept, focus on the listing of multitechnological key issues and practical roadmaps on how to tackle these issues (August 2005); www.ist-bread.org.

– Convergence of services – the same contents supplied over different platforms;

– Convergence of networks – different services supplied via the same network;

– Convergence of terminals – multifunctional terminals that can support different services (that might be supplied through different networks);

– Convergence of market players – the same companies supplies their products and services in different sectors;

– Convergence of regulation – the same regulator and the same set of rules apply in different sectors.

From the strategic and competitiveness perspective, it is very important to distinguish nevertheless between two alternative ways of capturing the opportunities of the deepening of digital convergence: the trend to ever increasing *embeddeness* of inter-communicating electronic components (*Ambient Intelligence*) and the socially driven trends based on Internet applications.

7.4.2. Generalisation of electronic components (embeddeness) as realisation of digital convergence

The major technological drivers of digital convergence are *embeddeness,* itself driven by cost-effective computing, miniaturization, ubiquitous communication, and advanced materials and sensing devices, *communication networks convergence*, and the *increasing standardisation and interconnectivity* of various devices.

The European concept of Ambient Intelligence adds Intelligent User-friendly Interfaces to the above-mentioned technological drivers. The objective of the AmI concept is to enable people and devices to interact with each other and with the environment [Punie (2005)]. The further main lines of development are towards solving the software and hardware incompatibilities [O'Brien (2005)], reducing costs of embedded systems and increase their interconnection. [124]

In 2000 already 98% of computing devices sold were embedded in products and were not apparent to the product's users [Borrielllo and Want (2000)]. In 2002, electronics accounted for 20% of total value creation in the automotive industry, of which two-thirds was generated by software-intensive systems. By 2015 electronics are expected to account for 35% to 40% of the total value created with each new car. Electronics and embedded software-intensive systems are expected to account for almost all (90%) of the future innovation in the automotive sector. Software-intensive Systems currently account for more than 70% of the cost of creating new handheld devices in telecommunication industries [ITEA (2005)].

In the consumer electronic industries, although the market is currently dominated by flat screens, MP3 devices and DVDs, mobility seems to drive the current wave, through products like iPod (32 million sold in 2005 [125]) game consoles (28 million units sold in 2005, growing to 40 million in 200 [126]) or mobile video and TV broadcast devices.

The current shift in healthcare services from reactive to preventive treatment and from hospital to outpatient care opens new opportunities for the development of interconnected and mobile medical devices. However, today, while two out of three big companies producing medical imaging devices are European, the EU lags behind in terms of usage of ICT in the health sector.

7.4.3. Social computing as exploitation of digital convergence

On the other hand, over the last few years, Internet has seen the emergence of a plethora of new applications facilitating social interaction, in particular self-publishing, direct participation and collaboration, such as blogs and wikis [127], social networking websites, search engines, auction websites, games, VoIP and peer-to-peer services. These have facilitated creation and distribution of content with unprecedented speed and variety. Together, they are referred to as "web 2.0", indicating the new paradigm which considers the web as an operative system, or "social computing", because they open the possibility for innovative companies to exploit in a profitable way the connectivity of the Internet to support the networking of people and content. [128]

The success of these applications and the leading firms operating in the corresponding service markets is based on using the shared knowledge of the public. [129]

[124] Accenture found that in 2005 80% of consumers cite cost a major barrier to adoption and that 70% want someone else to aggregate the content, devices, and services used to run the digital home. (www.accenture.com).

[125] http://theappleblog.com/2006.

[126] http://news.softpedia.com.

[127] Wikis are websites that rely on collaborative software to enable collective content production by different users. The primary example is www.wikipedia.org, a free online encyclopaedia with 100.000 unpaid authors.

[128] See Burgelman et al., (2005) for a more complete overview these trends.

[129] Is the customers review that give much value to companies like Amazon and Netflix. Google search algorithms are fine-tuned by the results of each search. The number of click on particular adds give valuable marketing information, etc. (Wired, July 2006.)

More precisely, the common feature of these applications is that they enhance the *community building* capabilities of the Internet, enabling self-publishing, participation and collaboration [Blackman (2005)].

In this context, the user of these applications becomes a co-producer of the service provided, and thus, potentially, the whole of the user base becomes a source of content (Bloq, Wiki, Flickr), of taste/emotion, therefore of marketing information (Amazon, Delicious), of goods (eBay), of contacts (myplace.com), of relevance (Google pagerank), of reputation and feedback (eBay, Tripadvisor), of storage and server capacity (P2P), of connectivity (wifi sharing, mesh networks), of intelligence (business web 2).

Social computing is reinforcement, on an unprecedented scale, of the very strong network effects already exploited through the Internet, and appears to be accompanied by societal changes. The growth of the constituent applications has already had visible social and economic impacts: bloggers played a very influential role during the 2004 US presidential elections and 2005 French referendum on the EU constitution; 740.000 Americans and 170,000 Europeans now rely on eBay as a source of income; in 2005 Myspace.com (a social networking website which is the most viewed website of the Internet after Yahoo) was purchased for $580 million by Rupert Murdoch's News Corporation.

With regard to the ICT industry, these socially driven Internet based trends are a factor of structural change. They act on markets by lowering entry costs, they promote new business models largely relying on advertising as an effective source of revenue and they give rise to new players. Their influence is felt beyond the ICT industry as they provide new channels of delivery for traditional services.

7.4.4. Evolving business strategies in the context of emerging trends

Two tendencies are specific to the present transformation of ICT markets. First is the redistribution of value-added along the various segments of the ICT industry: equipment and software producers, network operators, platform- and application-integrators, and end users. The second is the integration of vertical chains and emergence of new horizontal markets, raising important challenges for the regulation of competition.

The outstanding example is that of companies, predominantly US-based, which promote the application platforms for the new socially driven trends. The most successful of these tend to integrate downstream and upstream segments of the value chain to gain market dominance for their own final products. In doing so, their strategies shift from cooperation and mutual benefit (e.g. advertisement brokerage to finance free content) to market consolidation (mergers and alliances with Internet and telecom providers).

In many cases, this involves alliances with European companies, as for instance the several major alliances formed in the area of portals (Google with T-Mobile), instant messaging (Microsoft/MSN with Vodafone) etc. Through vertical integration, they raise barriers to creative destruction in their original markets. These strategies allow them to surpass their original ambition of controlling Internet based service markets (search, instant messaging, e-mail, online payment), expanding into various areas of content production such as digital TV, music, video, as well as in the areas of the digital home and network access [IDATE (2005)].

The new architecture is dynamic, with emerging trends pulling the realignment and redesign of the value chains. Success and competitiveness still belong to innovative companies acting in markets with high rates of entry and exit ("creative destruction") or relying on rapid value accumulation based on high sunk costs, mostly R&D-related ("creative accumulation").

Although an oversimplification, it is useful to broadly associate the production of ambient intelligence with the innovative type of "creative accumulation", given the prevalence of large established firms and the presence of corresponding barriers to entry for new innovators. Quite on the contrary, in the service markets based on social computing, suppliers are natural candidates for the "creative destruction" type of innovation, with the technological ease of entry and a major role played by entrepreneurs and new firms in innovative activities.[130]

It is worth noting that Internet heavyweights such as Yahoo, Google and eBay originate[131] from national markets with business environments more prone to the "creative destruction" type of innovation, as well as with a more vivid innovation culture, mostly from US. This is supported by the much higher rate of entry-exit of firms and higher dynamics of mergers and acquisitions[132] than in Europe. The trade of ideas replaces the nurturing of R&D capabilities, while the risk is transferred to venture capitalists. This pinpoints

[130] For further discussion of innovation types, see Malerba (2002)

[131] Or migrate, as it is the case of Skype, founded in Luxembourg, currently a subsidiary of eBay

[132] Instead of developing their own R&D departments, big American companies tend to buy spin-offs already successful in new markets. In the last 12 years, Cisco acquired 107 companies building up its profile as one of the most valuable tech companies in the world. In 2005 News Corp bought of MySpace parent company and in 2006 the online karaoke player kSolo and News aggregator Newroo (etc).

the role of innovation systems in defining the profile of the ICT competitiveness.

This process is accompanied by permanent and active reallocation of lower value-added activities, particularly from manufacturing towards developing economies, as well as of mainly non-core R&D. This "specialisation", including that involved in generating and leading emerging segments, has among its determinant factors the inner features of the national/local innovation systems,[133] and thus may continue in future to generate the distribution of competencies and market segments in a more globalised world.

7.4.5. Policy considerations regarding the competitiveness of the EU ICT industry

ISTAG (2006) highlighted the EU's main industrial and technological strengths in global markets. They are in:

- Both traditional telecommunications, and IP-infrastructure;
- Embedded computing;
- Micro- and nano-electronics and Microsystems;
- "Smart" integrating systems; and,
- Multicultural audiovisual content.

Threats to EU competitiveness in ICT include those arising from:

- Slow user uptake of new technologies;
- Growing investments in emerging economies, leading to the reallocation of lower value-added activities;
- Further expansion of US dominance in computing and the innovativeness of American firms; and,
- Strong technological niches appropriated by Japanese companies.

Given these threats, Europe can maintain and enhance its competitiveness through building upon its ability to develop frontier technologies and facilitating the demand for theses in potential leading markets, within the context of the European social model.

In the context of the Lisbon process, Member States are invited "to facilitate the spread and use of ICT and build a fully inclusive information society" (Guideline N°9), also by encouraging "the development of strong ICT and content industries". However, in general, in their National Reform Programmes (NRPs) Member States did not address directly the promotion of the ICT industry, except as far as the regulatory framework is concerned. Other than this, the main areas for action are e-government, broadband infrastructure and digital literacy. Whilst the main objective of these measures may lie in other policy areas (for instance, modernising public administration, providing faster access to public services, social and territorial inclusion), they can also be seen as contributing to increase the demand of ICT products and services. Many NRPs refer to the EU i2010 framework (ref. next paragraph), therefore recognising common objectives.[134]

The Commission Communication[135] "i2010 – A European Information Society for growth and employment" encompasses a number of policy initiatives directed towards both the demand and supply side of ICT which could further strengthen the competitiveness of the EU ICT sector.[136] The Communication outlines three priorities for Europe's information society and media policies: completion of a single European information space, strengthening innovation and investment in ICT research and achieving an inclusive European information society.

In the light of the discussion of digital convergence, of particular relevance is the first priority of i2010, aiming at establishing a consistent system of rules for the information society and media. This covers the review of the e-communication regulatory framework, spectrum management, interoperability – particularly as concerns the management of digital rights, and security (e.g. responding to system attacks or failures, identity management, protection of privacy etc).

Concerning other microeconomic policies, R&D is key in ICT innovation and thus competitiveness. However, in terms of R&D intensity[137], the EU position is worrying. R&D intensity in ICT sectors in the EU is less than half that in US and in Japan [CSTI

[133] The innovation systems literature distinguishes between the American model of innovation systems and the Continental European one. More precisely, the American model is characterised by 1) strong IPR and patent systems; 2) corporate governance systems dominated by outsiders, with innovations being financed through financial markets; 3) a flexible and efficient external labour market, allowing high rate of ventilation of human capital. The Continental European one is based on 1) open knowledge, with firms competitiveness based more on the retention of specific capabilities than on IPR protection; 2) corporate governance systems dominated by insiders; 3) efficient internal labour markets designed to build up, inside the firm, the capabilities and competencies needed for innovative activities [Coriat and Weinstein (2004)].

[134] See Annex of the Commission's Annual Progress Report COM (2006) 30 final of 25.01.2006, *Time to Move up a gear*.

[135] COM (2005) 229 final of 1.06.2005.

[136] "i2010 – A European Information Society for Growth and Employment" COM (2005) 229 final.

[137] Calculated as the ratio between R&D expenditures in the ICT business sector and the total production of ICT.

(2005)]. Even though these numbers may hide methodological limitations they show that, overall, the EU lags behind.[138] However, one characteristic feature of Europe is that the R&D investment is strongly concentrated in larger firms, and that the EU companies that invest in R&D do invest more in comparison with their non-EU counterparts. This explains why the activities developed with the need for high R&D sunk costs are seen as competitively advantageous for EU despite the lesser overall R&D effort[139].

Given the socially driven trends discussed earlier, it is suggested that the R&D effort would be more efficient in Europe if it takes into account the specificities of European societies and their specific current and expected demands: inclusion, multilingual diversity, ageing population, highly-educated labour force, and specific values (such as environmental protection, consumer protection, privacy and security). Also, much will depend on its capacity to develop synergies with *the next wave of new* technologies. Perez (2004) expects that the next technological wave will be driven by biotechnology, bioelectronics, nanotechnology and new materials, in which ICT sectors might find opportunities for further development.

Finally, some adjustments and corrections to the innovation model might open new potential niches. For instance, on the content market, although the European cultural heritage and diversity of Europe constitutes a natural and strong competitive advantage, today's European online content sector is less than 3% of the total revenues from music, video and games [ISTAG (2006)]. The global online content market is dominated by the USA, in part because of the nature of the innovation model. So far, European groups have met with limited success in deriving sufficient competitive advantage from their contribution to standards like MPEG. Without dynamic innovative entrepreneurs that would promote European content, current strengths of EU ICT research and industry such as those in image processing, representation and coding, semantics and knowledge management could be lost or result in their becoming "vehicles" for largely non-European content.

Another aspect relates to general business environment. The success of embedded computing is essentially an asset of EU companies in several leading sectors such as the automotive industry, medical equipment, telecommunication equipment and some consumer electronics products (e.g. high-end audio and video systems). However, due to the prevalence of in-house research and production of embedded systems in the sectors to which they apply, their success has a very limited direct impact on the ICT sector as such. Measures like the setting-up of European Technology Platforms, or networking through research programmes might be beneficial for a more intense subcontracting of ICT activities towards the ICT sector.

Finally, the further competitiveness of the European telecommunication services sector will strongly depend on the evolution of the regulatory framework and the type of innovation this will promote in the various segments of the telecommunications market. The single market, the strengths of EU industry in telecommunication equipment and mobile and networked services as well as the widespread efforts aimed at promoting broadband access all support the notion that policies can play an important role in furthering the future competitiveness of the sector.

7.5. Summary and conclusions

The EU ICT manufacturing trade deficit is caused by EU's industries not being able to compete with relatively homogenous and labour intensive goods. The improvement in terms-of-trade indicates that even though quantities of imports have increased quite substantially relative quantities of exports, export prices have risen relative to import prices. This implies that EU has comparative advantages in differentiated goods of higher quality goods commanding higher prices. Furthermore, the increased trade in intermediate goods which in large amounts take place as intra-firm trade indicates that some of the imports are used as intermediate products in finished goods of a relative high quality.

EU has comparative advantages in production of ICT services which has manifested itself through a trade surplus which has kept growing since the mid 1990's. Especially the ICT services industries in Belgium, Ireland and UK are successful. The comparative advantages are based on the ability of EU to produce services with relatively high quality and value added. This is especially true for the production of software which requires much human capital in the development process.

The increased globalisation has created possibilities to fragmentise production and locate production of elements of products in locations with comparative advantages for the different parts of the production process. As a consequence, chip design is made in Europe while mass production of chips takes place in South-East Asia; software development is carried out in European software labs while the coding of software is done in India. Proximity to the customers of specialised products such as customised software is yet another argument for location in the EU. The

[138] For instance, ICT production in the USA does not include the defence sector, where a significant part of research in ICT is carried out.

[139] IPTS (2005) "The 2005 EU industrial R&D investment SCOREBOARD".

evidence suggests that knowledge-intensive production, product development and strategic R&D are still located in Europe while labour-intensive production of mature standardised goods has been located to Asia.

This said, ICT producers in the new member states have shown that it is still possible to be competitive in EU with low-cost and scale intensive production such as insulated wire, radio and TV receivers and other consumer electronics as well as computers. It is however unlikely that this kind of production is competitive in the longer perspective. It is therefore necessary to further strengthen the links between systems of innovation of old and new member states and thereby reaping the full potential of the relatively high skilled labour force in the new Member States.

The analysis in the previous sections has shown that EU has comparative advantages in knowledge intensive production of high quality products. With regards to ICT services, EU is specialised particularly in IT services and software production. For ICT manufacturing, EU comparative advantages are found in the production of scientific instruments, electronic products and telecommunications equipment of high quality. The answer to the challenge from low-cost producers lies in further climbing up the quality ladder and a fast flow of new innovative products satisfying the growing demand for advanced goods and services. Achieving this objective will be easier if the right sector-specific and more general micro-economic policies are in place. Such policies could include the ones ensuring the availabilities of e-skills required by the EU industry in the years to come, and the ones promoting the ICT uptake and usage by all sectors and in particular by SMEs.

At sectoral level, the Commission launched an ICT Task Force in June 2006 with a mandate to provide sector-specific policy recommendations concerning ICT uptake, IPR, innovation, SMEs and entrepreneurship, skills and completing the single market. They would complement the i2010 initiative and the many measures that Member States have committed to implement in their National Reform Programmes in the areas of *e*-government, broadband infrastructure and digital literacy, which contribute, indirectly, to a faster and wider take up of ICT.

The links between innovation and standardisation discussed in chapter 6 of this report points to the importance standards have for fostering innovation activities in new innovative technology areas, especially those which require interoperability between different applications. The Commission should ensure that the EU ICT standards setting policy is optimised to respond to current and future societal and market needs.

Raising the R&D investments of the EU ICT sector will be crucial for its future competitiveness given the lags already existing vis-à-vis its main competitors. This is not so much a necessity for the larger EU enterprises of the sector as for the smaller ones and start ups. This points to the existence of a more systemic weakness in generating – and financing research in – small innovative firms which cannot be addressed by sector specific measures alone; it rather necessitates the horizontal policy responses reviewed in the chapter on the financing of innovation.

As concerns the more general business environment, and for a fast moving sector such as ICT, the policies that matter most are those bearing on the framework conditions that determine change and innovation: R&D, education and lifelong learning, competition and market opening as well as less red tape, i.e. those composing the EU Strategy for Jobs and Growth.

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Annex Table 7.1: Definition of the ICT sector according to international industrial classifications.

Description	ISIC Rev. 3.	NACE Rev. 1.
Manufacture of computers and other information processing equipment	3000	30.02
Manufacture of office machinery	3000	30.01
Manufacture of insulated wire and cable	313	31.3
Manufacture of electronic valves and tubes and other electronic components	321	32.1
Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	322	32.2
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	323	32.3
Manufacture of industrial process control equipment	331	33.3
Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	331	33.2
Wholesale of office machinery and equipment	5150	51.64
Telecommunications	642	64.2
Hardware consultancy	721	72.1
Software consultancy and supply	722	72.2
Data processing	723	72.3
Database activities	724	72.4
Maintenance and repair of office, accounting and computing machinery	725	72.5
Other computer related activities	729	72.6

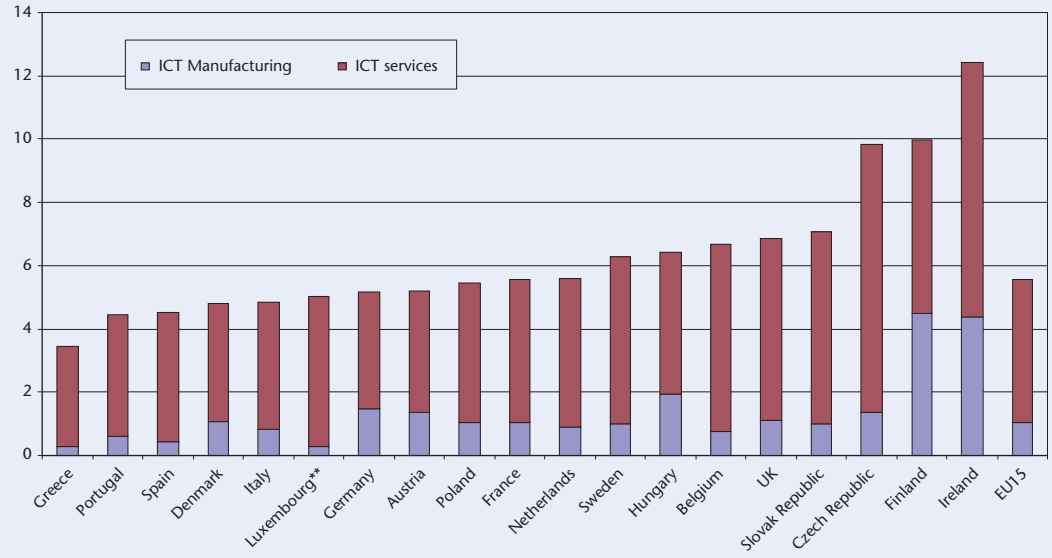
Annex Table 7.2: Some characteristics of the ICT manufacturing and service industries in EU. 2003 or most recent year available

	ICT Manufacturing				ICT Services			
	Value added € million	Number of Persons employed	Number of enterprises	Turnover € million	Value added € million	Number of Persons employed	Number of enterprises	Turnover € million
EU25	84 724	1 537 180	63 183	335 303	314 332	3 723 118	521 638	767 135
Belgium	2 073	22 763	512	5 510	9 612	89 356	12 723	28 296
Czech R.	847	63 047	5 199	6 073	3 016	74 005	24 008	6 151
Denmark	1 094	16 558	597	2 989	3 192	43 793	6 983	9 174
Germany	21 873	339 439	7 144	79 861	65 073	634 518	46 392	155 328
Estonia	66	6 970	179	247	311	7 659	977	788
Greece	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Spain	2 187	53 802	3 158	9 614	24 314	28 3642	29 763	58 373
France	14 888	254 105	6 649	59 610	44 488	494 939	50 357	104 932
Ireland	2 862	26 100	190	19 503	2 547	26 542	3 644	7 244
Italy	8 402	171 153	14 359	27 434	40 383	508 014	92 870	106 200
Cyprus	n.a	n.a	n.a	n.a	403	4 977	310	620
Latvia	20	2 657	116	62	444	12 497	1 177	991
Lithuania	107	11 275	186	365	415	16 310	1 495	1 331
Luxembourg	63	1 625	12	146	926	6 385	1 174	2 816
Hungary	1 784	69 917	3 495	12 260	2 532	72 529	21 918	7 868
Malta	185	3 353	60	1 134	48	1 972	701	112
Netherlands	1 481	19 210	1 275	4 864	7 656	126 373	20 495	23 924
Austria	2 402	34 281	605	7 329	6 263	73 804	13 499	15 845
Poland	1 527	76 658	7 332	6 089	1 341	79 107	25 651	4 966
Portugal	703	16 994	490	3 633	4 044	47 764	4 419	11 492
Slovenia	289	11 812	672	901	424	12 858	2 153	1 599
Slovak R.	220	26 832	313	1 189	783	22 249	1 369	1 833
Finland	6 746	44 497	698	27 376	4 428	57 675	4 874	12 202
Sweden	1 425	61 195	1 809	15 026	10 291	150 433	29 751	28 927
UK	13 481	202 937	8 133	44 089	81 400	875 717	124 935	176 122

Source: EUROSTAT, New Cronos 2006.

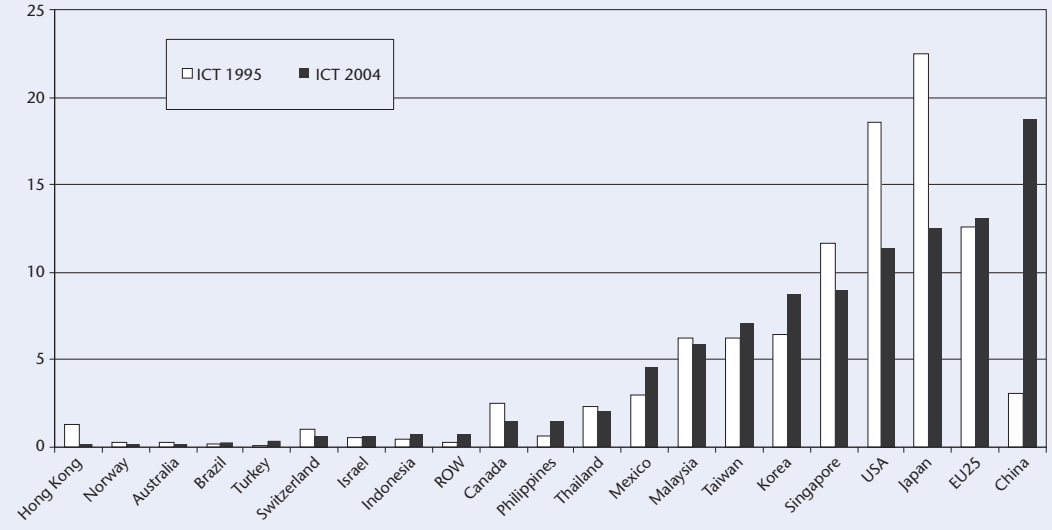
Notes: No data is available for Cyprus or Greece. Data for Malta, Poland and Sweden refer to 2002. Data on employment, turnover and value added data for manufacturing in Luxembourg is only available for NACE 33.2. Manufacturing data for Denmark, Latvia and Sweden do not include NACE 31.3. Data on employment, turnover and value added in manufacturing for Netherlands do not include NACE 32.3. Employment data for Netherlands do not include NACE 30. Manufacturing data for Lithuania and Malta do not include NACE 33.3. ICT services data for Malta refer to 2002. German data for 51.43 refer to 2002. Luxembourgian data for NACE 72 refers to 2002. Slovenian data for NACE 64.2 refers to 2002. Data for the Czech ICT services industry do not include 51.43. Data for the Danish, Irish, Maltese and Polish ICT services industries do not include 64.2. Data on employment and value added are nor available for NACE 64.2 in Netherlands. Data on employment for manufacturing in Malta and Slovenia do not include NACE 33.2. Employment data for manufacturing in Latvia does not include NACE 31.3. Employment data for manufacturing in Lithuania does not include NACE 33.3. Data on turnover for manufacturing in Latvia does not include NACE 33.2. Data on turnover in Maltese manufacturing does not include NACE 31.3. Data on turnover in the Estonian and Maltese ICT service industries do not include NACE 64.2. Data on value added in the Estonian and Polish ICT service industries do not include NACE 64.2.

Annex Graph 7.1: Average shares of GDP for ICT manufacturing and ICT services 2001-2003



Source: Groningen Growth and Development Centre, 60-Industry Database, October 2005, http://www.ggdc.net.
Note. Communications includes postal services.

Annex Graph 7.2: ICT manufacturing export shares 1995 and 2004 (ExtraEU trade, percent)



Source: United Nations Comtrade (2006)

Annex Table 7.3: Export shares in ICT manufacturing industries 2004. (Extra-EU trade, percent)

	Office machinery	Insulated wire	Electronic valves and tubes	Telecom equipment	Radio and TV receivers	Scientific instruments
Australia	0.3	0.3	0.1	0.3	0.2	0.5
Brazil	0.1	0.8	0.1	0.3	0.7	0.2
Canada	1.2	2.2	0.9	3.7	0.9	2.4
China	29.0	12.4	7.1	21.6	26.2	8.8
Hong Kong	0.2	0.0	0.5	0.0	0.0	0.1
Indonesia	0.9	1.4	0.3	0.7	1.3	0.1
Israel	0.3	0.2	0.5	2.0	0.5	1.1
Japan	8.6	7.3	15.5	12.3	12.5	16.7
Korea	7.2	3.7	9.0	9.8	15.2	3.6
Malaysia	6.7	1.6	8.7	3.1	5.3	1.5
Mexico	4.6	20.5	1.1	4.9	8.4	2.5
Norway	0.1	0.9	0.0	0.5	0.1	0.6
Philippines	2.1	2.7	2.3	0.7	0.3	0.1
ROW	0.3	6.5	0.3	0.8	0.5	1.5
Singapore	9.2	1.3	16.8	3.2	4.7	2.5
Switzerland	0.2	1.7	0.4	0.4	0.3	2.9
Taiwan	6.5	2.2	10.9	4.0	3.1	9.2
Thailand	2.8	1.7	2.5	2.3	1.4	0.2
Turkey	0.0	1.8	0.0	0.1	1.7	0.1
USA	9.4	13.3	13.5	11.3	3.6	22.0
EU25	10.3	17.5	9.5	18.1	13.0	23.3
	100	100	100	100	100	100

Source: United Nations Comtrade (2006)

Annex Table 7.4: Revealed Comparative Advantages in EU-25 ICT manufacturing industries 2004.

	Office machinery	Insulated wire	Electronic valves and tubes	Telecom equipment	Radio and TV receivers	Scientific instrument	ICT
Austria	0.3	1.6	0.5	0.2	0.4	0.6	0.4
Belgium	0.4	0.4	0.1	0.3	0.4	0.3	0.3
Cyprus	0.0	0.0	0.7	0.0	0.0	0.0	0.2
Czech Rep.	1.1	3.5	0.3	0.6	1.0	0.6	0.9
Denmark	0.5	0.5	0.1	0.6	1.3	1.2	0.6
Estonia	0.0	3.5	0.2	6.4	2.6	0.9	1.4
Finland	0.1	0.9	0.2	2.7	3.3	0.7	1.1
France	0.4	0.7	0.4	0.6	0.6	0.9	0.5
Germany	0.6	0.8	0.4	0.5	0.7	1.2	0.6
Greece	0.1	2.5	0.1	0.9	0.3	0.4	0.3
Hungary	1.2	3.2	0.4	2.0	5.1	0.8	1.8
Ireland	3.1	0.5	1.1	0.6	0.2	0.4	1.4
Italy	0.1	0.8	0.2	0.4	0.2	0.5	0.3
Latvia	0.1	2.2	0.1	0.2	0.4	0.5	0.3
Lithuania	0.3	5.5	0.7	0.6	0.8	0.5	0.7
Luxembourg	0.4	0.1	0.2	0.1	0.8	0.5	0.4
Malta	0.3	0.2	10.9	0.1	0.1	0.3	3.0
Netherlands	2.5	0.5	1.1	0.9	0.9	0.7	1.4
Poland	0.1	3.4	0.2	0.6	0.6	0.3	0.4
Portugal	0.4	3.7	0.5	0.3	0.9	0.3	0.6
Slovakia	0.5	4.6	0.2	0.1	0.7	0.2	0.5
Slovenia	0.1	0.6	0.1	0.6	0.0	0.7	0.2
Spain	0.2	1.2	0.2	0.3	0.6	0.4	0.3
Sweden	0.3	1.0	0.1	3.0	1.4	0.9	0.8
UK	1.0	0.6	0.6	0.9	0.8	1.4	0.9

Source: United Nations Comtrade (2006).

RCA for the ICT manufacturing industry in an individual country *k* relative to the total world is calculated as follows:[140]

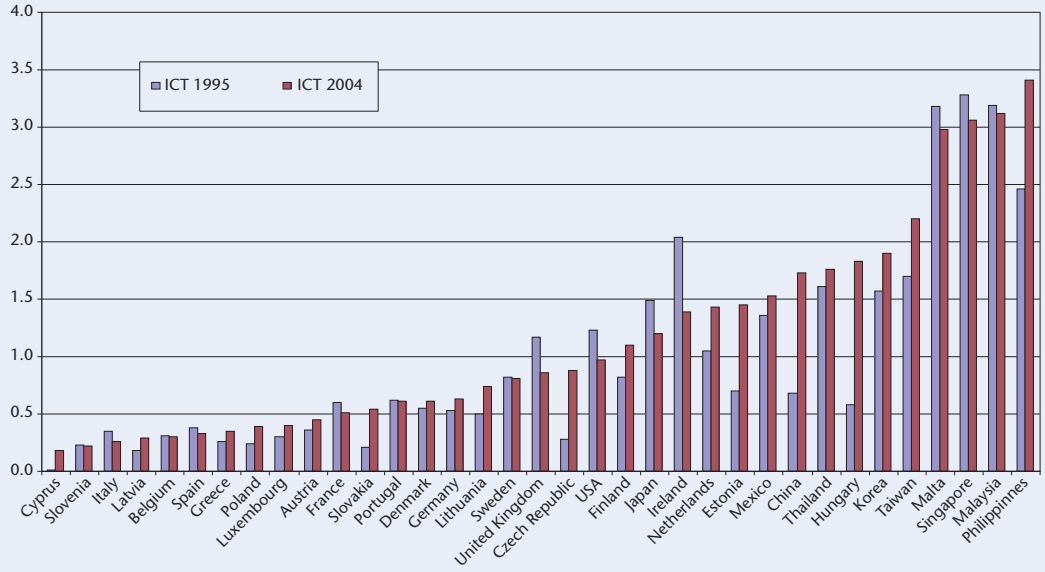
$$RCA_{ICT}^{k} = \frac{\frac{X_{ICT}^{k}}{X_{manufacturing}^{k}}}{\frac{X_{ICT}^{World}}{X_{manufacturing}^{World}}}$$

where X denotes exports.

Suppose that the ICT industry in country *k*, is the Japanese ICT manufacturing industry. If the industry's share of world exports of ICT equipment is larger than the Japanese share of world exports of all goods, this indicates that the Japanese ICT producer is internationally competitive. In this case, RCA_{ICT}^{k} has a value larger than one.

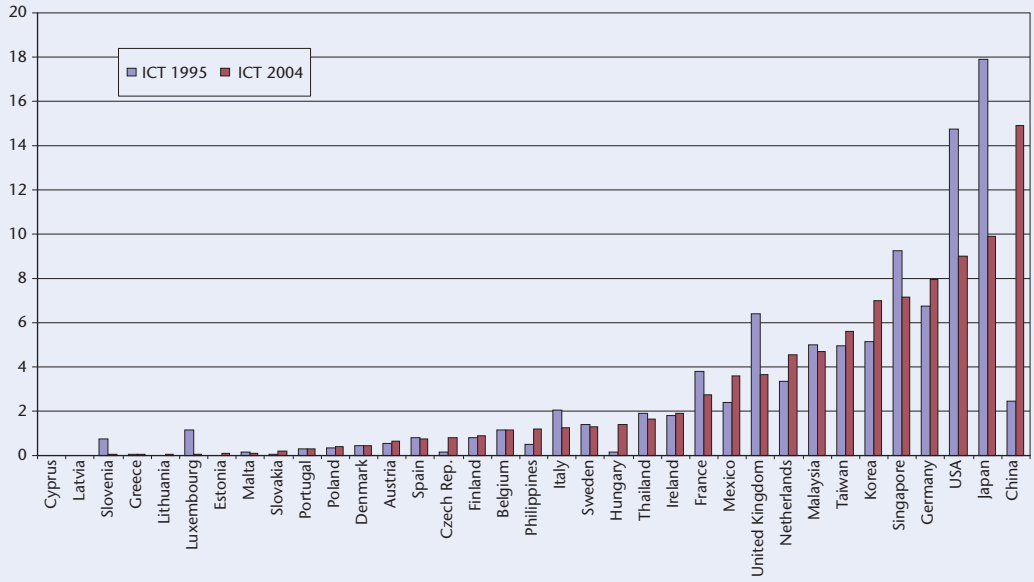
[140] See OECD (2002) and (2003) and J.M. Irogoyen (2003). "Indicators for tracking EU industries' competitiveness", Enterprise DG, January 20.

Annex Graph 7.3: Revealed Comparative Advantages in the ICT manufacturing industries 1995 and 2004. (Intra-EU trade included)



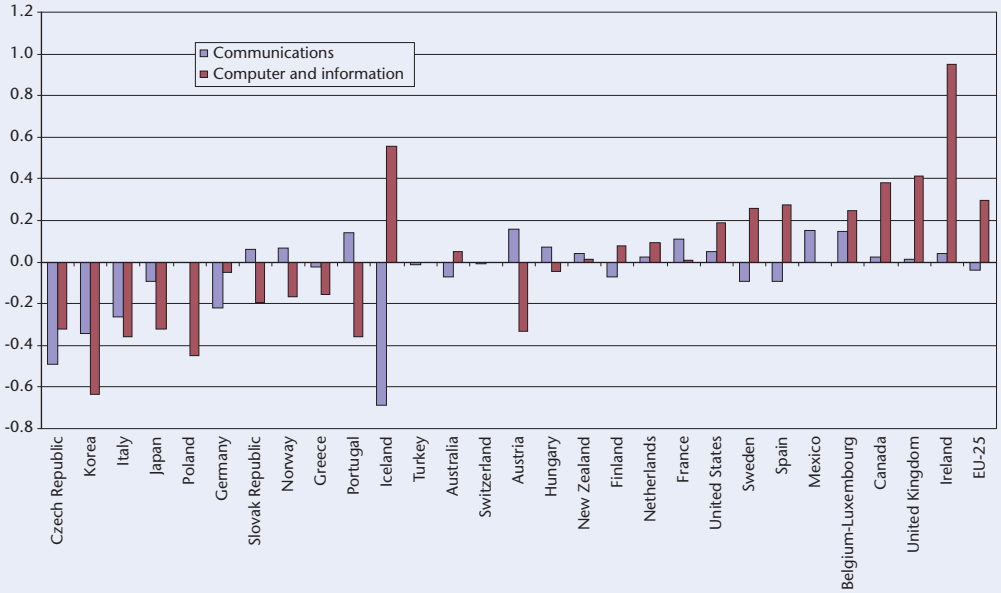
Source: United Nations Comtrade (2006)

Annex Graph 7.4: Export shares in the ICT manufacturing industries 1995 and 2004. (Percent. Intra-EU trade included)



Source: United Nations Comtrade (2006)

Annex Graph 7.5: Relative Trade Balances (RTB) in the ICT services industries 2003. (Intra-EU trade included for the individual EU countries)



Source: OECD. Statistics on International Trade in Services. (2006). Note. EU-25 is an aggregate estimated by Eurostat which excluded Intra-EU trade. EU-18 is the sum of the market shares for the individual Member States for which there are data available. Communication services includes postal and telecommunications.

The measure relative trade balance which is used for ICT services, RTB is defined as

$$RTB = \frac{(X_{ICT} - M_{ICT})}{(X_{ICT} + M_{ICT})}$$

where X and M denotes exports and imports respectively. The measure can take on values between minus one and one. A positive value indicates that the country is performing well. The higher value the more competitive is the country's ICT services sector.

Chapter 8: Competitiveness in the Pharmaceutical industry

8.1. Introduction

This chapter examines the competitive position and performance of the European pharmaceutical industry. Since in this sector, US and Europe represent the main producers and the main markets, the analysis will focus on comparing their performance and respective characteristics. Other regions and countries will also be reviewed when relevant.

8.2. Profile of the industry

Total expenditure on pharmaceuticals represents between 0.7% (Luxembourg) and 2.3% (Slovak Republic) of GDP across OECD countries, with a mean of approximately 1.5%[141]. At 1.9%, the US share is higher than the OECD average, whereas the EU-15 average is 1.4%. The worldwide market for pharmaceuticals has doubled in size since 1995, to €447, 3 billion (as of 2005).

The US market is not only by far the largest national pharmaceutical market, but has also grown impressively during the last decade In recent years the US pharmaceutical market, measured by sales at ex-factory prices, has grown faster than European markets. The US market is currently twice as large as the EU-15 aggregate (see Table 8.1; Berndt, 2001), and accounts for approximately 50% of the world market for pharmaceuticals (up from 31.2% in 1995). Europe held a 30% share of the global pharmaceutical market in 2003, while Japan's share in 2005 was nearly 12% (see Table 8.1). China, Brazil and India are growing fast, gaining shares in the international market. Poland, Hungary and, to a lesser extent, the Czech Republic are among the fastest-growing national pharmaceutical markets in Europe.

Employment in the pharmaceutical industry is considerably higher in the EU than in the US. In 2001, pharmaceutical firms based in the EU-15 countries employed 471,000 people, equivalent to 1.7% of total employment in manufacturing. 2003 figures for EU-25 are 576000, which is also 17% of employment in manufacturing. The corresponding figures for the US are 276,000 employees, and a 1.5%t share of manufacturing employment in 2001 (increased to 1.7% in 2003). Although employment in the European pharmaceutical industry is higher than in the US, the US outperforms Europe and Japan in terms of both rates of growth and the incidence of pharmaceutical production over total manufacturing (see Table 8.2). On average, from 1995 to 2003 the US production of pharmaceuticals has grown slightly faster than in Europe, and considerably faster than in Japan.

Table 8.3 shows pharmaceutical trade flows for the EU, the US, and Japan. Trade in pharmaceutical products has been increasing at fast rates both in the EU and in the US, and more slowly in Japan. Europe has experienced an increasingly positive trade balance, while the US trade balance turned negative in 2002, mainly due to exchange rate fluctuations and to re-importation flows from European subsidiaries of US multinationals. Japan has shown a constantly negative trade balance over the years. Finally, a progressively larger share of total EU trade is accounted for by intra-EU trade, pointing to increasing integration. The share of EU-15 exports in pharmaceuticals going to the US has increased in recent years, to the extent that the US has become the main destination of EU pharmaceutical exports. Also the share of pharmaceutical imports into the EU from the US has increased over time, reaching 55.9% of total EU imports in 2004.

[141] Data refers to 2003. Source: OECD. Analyses in sections 8.2 and 8.3 rely on data from a wide set of sources, including IMS Health, OECD-STAN, Eurostat, NBER-UN, GGDC. Only limited information is available about New Member States in most sources, therefore data for the EU-25 aggregate are not presented. As for the analysis in Section 8.5, Malta and Cyprus are not included in the EU-25 aggregate, due to unavailability of data in the CERM database.

Table 8.1. The size and growth of main national pharmaceutical markets (€ million; growth rates are calculated in national currencies) (1)

Rank	Country	1999		2000		2001		2002		2003	
2003		€ mil	+nc	€ mil	+nc	€ mil	+nc	€ mil	+nc	€ mil	+nc
1	US	124.261	18	163.439	14	197.351	17	208.970	12	194.061	11
-	EU-15	72.094	8	79.962	10	90.100	10 (2)	96.825	8	103.142	8
2	Japan	50.246	7	62.606	3	59.744	4	55.736	1	52.092	3
3	Germany	17.135	5	18.112	6	19.904	10	21.445	8	23.288	8
4	France	16.574	5	18.066	9	19.402	7	20.117	4	21.352	6
5	Italy	10.445	8	11.961	15	13.430	12	14.089	5	14.742	4
6	UK	10.434	11	12.091	7	13.148	11	14.446	11	14.528	11
7	Spain	6.556	16	7.692	16	8.342	10	9.144	10	10.205	12
8	Canada	5.274	11	6.843	13	7.899	17	8.476	15	8.827	11
9	China	4.290	*n.a.*	5.442	*n.a.*	6.316	*n.a.*	6.460	*n.a.*	6.576	*n.a.*
10	Mexico	4.440	*n.a.*	6.247	*n.a.*	7.318	*n.a.*	7.589	*n.a.*	6.450	*n.a.*
11	Brazil	5.882	*n.a.*	7.243	*n.a.*	6.015	*n.a.*	5.318	*n.a.*	4.782	*n.a.*
14	India	3.243	9	3.706	3	4.080	12	4.152	11	3.929	8
16	Netherlands	*n.a.*	*n.a.*	*n.a.*	*n.a.*	2.983	*n.a.*	3.268	10	3.550	9
17	Belgium	2.530	8	2.715	7	2.860	6	3.039	7	3.329	10
18	Poland	2.128	16	2.744	22	3.249	8	3.205	4	3.174	13
19	Greece	1.324	20	1.519	19	1.803	20	2.274	26	2.740	21
20	Sweden	2.017	11	2.327	11	2.276	7	2.474	8	2.532	2
21	Switzerland	1.711	10	1.905	8	2.169	10	2.389	7	2.519	10
23	Austria	1.669	11	1.762	6	1.862	6	2.032	9	2.160	6
24	Portugal	1.571	13	1.698	8	1.847	9	1.991	8	2.064	4
28	Hungary	767	19	840	13	1.016	19	1.275	19	1.440	18
29	Finland	974	9	1.069	10	1.200	12	1.326	11	1.410	6
33	Denmark	865	8	952	10	1.044	10	1.180	13	1.243	5
34	South Africa	898	15	1.097	19	1.027	12	901	13	1.175	12
35	Norway	766	13	854	9	961	11	1.180	14	1.142	3
36	Czech Republic	690	5	793	11	878	6	1.059	9	1.139	11

(1) Percentage increments are rounded to integer directly in the source.
(2) Cleaning of the data for Netherlands.

Source: IMS Health - World Review (various issues, original data in USD).

8.3. Productivity and cost competitiveness

Table 8.4 presents data on pharmaceutical labour productivity (value-added per employee, converted in 1997-PPP thousand US dollars) for the period 1980-2003, together with average annual growth rates. The table shows that Europe lags behind the US in labour productivity and that the productivity gap with the US is much larger in pharmaceuticals than in overall manufacturing. In 2003, labour productivity in the European pharmaceutical industry was 53.1% that of the US[142]. Only in Ireland and Sweden value added by employee was higher than in the US. Moreover, most recent data show an upsurge of US productivity growth (6.4% versus 5.8% in EU-15), and that gap continues to widen.

Even though overall increase in productivity in EU-15 is lower than in the US, differences across European countries are significant. From 1996 to 2003 the best performers in terms of labour pro-

[142] Calculating productivity on a per hour worked basis would reduce patially the EU-US productivity difference.

Table 8.2: Total production of pharmaceuticals in current € millions and as percentage of the value of total manufacturing production (in italics); Compound Annual Growth Rates (CAGR) calculated in national currencies

Countries	1990	1995	2000	2001	2002	2003	CAGR in NC (1)	
							1990-1995	1995-2001
EU-15 (2)	-- --	88.251 *2,4%*	126.891 *2,6%*	135.313 *2,8%*	-- --	-- --	-- --	7,4% *0,07%*
USA	43.779 *1,9%*	60.750 *2,2%*	125.338 *2,6%*	141.156 *3,0%*	133.977 *3,1%*	123.121 *3,3%*	7,3% *0,06%*	8,0% *0,14%*
Japan	33.981 *1,9%*	54.832 *2,2%*	72.529 *2,4%*	70.068 *2,6%*	64.261 *2,8%*	60.498 *2,8%*	1,5% *0,06%*	2,0% *0,08%*
France	15.699 *2,8%*	21.721 *3,4%*	27.707 *3,5%*	30.508 *3,7%*	31.763 *3,9%*	-- --	5,4% *0,12%*	5,9% *0,05%*
Germany	12.974 *1,4%*	18.035 *1,7%*	22.893 *1,8%*	24.304 *1,9%*	-- --	-- --	4,7% *0,04%*	5,9% *0,03%*
United Kingdom	8.739 *2,1%*	12.189 *2,6%*	19.144 *2,8%*	20.822 *3,1%*	22.382 *3,5%*	20.667 *3,5%*	10,0% *0,11%*	4,2% *0,08%*
Italy	15.770 *2,7%*	12.210 *2,2%*	17.747 *2,4%*	18.090 *2,4%*	21.298 *2,8%*	-- --	1,5% *-0,11%*	5,1% *0,04%*
Korea	4.708 *2,2%*	8.943 *2,3%*	12.311 *2,1%*	11.740 *2,1%*	12.568 *2,2%*	10.977 *2,1%*	16,3% *0,03%*	7,0% *-0,03%*
Spain	5.305 *2,3%*	6.263 *2,4%*	7.981 *2,2%*	9.126 *2,4%*	9.219 *2,4%*	-- --	8,3% *0,01%*	6,8% *0,00%*
Belgium	1.880 *1,6%*	3.668 *2,6%*	6.212 *3,5%*	7.398 *4,1%*	-- --	-- --	12,0% *0,19%*	13,3% *0,26%*
Canada	2.679 *1,3%*	2.885 *1,2%*	5.435 *1,2%*	6.536 *1,5%*	-- --	-- --	5,3% *-0,01%*	9,8% *0,04%*
Netherlands	1.988 *1,5%*	3.575 *2,1%*	6.214 *2,9%*	6.505 *3,1%*	7.366 *3,5%*	-- --	10,2% *0,14%*	11,3% *0,16%*
Sweden	1.898 *1,7%*	3.411 *3,0%*	5.726 *3,4%*	5.963 *3,8%*	6.870 *4,5%*	-- --	17,3% *0,26%*	9,6% *0,14%*
Ireland	626 *2,4%*	1.736 *4,2%*	4.821 *5,1%*	5.028 *5,1%*	5.885 *5,9%*	-- --	23,9% *0,35%*	18,7% *0,16%*
Denmark	1.068 *2,3%*	1.923 *3,3%*	3.746 *5,4%*	3.873 *5,4%*	4.032 *5,5%*	4.050 *5,6%*	10,8% *0,20%*	12,6% *0,35%*
Australia (3)	1.327 *1,3%*	2.185 *1,9%*	3.250 *2,3%*	-- --	-- --	-- --	12,3% *0,13%*	8,6% *0,11%*
Austria	1.177 *1,7%*	1.728 *2,0%*	2.572 *2,4%*	1.988 *1,8%*	2.252 *2,0%*	-- --	5,8% *0,06%*	3,1% *-0,03%*
Poland (4)	-- --	937 *1,3%*	1.165 *1,1%*	1.538 *1,3%*	-- --	-- --	-- --	11,8% *0,00%*
Hungary	-- --	700 *3,2%*	1.024 *2,1%*	1.223 *2,3%*	1.308 *2,4%*	-- --	7,5% *0,64%*	18,1% *-0,15%*
Portugal	584 *1,3%*	781 *1,5%*	1.045 *1,6%*	998 *1,5%*	-- --	-- --	7,7% *0,03%*	4,5% *-0,01%*
Norway	347 *0,9%*	529 *1,2%*	1.085 *1,8%*	985 *1,6%*	1.094 *1,7%*	-- --	9,7% *0,06%*	10,3% *0,06%*
Finland	451 *0,7%*	468 *0,7%*	611 *0,6%*	710 *0,7%*	-- --	-- --	4,0% *-0,01%*	8,0% *0,00%*
Greece	-- --	543 *1,6%*	473 *1,1%*	-- --	-- --	-- --	-- --	-0,8% *-0,10%*

(1) Compound Annual Growth Rate for absolute figures (in national currencies, euro used for the EU aggregate); annual average change for percentage figures (italics).
(2) Does not include Greece in 2001.
(3) 1999 instead of 2000.
(4) 1996 instead of 1995.

Source: OECD – STAN.

Table 8.3 International trade in pharmaceutical products (€ millions)

	1991	1995	2000	2004
EU exports				
intra EU15	12.150	19.736	38.993	81.978
extra EU15	10.324	17.207	39.731	56.927
NAC	430	1.269	2.976	4.691
US	1.604	2.692	11.045	21.152
Switzerland	932	1.884	4.583	7.841
Japan	1.418	2.337	3.224	3.468
Canada	292	437	1.331	2.668
Rest of the world	5.647	8.589	16.572	17.109
Total	22.473	36.944	78.724	138.905
EU imports				
intra EU15	12.150	19.736	21.017	81.978
extra EU15	5.120	8.452	9.689	29.974
Total	17.270	28.189	30.706	111.953
Trade balance extra EU15	**5.203**	**8.755**	**9.472**	**26.953**
Trade balance EU15-US	**-52**	**-228**	**-120**	**4.383**
US exports				
EU25	1.668	2.995	3.936	17.048
EU15	1.656	2.919	3.835	16.769
NAC	13	75	101	279
Switzerland	86	243	217	1.094
Japan	672	849	821	1.214
Canada	430	745	880	2.421
Rest Of the world	937	1.314	1.706	3.592
Total	3.793	6.146	7.560	25.368
US imports				
Total	2.494	4.283	5.629	28.436
Trade Balance US	**1.300**	**1.863**	**1.931**	**-3.068**
Japan exports				
EU25	340	674	723	1.333

Source: Author's elaborations on the NBER-UN World Trade database (1986-2000) and Comtrade-UN (2001-2004) database.
Note: Data for exports are based on imports of partner countries to achieve consistency.

ductivity growth rates were Ireland (9.1%), Sweden (9.1%), Denmark (8.4%), France (7.4%), UK (6.8%), and Belgium (6.8%), each of which had a labour productivity growth rate higher than the US. These countries have experienced the highest productivity levels among EU countries. However, their contribution to aggregate EU productivity remains low, due to a scale effect. Interestingly enough, much of the productivity increase in Ireland and Sweden is accounted for by local affiliates of foreign-based firms[143]. This evidence, coupled with well established empirical findings that foreign-owned subsidiaries are more productive than local firms, suggests that the good performances of Nordic countries can be explained in part by location decisions of large multi-

[143] In Ireland, between 70% and 80% of value added in the manufacturing sector was generated by firms under foreign control. In France, Sweden and the Netherlands this ratio was between 25% and 30%. In other countries, it was below 20%. Labour productivity (value added per employee) of foreign affiliates in the manufacturing sector was greater than the national average in all countries for which data are available (OECD, 2005).

Table 8.4: Real Value Added per Employee in the Pharmaceutical Industry – Labour productivity (1997-PPP thousand USD)

	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value
	1980	1981-1985	1985	1986-1990	1990	1991-1995	1995	1996-2001	2001	1996-2003	2003 (1)
Austria	30,3	2,0%	33,6	10,5%	56,6	6,2%	77,3	-0,7%	74,3	4,2%	108,1
Belgium	--	--	--	--	--	--	115,9	8,1%	188,0	6,8%	199,4
Germany	39,3	1,9%	43,2	2,4%	48,7	6,8%	68,5	4,6%	90,2	4,0%	94,0
Denmark	49,0	0,5%	50,3	1,6%	54,6	8,2%	82,2	11,9%	167,6	8,4%	160,4
Spain	48,6	0,0%	48,5	6,8%	68,3	3,6%	81,7	2,2%	93,2	1,3%	90,9
Finland	54,1	2,4%	61,1	-0,3%	60,1	-0,3%	59,3	4,5%	77,5	4,2%	83,2
France	31,0	9,0%	48,6	8,9%	75,9	7,5%	110,3	7,4%	171,5	7,4%	199,1
UK	40,3	4,3%	49,9	6,9%	70,3	5,0%	90,1	9,9%	163,1	6,8%	154,8
Greece (2)	--	--	--	--	--	--	22,3	1,2%	23,7	--	--
Ireland	--	--	--	--	70,6	12,8%	133,8	4,9%	179,7	9,1%	276,5
Italy	41,8	9,7%	68,1	4,0%	83,2	0,4%	85,0	4,6%	112,4	3,7%	114,7
Netherlands (3)	--	--	--	-5,6%	52,9	12,5%	98,8	5,4%	136,6	2,8%	123,7
Sweden	40,7	5,6%	53,8	5,8%	71,7	12,5%	134,3	6,7%	201,0	9,1%	278,8
EU-8 (4)	**38,8**	**5,5%**	**51,1**	**5,3%**	**66,7**	**5,3%**	**87,1**	**6,7%**	**130,0**	**5,8%**	**139,0**
EU-15 (5)	--	--	--	--	--	--	**88,7**	**6,4%**	**130,3**	**5,7%**	**140,0**
US	**71,0**	**9,0%**	**111,2**	**4,7%**	**141,0**	**2,1%**	**156,5**	**5,3%**	**215,2**	**6,4%**	**261,9**

(1) Values for 2003 have been obtained as projections from Eurostat survey data (except for Denmark and the US).
(2) Read 2000 instead of 2001.
(3) Read 1987-1990 instead of 1986-1990.
(4) The EU-8 aggregate includes: Austria, Germany, Denmark, Finland, France, UK, Italy and Sweden.
(5) Excluding Greece, Luxembourg and Portugal.

Source: our computations on OECD – STAN, OECD - Main Economic Indicators, Eurostat and GGDC (for all, last data available).

national companies, mainly American, which export their organizational and business model, characterized by high capital intensity and high labour productivity.

However, labour is less expensive in Europe than in the US. In 2003, labour cost per employee was 30% lower in EU-15 than in the US while in 1995, the gap was significantly narrower (10%).

Table 8.5 shows the pattern of capital[144] per employee relative to the US for the EU-15 countries for the period 1981-2003. The largest three, namely Germany, France and UK, are included in the aggregate EU-3. For the most recent period, we refer to an aggregate consisting of 10 countries (EU-10): Austria, Belgium, Germany, Finland, France, UK, Ireland, Italy, Netherlands, and Sweden.

Table 8.5 shows that capital deepening in the US happened at consistently faster rates than the EU average throughout the period, with a few exceptions (e.g., France and Belgium). Also, in 2003 capital per employee in the US was 56.6% higher than in the EU-10 aggregate. In addition, the growth rate of capital per employee was 2.1 percentage points higher (in the period 1996-2003). From 1990 to 2003 the US capital stock almost doubled in real terms.

All in all, the US seems to be headed toward a highly capital intensive production model, as are the small Northern EU members. Other European countries are specialized in low value-added activities, with low capital intensity. France seems to follow a relatively well balanced path of capital accumulation, while the

[144] Expressed in standard efficiency units (built following the perpetual inventory method described in the sidebar "Growth decomposition and TFP") and converted to PPP USD by using PPP rates for Gross Fixed Capital Formation (source: OECD).

Table 8.5: Capital per Employee in the Pharmaceutical Industry (1997-PPP thousand USD, beginning of period values)

	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value	Annual Growth	Value
	1981	1982-1985	1985	1986-1990	1990	1991-1995	1995	1996-2001	2001	1996-2003	2003 (1)
Austria	51,5	*-2,3%*	47,1	*7,6%*	68,8	*2,3%*	77,0	*3,6%*	95,4	3,8%	*104,4*
Belgium	--	--	--	--	--	--	35,2	*11,5%*	70,1	8,9%	*72,0*
Germany	28,7	*4,3%*	34,2	*2,7%*	39,2	*6,0%*	52,9	*3,3%*	64,4	2,7%	*65,6*
Finland	82,4	*-0,5%*	80,6	*-2,8%*	70,2	*-1,8%*	64,1	*-0,9%*	60,8	2,3%	*76,8*
France	18,4	*7,1%*	24,4	*8,5%*	37,3	*8,2%*	56,2	*4,1%*	71,8	4,5%	*80,5*
UK	53,4	*4,6%*	64,3	*3,5%*	76,7	*3,7%*	92,4	*2,7%*	108,6	1,7%	*106,1*
Ireland	--	--	--	--	--	--	147,1	*-5,7%*	104,2	-3,4%	*111,6*
Italy	--	--	--	--	--	--	92,7	*-0,2%*	91,7	0,1%	*93,8*
Netherlands (2)	--	--	--	*10,5%*	54,6	*4,0%*	66,8	*-0,2%*	66,2	2,2%	*79,9*
Sweden	--	--	--	--	--	--	103,6	*3,2%*	125,3	2,2%	*123,2*
EU-3 (3)	33,6	*4,5%*	40,2	*4,0%*	49,1	*5,5%*	64,7	*3,0%*	77,6	2,6%	*79,7*
EU-10 (4)	--	--	--	--	--	--	72,0	*2,3%*	82,6	2,1%	*85,3*
USA	41,1	*7,4%*	55,3	*4,4%*	69,0	*6,4%*	95,2	*3,2%*	115,2	4,2%	*133,6*

(1) Values for 2003 have been obtained as projections from Eurostat survey data (except for Denmark and the US).
(2) Read 1987-1990 instead of 1986-1990.
(3) The EU-3 aggregate includes Germany, France and UK.
(4) The EU-10 aggregate includes: Austria, Belgium, Germany, Finland, France, UK, Ireland, Italy, Netherlands and Sweden.
Source: authors' calculations on OECD – STAN, OECD Main Economic Indicators, Eurostat and GGDC (for all, last data available).

UK has a sizeable capital stock but its current capital deepening rate is probably too low. Finally, Germany and Italy are characterized by low capital intensity.

It is possible to use traditional growth accounting techniques to estimate the contribution of each factor to valued-added growth and to the growth of labour productivity. Results are summarized in Table 8.6 and Table 8.7.

From 1996 to 2003 the annual rate of growth of production in the EU-10[145] amounted to 7.17%, slightly lower than the US rate (7.8%). Given the similar growth rates for labour (1.23% in EU-10 vs. 1.55% in US), overall productivity growth rates for the EU-10 and the US are quite similar (5.94% versus 6.43%).

Productivity growth in the US was mostly the outcome of a significant process of capital deepening (2.6% average growth from 1996 to 2003), while the most important component of the EU-10 aggregate was total factor productivity (TFP) growth (5.0% average growth in 1996-2003), accounting for 83.8% of labour productivity growth. Capital deepening in Europe increased at a modest rate of 1.0%.

Again, the EU-15 aggregate conceals very different situations among countries: in 1996-2003 Belgium, France, UK, Ireland and Sweden experienced significant productivity gains, associated with both high capital deepening and high TFP growth. The high value of TFP growth for these countries can be considered the payoff resulting from previous capital investments.

The analysis of value added growth and its decomposition into labour, capital and TFP growth for the US reveals a slowdown in US labour productivity growth, together with a similar reduction in TFP growth between the early 1980s and the middle 1990s. In the middle 1990s, the US pharmaceutical industry dramatically increased its investments, as indicated by rates of capital deepening higher than

[145] The EU-10 aggregate as defined in the previous section includes the following countries: Austria, Belgium, Germany, Finland, France, UK, Ireland, Italy, Netherlands and Sweden.

Table 8.6: Value added growth and its decomposition into labour, capital and TFP growth; 1982-2003 (%) ([1])

	1982-1990				1991-1995				1996-2001				1996-2003 ([2])			
	production	labour	capital	TFP	production	labour	capital	TFP	production	labour	capital	TFP	production	labour	capital	TFP
	$\dot{Y}$	$\dot{L}$	$\dot{K}$	$\dot{A}$	$\dot{Y}$	$\dot{L}$	$\dot{K}$	$\dot{A}$	$\dot{Y}$	$\dot{L}$	$\dot{K}$	$\dot{A}$	$\dot{Y}$	$\dot{L}$	$\dot{K}$	$\dot{A}$
Austria	10,24	3,47	6,68	5,34	7,35	1,12	3,38	5,21	-0,87	-0,21	3,35	-2,02	4,66	0,46	4,27	2,64
Belgium	--	--	--	--	--	--	--	--	11,49	3,42	14,88	2,05	10,41	3,63	12,55	2,07
Germany	3,57	1,04	4,48	1,54	5,51	-1,33	4,67	5,17	5,61	1,04	4,32	3,65	1,04	4,32	3,65	4,62
Finland	2,97	3,54	1,76	0,49	0,23	0,52	-1,28	0,67	4,99	0,51	-0,37	4,96	3,59	-0,66	1,59	3,30
France	10,56	1,83	9,71	5,88	7,30	-0,17	8,02	4,19	7,57	0,21	4,28	5,40	7,50	0,11	4,60	5,21
UK	6,72	0,12	4,13	5,09	3,86	-1,09	2,65	3,56	8,56	-1,33	1,36	8,76	6,34	-0,42	1,31	6,11
Ireland	--	--	--	--	--	--	--	--	13,41	8,49	2,75	9,54	15,52	6,44	2,99	11,78
Italy	--	--	--	--	--	--	--	--	6,15	1,50	1,33	4,73	5,16	1,42	1,56	3,67
Netherlands	--	--	--	--	11,89	-0,59	3,44	10,69	7,28	1,88	1,73	5,50	4,05	1,23	3,47	2,06
Sweden	--	--	--	--	--	--	--	--	11,13	4,41	7,57	4,71	12,87	3,74	5,91	7,75
EU-3 ([3])	**6,48**	**0,98**	**5,20**	**4,12**	**5,63**	**-0,95**	**4,58**	**4,65**	**7,21**	**0,18**	**3,21**	**5,84**	**6,56**	**0,74**	**3,35**	**4,79**
EU-10 ([4])	--	--	--	--	--	--	--	--	**7,56**	**0,98**	**3,28**	**5,40**	**7,17**	**1,23**	**3,36**	**4,98**
USA	**7,63**	**0,87**	**6,63**	**3,98**	**5,03**	**2,94**	**9,38**	**-1,71**	**7,75**	**2,44**	**5,61**	**3,37**	**7,98**	**1,55**	**5,78**	**3,81**

([1]) See sidebar "Growth Decomposition and TFP" for a description of the methodology applied to decompose the growth of output.
([2]) Values for 2003 have been obtained as projections from Eurostat survey data (except for Denmark and the US).
([3]) The EU-3 aggregate includes Germany, France and UK.
([4]) The EU-10 aggregate includes: Austria, Belgium, Germany, Finland, France, UK, Ireland, Italy, Netherlands and Sweden.

Source: Authors' computations on OECD – STAN, OECD - Main Economic Indicators and GGDC (for all, last data available).

Table 8.7: Factors contribution to value added growth and to labour productivity growth; 1996-2003 (1) (2)

	value added	labour contribution	labour share	capital contribution	capital share	TFP	labour productivity growth	Capital deepening	TFP
	$\dot{Y}$	$(1-\alpha)\,\dot{L}$	$(1-\alpha)$	$\alpha\dot{K}$	α	$\dot{A}$	$\dot{Y}-\dot{L}$	$\alpha(\dot{K}-\dot{L})$	$\dot{A}$
Austria	4,66	0,15	0,55	1,87	0,45	2,64	4,20	1,55	2,64
Belgium	10,41	1,54	0,44	6,80	0,56	2,07	6,78	4,71	2,07
Germany	5,72	1,20	0,70	1,33	0,30	3,19	3,95	0,77	3,19
Finland	3,59	-0,37	0,51	0,66	0,49	3,30	4,25	0,95	3,30
France	7,50	0,05	0,51	2,25	0,49	5,21	7,39	2,18	5,21
UK	6,34	-0,32	0,58	0,55	0,42	6,11	6,76	0,66	6,11
Ireland	15,52	1,16	0,17	2,57	0,83	11,78	9,08	-2,70	11,78
Italy	5,16	0,79	0,55	0,70	0,45	3,67	3,74	0,07	3,67
Netherlands	4,05	0,47	0,50	1,51	0,50	2,06	2,82	0,75	2,06
Sweden	12,87	1,31	0,34	3,80	0,66	7,75	9,13	1,38	7,75
EU-3 (3)	**6,56**	**0,43**	**0,60**	**1,33**	**0,40**	**4,79**	**5,82**	**1,02**	**4,79**
EU-10 (4)	**7,17**	**0,66**	**0,54**	**1,54**	**0,46**	**4,98**	**5,94**	**0,96**	**4,98**
USA	**7,98**	**0,61**	**0,38**	**3,56**	**0,62**	**3,81**	**6,43**	**2,62**	**3,81**

(1) See sidebar "Growth Decomposition and TFP" for a description of the methodology applied to decompose the growth of output.
(2) Values for 2003 have been obtained as projections from Eurostat survey data (except for Denmark and the US).
(3) The EU-3 aggregate includes Germany, France and UK.
(4) The EU-10 aggregate includes: Austria, Belgium, Germany, Finland, France, UK, Ireland, Italy, Netherlands and Sweden.

Source: authors' computations on OECD – STAN, OECD - Main Economic Indicators, Eurostat and GGDC (for all, last data available).

historical average. This process was accompanied by a similar increase in labour growth.

The slowdown in TFP growth experienced by the US pharmaceutical sector in the last decade suggests that the current business model has some potential fragility. This slowdown has resulted from various factors: an upsurge since the middle 1990s in the level of investment, delay in the production of measurable output from past R&D, and a slowdown in market growth rates for new innovative products.

Investments in R&D and in R&D General Purpose Technologies constitute an important share of US fixed capital formation in pharmaceuticals (see GCP, 2000)[146]. As is well known (David, 1990), firms require time to implement the organizational changes needed to derive maximum gain from general-purpose innovation. In the transition period we observe an increase of inputs, capital and labour, while an increase in output is possible only at the end of a transition period, thereby inducing lower TFP growth during the transition stage. The recent upturns in both trend labour productivity growth and trend TFP growth in US pharmaceuticals seems to support this interpretation. It can be expected that both will continue to display sustained rates of growth in the coming years, when the full effects of investments in GPTs will unfold (see Gordon 2000).

In the long run, productivity as well as the rate and direction of pharmaceutical innovation in both Europe and the US will be critically affected by the interplay between technological and demand dynamics, especially in relation to cost containment measures adopted by both public and private reimbursement programs.

8.4. R&D and Innovation

The empirical literature aimed at measuring technological change has proposed a wide set of measures and indicators, the most prominent of which are the number of patents and of patent citations.

[146] See also Table III.2 in the present report: the R&D ratio in the US during the period 1991-1995 was 1 per cent higher than in surrounding periods.

Patents are a unique source of information about innovative activities, particularly in the pharmaceutical industry, where they play a prominent role in protecting returns from R&D (see Cohen et al, 2000).

Tables 8.8 and 8.9 represent all pharmaceutical and biotechnological patents granted from 1974 to 2003 by the United States Patent and Trademark Office (USPTO) to inventors and institutions located in the US, Japan, and the main European countries[147].

The data indicate that the US is the main locus of innovative activities, and that its lead has grown over time.

Table 8.8 shows that the majority of patents in biotechnology and pharmaceuticals are held by inventors located in the US[148]. The number of pharmaceutical patents held by US-based inventors increased by 7 percentage points between 1984-1993 and 1994-2003. The increase is even more striking if we weight each patent by its importance, as approximated by the number of citations it receives (see Table 8.9). Canada, Denmark and Sweden are the only other countries that have experienced an increase in the number of pharmaceutical patents granted to locally-based inventors between those two periods, although the increase is much lower than in the US.

Interestingly, the share of EU-25 inventors is higher than the share of EU-25 institutional assignees. The opposite is true for the US, even if the imbalance is gradually disappearing. In other words, there are more European inventors involved into research assigned to US organizations and performing their research in the US than vice-versa, although the globalisation of R&D activities is gradually eroding this disparity. A large share of the patents is obtained through research undertaken by US inventors.

[147] Pharmaceutical patents have been identified based on the International Patent Classification. Specifically, we have selected patents in classes A61K (preparations for medical, dental, or toilet purposes) and A01N (preservation of bodies of humans or animals or parts thereof). As far as the biotechnology patents are concerned, we have selected the US Patent Classes 424 (Drug, Bio-Affecting and Body-Treating Compositions); 435 (Chemistry, Molecular Biology and Microbiology); 514 (Drug, Bio-Affecting and Body-Treating Compositions); 800 (Multicellular Living Organisms and Unmodified Parts Thereof and Related Processes).

[148] Patents granted by the US Patent and Trademark Office might "overestimate" the patenting performance of US scientists and research organizations as compared to foreign ones. Dernis and Khan (2004) estimate that the share of USPTO patents of US companies in 1999 (52.6%) is well above their share of EPO patents (27.8%) and triadic patent families (34%). However, this problem may be attenuated by comparing patent shares over time and by using multiple indicators of innovation and R&D performances.

Table 8.8: Shares of USPTO-granted pharmaceutical patents by countries based on the nationality of the assignee (A) and location of the inventor (I)

	1974-1983			1984-1993			1994-2003		
	Assignee	Inventor	I-A	Assignee	Inventor	I-A	Assignee	Inventor	I-A
France	5,97%	*6,05%*	*0,08%*	5,39%	*5,28%*	*-0,11%*	5,71%	*5,79%*	*0,08%*
Germany	11,63%	*11,57%*	*-0,06%*	10,28%	*10,45%*	*0,18%*	7,13%	*7,25%*	*0,12%*
Sweden	0,81%	*0,87%*	*0,06%*	0,68%	*0,67%*	*-0,01%*	1,15%	*1,09%*	*-0,06%*
Denmark	0,31%	*0,31%*	*0,00%*	0,50%	*0,54%*	*0,04%*	0,82%	*0,83%*	*0,01%*
Italy	1,86%	*2,05%*	*0,19%*	2,29%	*2,49%*	*0,21%*	1,44%	*1,76%*	*0,33%*
Spain	0,12%	*0,16%*	*0,04%*	0,25%	*0,29%*	*0,04%*	0,30%	*0,38%*	*0,08%*
UK	5,53%	*7,34%*	*1,82%*	4,68%	*6,41%*	*1,73%*	3,86%	*5,14%*	*1,28%*
Other EU-25	2,02%	*2,50%*	*0,48%*	3,24%	*3,08%*	*-0,16%*	2,66%	*2,54%*	*-0,12%*
EU-25	28,26%	*30,85%*	*2,59%*	27,30%	*29,22%*	*1,93%*	23,07%	*24,79%*	*1,72%*
USA	59,02%	*52,28%*	*-6,74%*	55,16%	*50,79%*	*-4,37%*	60,06%	*57,29%*	*-2,76%*
Canada	0,74%	*1,30%*	*0,56%*	1,07%	*1,39%*	*0,32%*	2,53%	*2,64%*	*0,11%*
Japan	9,29%	*9,44%*	*0,15%*	13,41%	*13,55%*	*0,13%*	9,15%	*9,32%*	*0,17%*
Switzerland	1,60%	*4,29%*	*2,69%*	1,31%	*2,91%*	*1,60%*	1,35%	*1,42%*	*0,08%*
Other	1,10%	*1,84%*	*0,74%*	1,76%	*2,14%*	*0,39%*	3,85%	*4,53%*	*0,68%*
Total	100%	100%		100%	100%		100%	100%	

Source: authors' computations on USPTO data (granted patents only)

In recent years, the number of patents in pharmaceuticals and biotechnology granted by the Chinese patent office has increased. The same applies to US patents granted to Chinese inventors (see Table 8.10). These increases indicate a process of accumulation of scientific and technological capabilities. India's recent performance in biopharmaceutical innovation, as reflected in patents granted, is similar to that of China. If these trends persist, China and India will strengthen their positions, becoming attractive and competitive destinations of foreign direct outward investment by multinational corporations.

Table 8.9: Shares of patent citations of USPTO-granted pharmaceutical patents by countries based on the nationality of the assignee (A) and location of the inventor (I)

	1974-1983			1984-1993			1994-2003		
	Assignee	Inventor	I-A	Assignee	Inventor	I-A	Assignee	Inventor	I-A
France	5,11%	*5,11%*	*0,00%*	4,06%	*4,14%*	*0,07%*	4,23%	*4,56%*	*0,33%*
Germany	8,46%	*8,23%*	*-0,23%*	6,61%	*6,75%*	*0,14%*	4,90%	*5,14%*	*0,24%*
Sweden	1,28%	*1,22%*	*-0,06%*	0,82%	*0,77%*	*-0,05%*	1,05%	*1,01%*	*-0,04%*
Denmark	0,38%	*0,39%*	*0,00%*	0,50%	*0,57%*	*0,07%*	0,48%	*0,47%*	*0,00%*
Italy	1,04%	*1,27%*	*0,23%*	1,28%	*1,40%*	*0,12%*	0,89%	*1,30%*	*0,41%*
Spain	0,05%	*0,07%*	*0,02%*	0,11%	*0,14%*	*0,03%*	0,20%	*0,24%*	*0,04%*
UK	5,34%	*6,94%*	*1,60%*	3,66%	*5,44%*	*1,78%*	3,57%	*4,61%*	*1,04%*
Other EU-25	1,92%	*2,28%*	*0,36%*	2,38%	*2,12%*	*-0,27%*	2,16%	*1,73%*	*-0,42%*
EU-25	23,57%	*25,50%*	*1,92%*	19,43%	*21,33%*	*1,90%*	17,47%	*19,06%*	*1,59%*
USA	63,71%	*59,33%*	*-4,38%*	67,12%	*63,52%*	*-3,60%*	70,39%	*68,13%*	*-2,26%*
Canada	1,20%	*1,69%*	*0,50%*	1,31%	*1,80%*	*0,49%*	2,31%	*2,38%*	*0,07%*
Japan	9,26%	*8,99%*	*-0,27%*	9,55%	*9,64%*	*0,09%*	6,00%	*6,07%*	*0,07%*
Switzerland	1,24%	*2,85%*	*1,61%*	1,14%	*2,00%*	*0,85%*	1,19%	*1,31%*	*0,12%*
Other	1,02%	*1,64%*	*0,62%*	1,44%	*1,70%*	*0,26%*	2,64%	*3,05%*	*0,41%*
Total	100%	100%		100%	100%		100%	100%	

Source: authors' computations on USPTO data (granted patents only)

Table 8.10: Patents in pharmaceuticals and biotechnology, selected patent offices in developing countries (1995-2004)

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
China	no.	133	324	338	516	778	2284	2537	1820	2898	4826
	% change	-	*143,6*	*4,3*	*52,7*	*50,8*	*193,6*	*11,1*	*-28,3*	*59,2*	*66,5*
Russia	no.	1091	896	1569	1624	1944	1624	1084	1719	2259	2126
	% change	-	*-17,9*	*75,1*	*3,5*	*19,7*	*-16,5*	*-33,3*	*58,6*	*31,4*	*-5,9*
Brazil	no.	83	145	380	759	2452	3590	2584	2502	1931	3265
	% change	-	*74,7*	*162,1*	*99,7*	*223,1*	*46,4*	*-28,0*	*-3,2*	*-22,8*	*69,1*
South Africa	no.	1392	1635	1640	1706	1604	631	548	1463	1663	1828
	% change	-	*17,5*	*0,3*	*4,0*	*-6,0*	*-60,7*	*-13,2*	*167,0*	*13,7*	*9,9*
Israel	no.	1037	1012	599	839	1079	887	1425	1468	814	902
	% change	-	*-2,4*	*-40,8*	*40,1*	*28,6*	*-17,8*	*60,7*	*3,0*	*-44,6*	*10,8*
India	no.	69	84	201	114	195	213	202	226	325	-
	% change	-	*21,7*	*139,3*	*-43,3*	*71,1*	*9,2*	*-5,2*	*11,9*	*43,8*	-

Source: our computations on ATA database.

Table 8.11 presents statistics on co-invented patents, as a proxy of the extent of internationalisation of the innovation process in the life sciences.

Results in Table 8.11 show that R&D in pharmaceuticals and biotechnology is becoming increasingly globalise (i.e., the share of co-invented patents involving inventors located in a single region is decreasing), while the US research system occupies a prominent position in the international network of division of innovative labour.

The US dominance appears even stronger when we consider patent citations data. In fact, Table 8.12 suggests that on average patents assigned to US institutions have a much greater impact on future innovative activity. US biopharmaceutical patents received 5.56 citations on average between 1994 and 2003, far more than European (2.92) and Japanese (2.07) ones. Furthermore, the largest share (almost half) of the European and Japanese citations go to US patents, although this finding must be interpreted with caution, since we are considering data on patents granted by the USPTO. Nevertheless, the trends in pattern of citations of the EU citing US and JP citing US reveal an increasing importance of US research for inventors located in Europe and Japan.

Table 8.13 shows the evolution of R&D collaborations since 1991, by location of the company that originated/developed the innovation. The table shows the dominance of US institutions in the international network of R&D agreements, with EU institutions playing a subordinate role, as reflected in the much smaller number of agreements in which they are involved. The secondary role of the EU in pharmaceutical R&D is also confirmed by the relatively low number of intra-EU agreements.

Table 8.11: The internationalisation of R&D activities: co-invented patents

	1974-1983	1984-1993	1994-2003
USA			
Patent count	8.943	14.860	36.271
Mean number of inventors	1,78	2,22	2,93
Share of co-invented patents	51,72%	64,58%	76,25%
of which: ([1])			
US-US	95,09%	92,39%	87,73%
US-EU	2,77%	4,52%	7,86%
US-JP	0,82%	1,56%	1,46%
EU-25			
Patent count	5.238	8.525	15.904
Mean number of inventors	2,81	3,36	3,65
Share of co-invented patents	78,64%	84,14%	85,61%
of which: ([1])			
EU-EU	92,81%	88,78%	77,45%
EU-US	3,11%	6,05%	15,98%
EU-JP	0,22%	0,53%	1,15%
Japan			
Patent count	1.582	3.845	5.678
Mean number of inventors	4,05	4,20	4,28
Share of co-invented patents	92,35%	93,55%	91,72%
of which: ([1])			
JP-JP	96,78%	94,75%	89,34%
JP-US	2,60%	4,17%	7,76%
JP-EU	0,62%	1,06%	3,01%

([1]) Percentage do not sum to 100 because the inventors of a patent may have located in more than two countries.

Source: authors' computations on USPTO data (granted patents only).

Table 8.12:The internationalisation of R&D activities: patent citations

	1974-1983	1984-1993	1994-2003
USA			
Patent count	8.943	14.860	36.271
Number of citations ([1])	6.680	40.332	201.510
Mean number of citations	0,75	2,71	5,56
of which: ([2])			
US -> US	74,70%	73,00%	74,70%
US -> EU	18,29%	18,51%	18,82%
US -> JP	5,09%	7,06%	6,77%
EU-25			
Patent count	5.238	8.525	1.5904
Number of citations ([1])	3.153	15.004	46.396
Mean number of citations	0,60	1,76	2,92
of which: ([2])			
EU -> EU	55,25%	51,18%	43,64%
EU -> US	36,12%	38,83%	49,11%
EU -> JP	5,49%	7,96%	7,49%
Japan			
Patent count	1.582	3.845	5.678
Number of citations ([1])	959	5.833	11.746
Mean number of citations	0,61	1,52	2,07
of which: ([2])			
JP -> JP	40,88%	36,57%	35,96%
JP -> US	33,99%	37,68%	42,23%
JP -> EU	23,46%	23,90%	22,26%

([1]) Only backward citations to pharmaceutical patents are considered
([2]) Percentage do not sum to 100 because the inventors of a patent may have located in more than two countries.

Source: our computations on USPTO data (granted patents only).

The US has pioneered a new organizational arrangement within the pharmaceutical industry, based on a division of labour between small and large companies. Europe, in comparison, has been less effective in encouraging the growth of new technology suppliers and innovation specialists. European pharmaceutical producers have tended to rely on sources of research capabilities and innovation located in the US, which has made it even harder to establish a European industry of technology suppliers.

These characteristics of the sectoral innovation system are even more visible in Table 8.14 which shows the number and percentage of collaborative agreements signed by public research organizations ("PROs"), dedicated biotechnology firms ("DBFs") and established companies ("ECs") in North America, Europe, and the rest of the world, as well as the change in these figures between 1991 and 2004.

DBFs play a central role in the US innovation system, both as initiators and developers of new R&D projects. Their importance increased during the 1990s, to the extent that DBFs, complemented by PROs, currently initiate the largest share of collaborative R&D projects in the US. DBFs have also grown significantly in Europe since the early 1990s, but there are two marked differences with the US. First, the share of projects initiated and developed by DBFs is greater in the US than in the EU-25. Second, US DBFs differ from their European counterparts in participating actively in development. On the other hand, established firms play a much greater role in the EU, both as originators but also, especially, as developers of collaborative R&D projects.

Table 8.13:Collaborative R&D projects, by nationality of originator and developer, 1991-2004

nationality of the originator			nationality of the developer					
1991-1997		**total**	**USA**		**EU-25**		**Other**	
	USA	**840** *77,2%*	**541** *78,3%*	*64,4%* *49,7%*	**157** *76,2%*	18,7% *14,4%*	**142** *74,3%*	16,9% *13,1%*
	EU-25	**165** *15,2%*	**95** *13,7%*	57,6% *8,7%*	**42** *20,4%*	25,5% *3,9%*	**28** *14,7%*	17,0% *2,6%*
	Other	**83** *7,6%*	**55** *8,0%*	*66,3%* *5,1%*	**7** *3,4%*	*8,4%* *0,6%*	**21** *11,0%*	*25,3%* *1,9%*
	Total	**1088**	**691**	*63,5%*	**206**	*18,9%*	**191**	*17,6%*
1998-2004		**total**	**USA**		**EU-25**		**Other**	
	USA	**940** *66,4%*	**658** *74,9%*	*70,0%* *46,5%*	**141** *45,2%*	*15,0%* *10,0%*	**141** *62,4%*	*15,0%* *10,0%*
	EU-25	**305** *21,5%*	**124** *14,1%*	*40,7%* *8,8%*	**138** *44,2%*	*45,2%* *9,7%*	**43** *19,0%*	*14,1%* *3,0%*
	Other	**171** *12,1%*	**96** *10,9%*	*56,1%* *6,8%*	**33** *10,6%*	*19,3%* *2,3%*	**42** *18,6%*	*24,6%* *3,0%*
	Total	**1416**	**878**	*62,0%*	**312**	*22,0%*	**226**	*16,0%*

Source: author's computations on ATA database.

Reading key

number of projects

as % of developer's projects (total by column)

as % of originator's projects (total by row)

as % of total projects originated/developed in the period

Source: authors' computations on ATA database.

8.5. Industry Structure and Competition

This section investigates the relationship between industrial performance and certain distinctive features of different national pharmaceutical markets, including industry structure, intensity of competition as measured by firm and product turnover, entry of new molecules, and generic products.

On the one hand, a competitive environment facilitates efficient resource allocation and can spur the invention of new or improved products, services, or processes. The resulting innovation can boost national economic growth and living standards (see FTC, 2003).

On the other hand, competition is not necessarily conducive to rapid technological progress. In particular, firms will invest in R&D only if they can expect some form of transient ex post market power allowing a positive return on their investment. In addition, market power also helps to reduce uncertainty, associated with excessive

Table 8.14: Number of collaborative R&D Projects, by nationality and institution: temporal evolution (1)

Regions	public research organizations				dedicated biotech firms				established companies			
	projects originated		projects developed		projects originated		projects developed		projects originated		projects developed	
	num	*%*	*num*	*%*	*num*	*%*	*num*	*%*	*num*	*%*	*num*	*%*
	1991-1997											
USA	242	28,8%	4	0,6%	495	58,9%	374	54,1%	103	12,3%	313	45,3%
EU-25	54	32,7%	0	0,0%	72	43,6%	63	30,6%	39	23,6%	143	69,4%
Other	41	49,4%	1	0,5%	25	30,1%	46	24,1%	17	20,5%	144	75,4%
	1998-2004											
USA	218	23,2%	8	0,9%	638	67,9%	561	63,9%	84	8,9%	309	35,2%
EU-25	65	21,3%	3	1,0%	191	62,6%	134	42,9%	49	16,1%	175	56,1%
Other	49	28,7%	4	1,8%	96	56,1%	110	48,7%	26	15,2%	112	49,6%

(1) Percentages are calculated on the total number of projects originated and developed by institutional type in each country.

Source: our computations on ATA database.

rivalry, which tends to undermine the incentive to invest.

Table 8.15 reports price ratios for all pharmaceutical products, including brand-names and generics. (Prices have been converted into US dollars using both exchange rates and purchasing power parities or PPP.) The average prices of branded drugs in the US are almost double the corresponding prices in EU countries. EU average price for branded drugs is 56.2% of the US level. However, generic drug prices in the EU-15 countries are 95.6% their US counterparts.

After the price data are adjusted for PPP, it becomes clear that average prices of branded products in the EU-15 are 49.9% of the US prices, whereas generic prices in EU-15 are 81.7% the US price. More than half of the molecules included in the sample are priced higher in the US than in any country of the EU-15.

Price differences between the US and EU-15 are accounted for entirely by differences in prices for branded drugs. In fact, prices of generic drugs in the US are substantially aligned with prices in EU-15. In a few countries, such as Germany, generic prices are even higher than in the US.

Price at entry for branded drugs is 43.4% higher in the US than average price in the market. The corresponding price gap in the EU-15 is 28.2%, and in Japan just 3.9% (see Table 8.16). US generic products, by contrast, are priced at 60.3% of the average prices in the market.

These price differentials between the US and Europe reflect radical differences in the extent of market regulation[149]. Prices for branded drugs in countries with free or semi-regulated prices – such as the US and, to a lesser extent, UK and Germany – are higher than in countries where more direct forms of price regulation are in place, such as Italy and France. At the same time, the relatively unregulated markets tend to experience fierce price competition after patent expiry, since higher prices of branded drugs represent a strong incentive for generic entry and price competition à la Bertrand (Pammolli et al, 2002; Magazzini et al. 2004). In fact, generic penetration in terms of volume is much higher in the USA (33.67% of the market in 2004) and UK (31.01 %) than in the average EU-15 (13.8 %) and Japan (2.55 %).

The possibility to command substantially higher market prices for new and branded drugs can act as a powerful incentive for R&D and capital investments that can explain, to a certain extent at least, the different trends characterising the EU and US pharmaceutical industries. There appears to be a trade-off between demand and technological dynamics and the sustainability of health expenditures, with

[149] For an in-depth analysis of institutional aspects of national pharmaceutical markets, see OECS (2001).

Table 8.15: Median of the ratio between average molecule prices per SU, 2004 (US = 100)

	Exchange rate			Parity Purchase Power (1)		
Country	All products	Generics	Branded	All products	Generics	Branded
Austria	70,55	201,01	54,59	64,19	183,29	49,76
Belgium	62,99	136,99	49,54	55,69	121,62	43,78
Canada	69,17	102,66	60,71	73,94	109,92	64,97
China	16,58	12,56	20,33	77,35	58,79	94,70
Czech Rep.	41,24	51,71	34,44	72,06	90,33	60,47
Denmark	64,27	104,05	52,70	47,14	76,32	38,65
Estonia	46,60	85,58	35,29	88,42	162,48	66,93
Finland	66,26	160,71	51,64	54,75	132,84	42,64
France	66,50	138,00	55,25	57,38	117,48	47,51
Germany	75,86	141,14	60,08	67,00	123,07	53,03
Greece	45,23	58,36	36,92	49,72	64,30	40,64
Hungary	49,57	89,88	39,80	77,15	140,03	61,90
India	15,00	12,30	11,67	23,40	19,23	18,18
Ireland	58,93	109,18	47,58	49,52	91,89	39,85
Italy	59,34	103,94	46,71	57,82	104,14	45,46
Japan	71,23	94,10	52,00	57,32	73,04	41,76
Latvia	42,41	81,22	34,33	93,49	178,43	75,85
Lithuania	43,33	49,70	36,02	86,65	99,41	71,93
Luxembourg	61,66	144,60	46,06	59,90	143,64	44,76
Netherlands	66,09	111,26	55,08	54,26	91,33	45,22
Poland	43,80	48,94	37,37	83,14	91,95	70,93
Portugal	53,37	142,93	42,25	60,85	162,43	48,01
Slovak Rep.	41,21	51,81	33,65	79,55	100,00	64,98
Slovenia	65,41	144,33	49,51	86,94	191,45	66,00
Spain	48,36	107,01	40,37	47,94	106,21	40,03
Sweden	67,19	105,75	54,92	51,50	81,06	42,10
UK	68,63	100,55	57,01	55,62	81,51	46,00
EU-15	68,56	95,60	56,18	60,52	81,73	49,91
EU-25	64,42	94,05	53,72	61,85	83,79	50,90

(1) Parity Purchase Power from OECD, "National accounts and historical statistics" (last data available on line).

Source: authors' computations on CERM Data base.

Europe putting more emphasis than the US on cost containment through its Social Security price and reimbursement regulations.

Price convergence is taking place in Europe, as a combined effect of regulation at the level of single member states, parallel trade, and external reference pricing. Graph 8.1 shows that EU price convergence was more rapid in the second half of the 1990s as a result of the process of EU monetary convergence. Starting from 2000, we identify the emergence of two clubs: the core EU countries (France, Italy, Benelux, Sweden, Finland, Denmark, UK, Ireland) with a 15% average price gap; and a low-price club which includes the 10 new member states as well as Spain, Portugal and Greece, with average prices almost 40% lower than the EU-15 level.

Interestingly, Germany is an outlier with an average price 15% higher that EU-15 average.

Overall, the US market is more concentrated than all the most important EU markets (Germany, France, Italy and Spain, but not the UK), as well as Japan, China and India (see Table 8.17). On average, the three leading products in each of 100 different thera-

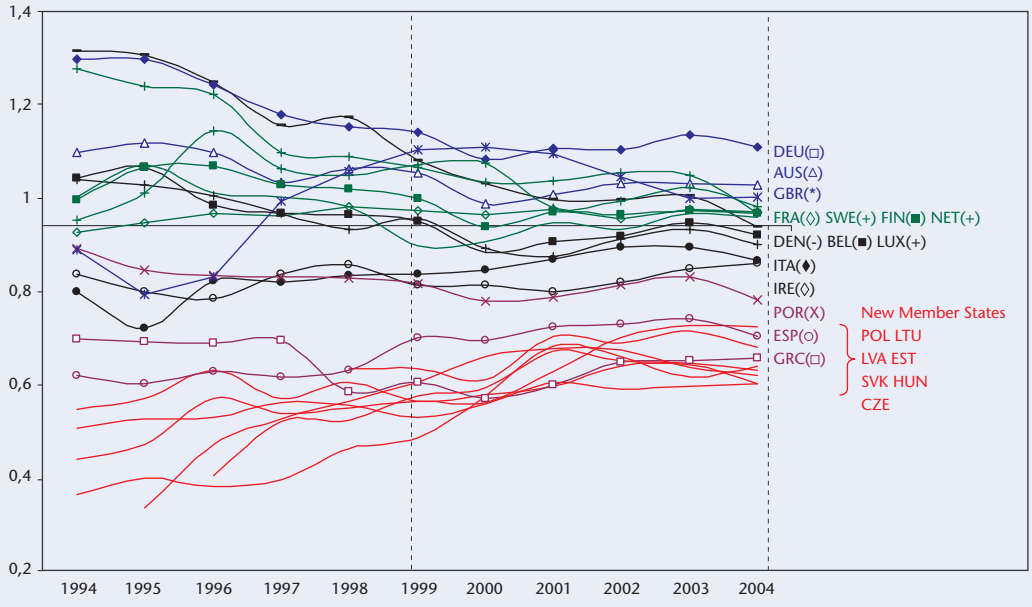
Table 8.16: Ratio between drug price at launch and the mean price of branded drugs in the market. Average on all ATC4 markets, 1994-2004

	Branded	Generics
Austria	1,220	0,836
Belgium	1,181	0,659
Finland	1,253	0,855
France	1,339	0,769
Germany	1,061	0,735
Italy	1,248	0,827
Japan	1,039	0,820
Portugal	1,162	0,777
Spain	1,550	0,703
Sweden	1,437	0,793
UK	1,410	0,873
USA	1,434	0,603
EU 15 ([1])	1,282	0,776

([1]) Weighted average of available countries

Source: authors' computations on CERM database.

Graph 8.1: Price convergence in EU25, median prices, 1994-2004 (EU-15 average price = 1)



Source: our computations on CERM database.

peutic categories account for 85.6% of total market share in the US, as compared with a total market share of 76.5% in the EU-25. It is clear that European markets are much more fragmented than the US market. The US market is as concentrated as the European one in terms of volume, while it is the most concentrated in terms of sales. To a large extent, the high concentration of the US market is due to the "premium price" that best-in-class products can command. Indeed, the relative price of the market leader in the US is 44% higher than the market average price – more than in Europe (22%) and Japan (15%). Notably, the skewness of relative prices distribution boosts the concentration level of the US mar-

Table 8.17: Average market concentration (sales and volumes) and relative prices of the first three products on the market, top 100 ATC4 classes, 1994-2004

	$C_1(S)$	$C_1(Q)$	P_1	$C_2(S)$	$C_2(Q)$	P_2	$C_3(S)$	$C_3(Q)$	P_3
EU-15	41,18	34,17	1,22	63,83	56,05	1,15	76,53	70,49	1,09
Japan	39,77	34,61	1,15	62,74	54,75	1,15	78,25	69,36	1,13
United States	49,72	34,63	1,44	74,96	59,48	1,26	85,56	70,74	1,21
India	21,98	21,80	1,01	37,06	38,10	0,97	47,21	47,96	0,98
Germany	29,97	22,94	1,31	47,42	38,49	1,23	58,87	50,95	1,16
China	36,15	19,20	1,88	56,78	32,31	1,76	67,62	39,95	1,69
Italy	36,68	33,49	1,10	57,57	54,07	1,06	71,49	67,14	1,06
France	39,01	31,21	1,25	64,88	54,45	1,19	78,18	71,16	1,10
Spain	40,36	32,62	1,24	62,37	52,72	1,18	75,94	67,92	1,12
Canada	42,03	32,68	1,29	65,71	54,51	1,21	79,35	69,12	1,15
Latvia	45,07	35,23	1,28	68,63	63,24	1,09	82,96	79,67	1,04
Czech Rep.	46,26	40,80	1,13	72,70	66,68	1,09	86,77	83,83	1,04
Portugal	46,73	39,65	1,18	70,41	61,34	1,15	84,32	79,63	1,06
Belgium	48,33	42,24	1,14	76,64	70,27	1,09	92,24	86,65	1,06
Austria	48,43	41,12	1,18	74,19	66,51	1,12	87,70	82,03	1,07
Netherlands	48,56	37,60	1,29	72,35	58,42	1,24	86,24	76,38	1,13
Luxemburg	49,54	39,93	1,24	76,49	68,20	1,12	89,91	83,20	1,08
Slovak Rep.	50,02	42,52	1,18	76,77	72,70	1,06	90,69	90,27	1,00
Poland	50,16	39,71	1,26	76,55	68,63	1,12	89,29	85,30	1,05
Ireland	51,19	43,77	1,17	77,50	72,42	1,07	91,76	87,10	1,05
Lithuania	51,53	44,06	1,17	77,37	72,95	1,06	90,67	88,95	1,02
Finland	52,30	45,58	1,15	78,95	73,26	1,08	92,65	89,54	1,03
Greece	52,73	43,08	1,22	78,00	69,76	1,12	88,90	83,08	1,07
Denmark	53,50	45,22	1,18	80,34	75,33	1,07	93,07	91,05	1,02
Sweden	53,68	44,70	1,20	79,70	75,51	1,06	91,60	89,95	1,02
Estonia	54,71	45,13	1,21	80,74	75,51	1,07	93,32	91,67	1,02
Hungary	54,85	52,29	1,05	84,04	82,19	1,02	96,11	95,72	1,00
United Kingdom	55,69	48,34	1,15	79,61	75,16	1,06	90,20	87,75	1,03
Slovenia	61,25	54,13	1,13	88,25	84,98	1,04	97,89	97,47	1,00

Source: authors' computations on CERM database

ket. Contrary to many other high-tech industries, the pharmaceutical industry remains fairly fragmented. In all countries, pharmaceutical industry concentration at the corporate level is lower than at the market level, since the pharmaceutical industry is composed of several independent sub-markets (Sutton, 1998).

Higher concentration in the US market does not imply less competition. On the contrary, firm turnover in the US is almost double that of the EU-15 and EU-25.

The "premium price" for new innovative drugs tends to induce higher levels of industrial concentration in the US. The lower turnover of EU markets translates into a higher persistency and a lower contestability of the leading products. The US average persistency of the leading product is slightly less than 6 years, while in the EU it is almost 10 years and in Japan more than 15 years.

As shown in Table 8.18, the US market has the highest product turnover. The US rate is 59.5% higher than EU-15, and 38.8% higher than Japan. The most striking difference is found in product exit rate, which is on average 77.2% higher in the US than in the EU-15, and 40.7 higher than in Japan. Product entry rates are 51.3% higher in the US than in the EU-15, and 38.8% higher than in Japan. Therefore, the process of creative destruction is much more intense in the US market than in European or Japanese markets.

Table 8.18: Product turnover as a share of existing products (top 100 ATC4 classes, 1995-2004)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	average
	Product entry rate (%)										
USA	12,15	16,64	18,81	15,30	15,45	9,05	14,13	29,05	11,00	12,29	*15,39*
Japan	8,46	24,59	8,69	11,28	8,11	9,63	8,60	9,46	15,02	7,87	*11,17*
EU-15	9,12	9,53	9,15	11,78	11,07	10,62	9,41	9,98	10,28	10,71	*10,17*
EU-25	9,30	9,54	9,33	11,91	11,11	10,67	9,46	10,00	10,31	10,65	*10,23*
	Product exit rate (%)										
USA	13,39	7,51	7,44	6,25	8,38	13,43	6,87	7,61	6,09	6,37	*8,33*
Japan	5,49	4,88	6,52	5,66	7,09	7,45	5,38	7,06	5,41	4,24	*5,92*
EU-15	6,72	4,92	4,51	4,29	4,60	4,03	3,87	4,04	4,66	5,39	*4,70*
EU-25	6,71	4,92	4,57	4,38	4,64	4,15	4,11	4,17	4,68	5,58	*4,79*
	Product turnover (%)										
USA	25,54	24,14	26,25	21,55	23,84	22,47	21,00	36,66	17,10	18,66	*23,72*
Japan	13,94	29,47	15,21	16,94	15,20	17,08	13,98	16,52	20,44	12,11	*17,09*
EU-15	15,84	14,44	13,66	16,07	15,67	14,65	13,28	14,02	14,94	16,10	*14,87*
EU-25	16,01	14,46	13,91	16,29	15,76	14,82	13,57	14,17	15,00	16,23	*15,02*
	Product net entry (%)										
USA	-1,24	9,13	11,37	9,05	7,07	-4,38	7,26	21,44	4,91	5,92	*7,05*
Japan	2,97	19,71	2,17	5,62	1,02	2,18	3,22	2,40	9,61	3,63	*5,25*
EU-15	2,40	4,61	4,64	7,49	6,47	6,59	5,54	5,94	5,62	5,32	*5,46*
EU-25	2,59	4,62	4,76	7,53	6,47	6,52	5,35	5,83	5,63	5,07	*5,44*

Source: our computations on CERM database

All in all, the US market for pharmaceuticals is both more concentrated and more volatile than markets in Europe. In other words, the higher concentration of the US market does not mean that it is less competitive. On the contrary, the US market is highly contestable; product turnover is much more frequent than in the EU and Japan; and competition from generic producers is substantial. US market behaviour is consistent with that of a market characterized by Schumpeterian competition, where innovators can gain temporary quasi-monopoly profits, which in turn spur innovation efforts by competitors that quickly leads to more innovative products and a high turnover of market shares. Dynamic competition is less evident in the EU as a whole, and especially in certain continental European countries. As documented extensively in Gambardella, Orsenigo, Pammolli (GCP, 2000), there is too little market-based competition in some of the European countries, resulting in a less-efficient industry, as reflected in productivity indicators and market performance.

8.6. Summary and conclusions

The US is not only by far the largest national pharmaceutical market, but has also grown rapidly since the middle 1990s. Firms based in North America (mainly the US) significantly increased their share of total world sales from 34% in 1989 to 47% in 2005. The US market is almost twice the size of the EU-15 market in terms of revenue.

Even though employment in the European pharmaceutical industry is higher than in the US, the US outperforms Europe and Japan in terms of both value of pharmaceutical production and its incidence over total manufacturing. Between 1995 and 2001, US production grew at an average annual rate of 8.0%, as compared to an increase of 7.4% for the EU-15.

Trade openness has increased significantly over the last ten years. Moreover, from 1998 to 2003 local corporations lost market shares in all major national markets. However, US corporations have maintained

their market shares in the US, while increasing their penetration in Europe by 3.6%.

The integration of the European market is a priority if the European pharmaceutical industry to enhance its competitiveness. In fact, even as the globalisation of the industry reduces the advantages resulting from larger domestic markets, the presence in Europe of barriers to trade and cross-border circulation of technological competences and factors of production gives US companies a significant size advantage.

Labour is less expensive in Europe than in the US. In 2003, labour cost per employee was 30% lower in EU-15 than in the US. In 1995, the gap was significantly narrower (10%).

However, Europe lags behind the US in labour productivity in pharmaceuticals. The productivity gap with the US is much larger in pharmaceuticals than in overall manufacturing. In 2003, labour productivity in the European pharmaceutical industry was 53.1% that of the US. Value added per employee in the US is higher than in Europe, with the exception of Ireland and Sweden. Overall productivity growth is lower in Europe, although certain countries have experienced higher labour productivity growth rates than the US (e.g., Ireland, Sweden, Denmark, France, UK, and Belgium between 1996 and 2003). To a considerable extent, productivity gains in Europe stem from increased US foreign direct investment.

The European pharmaceutical industry is more labour-intensive than its US counterpart. Capital deepening in the US has happened at consistently faster rates than in the EU, as demonstrated by the ratio of capital per employee between 1981 and 2003 (France is one of the few exceptions). In 2003 capital per employee in the US was 56.6% higher than in the EU-10 aggregate. From 1990 to 2003 the US capital stock, measured in real terms, has almost doubled.

Productivity growth in the US was mostly the outcome of a significant process of capital deepening (2.6% average growth from 1996 to 2003), while the most important component in Europe was total factor productivity (TFP) growth (5.0% average growth in 1996-2003), accounting for 83.8% of labour productivity growth. Capital deepening in Europe increased at a modest rate of 1.0%.

Since 2000, the US has consolidated its central role as a locus of innovation in pharmaceuticals. US firms hold the majority of biopharmaceutical patents, and that dominant position continues to expand. From the period 1984-1993 to the period 1994-2003, the share of biopharmaceutical patents held by US inventors has risen by approximately 7 per cent (from 50.8% to 57.3%). The share of EU-25 inventors is higher than the share of EU-25 institutional assignees. The opposite is true for the US, even if the imbalance is gradually disappearing. In other words, there are more European inventors involved into the research assigned to US organizations and performing research in the US than vice-versa, although the globalisation of R&D activities is gradually eroding this disparity.

US firms play a pivotal role in the global division of innovative labour in pharmaceuticals, as shown by the shares of co-invented patents at the international level. US dominance is even more pronounced when looking at patent citations data.

The internal structure of the US national innovation system is a powerful source of competitive advantage and industrial leadership. In the US the biotech sector play a vital role integrating explorations of new research opportunities with clinical and market development.

China and India are accumulating scientific and technological capabilities in the life sciences and in pharmaceuticals. This pattern poses a serious challenge to the European industry, which might be displaced in the long run by economies with lower labour costs and greater potential in terms of both market size and scientific capabilities.

The US market for pharmaceuticals is both more concentrated and more volatile than markets in Europe. In other words, the higher concentration of the US market does not mean that it is less competitive. On the contrary, the US market is highly contestable; product turnover is much more frequent than in the EU and Japan; and competition from generic producers is substantial. US market behaviour is consistent with that of a market characterized by Schumpeterian competition, where innovators can gain temporary quasi-monopoly profits, which in turn spur innovation efforts by competitors that quickly leads to more innovative products and a high turnover of market shares. Dynamic competition is less evident in the EU as a whole, and especially in certain continental European countries.

In sum, Europe is lagging behind the US in its ability to generate, organise, and sustain innovation processes and productivity growth in pharmaceuticals. Moreover, a disproportionate share of pharmaceutical R&D is performed in the US, with negative consequences in terms of both high value-added employment and complementary investments in clinical research.

Cost containment policies on behalf of European Social Security institutions can explain to a certain extent the different dynamics characterising the EU pharmaceutical industry vis-à-vis the US. However,

these cannot be fully explained by sector-specific factors. They are also the consequence of Europe's relative lack of dynamism in reforming its labour and capital markets, education systems, public spending, and regimes of market regulation. This is, for example, illustrated by the relative lack of dynamism of young technology-dedicated firms in generating and developing R&D projects.

Given the shortcomings in European competitiveness attributed at least partially to the distortions created by national pricing and reimbursement decisions, the Commission has taken the initiative to address some of the pressing issues by creating the Pharmaceutical Forum. It was established by Vice President Verheugen and Commissioner Kyprianou in June 2005 and brings together for the first time senior decision makers in Member States, industry and other stakeholders. Based on previous work, the G10 Medicines process, it will take forward the three topics "Information to Patients, Relative Effectiveness of Medicines and Pricing/Reimbursement".

In particular the two latter issues have been the source of market distortions in the Single Market for pharmaceuticals in the EU since national pricing/ reimbursement decisions and the diverging requirements to measure relative effectiveness have had negative spill-over effects on other Members States with different systems and have often caused unforeseen ramifications for the EU market as a whole.

The objective of the Forum is to find a way forward which will strike a balance between the public health objective of patients' access to new medicines at affordable costs and the need to create a predictable environment for business with economic rewards for innovators. Finding the right balance and creating an environment conducive to innovation will foster the competitiveness of the industry.

Based on the deliberations in this framework, concrete actions will have to follow at EU and particularly at Member States' level in order to regenerate Europe as a world centre of pharmaceutical innovation.

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ANNEX 1:
Sectoral competitiveness indicators

Explanatory notes

Geographical coverage: all indicators refer to EU-25

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. It 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-25 exports and imports of products of sector "i" to and from the rest of the World.

Revealed Comparative Advantage (RCA): this is the indicator used in the Pocketbook. 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 1: EU-25 production index annual growth rate (%)

NACE	Sector	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average 2001-2005
D	Manufacturing	3,2	0,1	4,5	3,7	1,6	5,3	0,1	-0,7	0,5	2,5	1,2	0,7
DA15	Food products and beverages	2,1	1,3	3,3	0,9	1,7	1,1	1,6	2,4	1,1	1,2	2,2	1,7
DA16	Tobacco products	-7,4	9,8	-1,3	1,6	-5,1	-6,1	-3,0	-0,2	-5,7	-5,9	-5,2	-4,0
DB17	Textiles	-1,6	-3,5	3,8	-1,9	-4,7	1,4	-3,9	-4,6	-3,3	-4,4	-4,8	-4,2
DB18	Wearing apparel; dressing; dyeing of fur	-2,1	-5,4	-3,7	-2,6	-10,0	-5,5	-3,3	-12,0	-5,8	-5,6	-9,3	-7,2
DC19	Tanning, dressing of leather; manufacture of luggage	1,0	-3,3	1,1	-5,5	-3,9	-3,3	-4,1	-7,8	-7,8	-11,4	-8,2	-7,9
DD20	Wood and of products of wood and cork	-0,9	-3,5	4,4	3,1	2,6	5,5	-3,0	0,3	1,3	3,2	0,5	0,4
DE21	Pulp, paper and paper products	-0,7	-2,0	5,1	0,7	2,3	3,3	-2,2	3,2	2,0	3,4	-0,8	1,1
DE22	Publishing, printing, reproduction of recorded media	-1,0	0,0	3,8	5,0	3,3	2,0	-1,6	-0,4	-0,7	2,2	-0,1	-0,1
DF23	Coke, refined petroleum products and nuclear fuel	1,7	0,0	-1,3	2,1	-5,9	2,4	0,1	-1,2	1,5	3,6	0,9	1,0
DG24	Chemicals and chemical products	3,5	2,5	6,4	3,2	4,6	5,2	2,8	5,3	2,1	1,1	2,1	2,7
DH25	Rubber and plastic products	3,0	-0,8	5,8	4,4	2,5	4,8	-0,7	0,2	1,8	1,9	0,4	0,7
DI26	Other non-metallic mineral products	2,0	-2,7	3,0	2,3	2,3	3,8	-0,9	-2,0	0,7	1,8	0,1	-0,1
DJ27	Basic metals	2,3	-2,2	6,4	0,9	-3,2	6,5	-1,6	-0,5	0,1	3,8	-1,8	0,0
DJ28	Fabricated metal products	6,6	-1,1	4,1	4,7	0,6	5,8	0,7	-0,1	0,3	2,9	1,3	1,0
DK29	Machinery and equipment n.e.c.	7,8	0,3	3,0	2,8	-2,5	5,7	1,4	-1,3	-0,8	3,7	3,5	1,3
DL30	Office machinery and computers	23,2	7,2	5,5	12,6	8,9	17,7	-2,3	-16,8	-0,3	-0,8	2,2	-3,9
DL31	Electrical machinery and apparatus n.e.c.	2,2	-0,3	4,9	5,0	3,2	7,8	1,5	-3,8	-0,9	3,5	1,9	0,4
DL32	Radio, television and communication equipment and apparatus	7,2	4,0	6,9	9,1	11,5	24,3	-9,6	-10,9	1,0	12,3	3,6	-1,1
DL33	Medical, precision and optical instruments, watches and clocks	4,3	0,2	2,4	3,8	1,3	10,3	4,5	-0,7	2,2	2,0	2,0	2,0
DM34	Motor vehicles, trailers and semi-trailers	5,9	2,8	8,1	11,2	3,6	7,8	1,9	1,0	2,3	5,2	1,7	2,4
DM35	Other transport equipment	-3,1	1,2	8,5	4,1	5,7	0,4	3,5	-6,2	2,8	2,6	3,5	1,2
DN36	Furniture; manufacturing n.e.c.	0,5	-1,5	1,4	4,7	2,5	2,5	-0,4	-4,9	-2,5	0,6	0,0	-1,5
DN37	Recycling	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4,1	6,7	-0,2	7,5	2,5	4,1

Source: Eurostat

Table 2: EU-25 number of persons employed annual growth rate (%)

NACE	Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average 2001-2005
D	Manufacturing	-1,4	-0,8	0,6	-1,1	-0,5	-0,3	-2,3	-1,8	-1,7	-1,1	-1,4
DA15	Food products and beverages	0,0	-0,3	0,8	-0,6	-0,9	-0,6	-0,7	-0,1	-1,3	0,2	-0,5
DA16	Tobacco products	-4,4	-4,3	-3,0	-4,7	-4,2	-4,3	-4,0	-4,4	-1,1	-2,9	-3,3
DB17	Textiles	-6,3	-2,8	-2,1	-5,2	-4,4	-2,8	-5,3	-7,3	-5,3	-3,6	-4,9
DB18	Wearing apparel; dressing; dyeing of fur	n.a.	-3,5	-2,2	-4,6	-6,9	-5,0	-7,1	-6,4	-6,8	-9,6	-7,0
DC19	Tanning, dressing of leather; manufacture of luggage	n.a.	-2,4	-4,2	-7,5	-5,9	-2,0	-3,3	-5,6	-8,8	-7,4	-5,5
DD20	Wood and of products of wood and cork	-1,4	-0,2	1,1	0,7	0,6	-0,5	-2,3	-2,2	-0,9	0,4	-1,1
DE21	Pulp, paper and paper products	-2,1	-1,3	0,8	-2,7	-1,2	-1,4	-1,8	-1,5	-0,9	-2,1	-1,5
DE22	Publishing, printing, reproduction of recorded media	0,1	0,2	1,5	1,6	0,4	-0,1	-2,0	-2,4	-1,2	-1,9	-1,5
DF23	Coke, refined petroleum products and nuclear fuel	-1,0	-4,4	-6,6	0,5	-1,9	-2,2	-2,2	-1,9	-2,0	-0,9	-1,9
DG24	Chemicals and chemical products	-1,6	-1,3	-1,1	-1,6	-1,4	-0,2	-0,2	-1,0	-3,0	-1,3	-1,2
DH25	Rubber and plastic products	-1,0	1,9	3,5	-0,3	2,1	0,7	-0,3	0,9	-0,1	-0,5	0,1
DI26	Other non-metallic mineral products	-2,9	-2,0	0,7	-1,6	-0,5	-1,0	-2,1	-2,5	-2,1	-1,4	-1,8
DJ27	Basic metals	-1,9	-2,5	-0,6	-2,8	-3,5	-2,1	-3,7	-2,8	-2,6	-1,0	-2,4
DJ28	Fabricated metal products	-0,4	0,1	2,2	1,0	1,3	1,0	-1,6	-0,8	0,5	0,6	-0,1
DK29	Machinery and equipment n.e.c.	-1,4	-0,6	0,5	-2,2	-1,1	0,2	-1,7	-2,3	-1,9	0,2	-1,1
DL30	Office machinery and computers	-2,9	1,0	3,2	2,3	1,1	-1,8	-11,0	-7,1	-5,7	-2,2	-5,6
DL31	Electrical machinery and apparatus n.e.c.	-1,9	-0,8	3,6	-0,5	0,9	1,1	-3,2	-2,8	-0,7	-1,4	-1,4
DL32	Radio, television and communication equipment and apparatus	-1,2	-2,2	1,7	0,5	5,8	1,0	-8,7	-6,0	-3,8	-2,3	-4,0
DL33	Medical, precision and optical instruments, watches and clocks	0,2	-0,4	-0,9	-1,7	-0,5	3,1	-1,1	-1,1	0,9	0,0	0,3
DM34	Motor vehicles, trailers and semi-trailers	0,7	1,2	3,0	0,5	2,3	1,2	-1,0	0,8	0,5	-1,5	0,0
DM35	Other transport equipment	-3,6	-3,0	-1,4	-1,6	-2,0	0,5	-2,0	-2,8	-1,8	-0,4	-1,3
DN36	Furniture; manufacturing n.e.c.	-0,6	-0,1	0,4	-0,3	0,6	0,2	-3,6	0,4	-2,0	-1,5	-1,3
DN37	Recycling	9,2	3,9	5,1	1,9	3,1	7,9	3,3	3,6	5,5	1,5	4,3

Source: Eurostat

Table 3: EU-25 number of hours worked annual growth rate (%)

NACE	Sector	2001	2002	2003	2004	2005	Average 2001-2005
D	Manufacturing	-1,6	-3,0	-2,2	-1,1	-1,4	-1,9
DA15	Food products and beverages	-1,5	-1,8	-1,9	-1,2	-1,0	-1,5
DA16	Tobacco products	-0,1	-6,4	-8,5	-1,0	-1,8	-3,6
DB17	Textiles	-3,3	-4,7	-6,2	-4,0	-6,1	-4,9
DB18	Wearing apparel; dressing; dyeing of fur	-6,4	-7,4	-7,2	-5,0	-7,4	-6,7
DC19	Tanning, dressing of leather; manufacture of luggage	-3,5	-7,7	-7,7	-7,6	-7,8	-6,9
DD20	Wood and of products of wood and cork	-2,4	-3,7	-2,6	-0,2	-0,2	-1,8
DE21	Pulp, paper and paper products	-1,2	-2,9	0,0	-1,8	-1,9	-1,6
DE22	Publishing, printing, reproduction of recorded media	-0,5	-3,4	-1,5	-2,6	-1,6	-1,9
DF23	Coke, refined petroleum products and nuclear fuel	-3,4	-1,0	-2,6	-1,0	-3,1	-2,2
DG24	Chemicals and chemical products	-1,8	-1,0	-1,3	-1,6	-2,4	-1,6
DH25	Rubber and plastic products	-2,0	-0,1	-0,4	0,4	-0,8	-0,6
DI26	Other non-metallic mineral products	-3,0	-2,9	-2,9	-1,3	-1,8	-2,4
DJ27	Basic metals	-3,0	-3,5	-4,4	-0,9	-1,9	-2,8
DJ28	Fabricated metal products	-0,2	-2,3	-1,8	0,1	0,0	-0,8
DK29	Machinery and equipment n.e.c.	-1,5	-2,8	-2,6	-0,3	-0,4	-1,5
DL30	Office machinery and computers	-2,5	-11,5	-6,4	-4,8	-3,7	-5,8
DL31	Electrical machinery and apparatus n.e.c.	-1,3	-2,9	-1,7	-0,7	-0,8	-1,5
DL32	Radio, television and communication equipment and apparatus	-2,8	-7,9	-5,7	-2,1	-2,2	-4,2
DL33	Medical, precision and optical instruments, watches and clocks	1,8	-1,8	-1,6	0,4	-0,3	-0,3
DM34	Motor vehicles, trailers and semi-trailers	-0,5	-1,9	0,7	1,3	-0,5	-0,2
DM35	Other transport equipment	-0,8	-2,5	-2,7	-1,9	-0,5	-1,7
DN36	Furniture; manufacturing n.e.c.	-0,7	-4,4	-2,7	-1,2	-1,9	-2,2
DN37	Recycling	4,2	3,0	-0,7	2,5	3,5	2,5

Source: Eurostat

Table 4: EU-25 labour productivity (per person employed) annual growth rate (%)

NACE	Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average 2001-2005
D	Manufacturing	1,5	5,3	3,1	2,8	5,8	0,4	1,6	2,3	4,2	2,3	2,2
DA15	Food products and beverages	1,3	3,6	0,1	2,4	2,0	2,2	3,1	1,2	2,5	2,0	2,2
DA16	Tobacco products	14,8	3,1	4,7	-0,4	-2,1	1,3	3,9	-1,4	-4,8	-2,3	-0,7
DB17	Textiles	2,9	6,8	0,3	0,5	6,1	-1,1	0,8	4,3	0,9	-1,2	0,7
DB18	Wearing apparel; dressing; dyeing of fur	n.a.	-0,2	-0,3	-5,6	1,4	1,7	-5,3	0,6	1,4	0,4	-0,3
DC19	Tanning, dressing of leather; manufacture of luggage	n.a.	3,6	-1,3	3,9	2,7	-2,1	-4,7	-2,3	-2,8	-0,9	-2,6
DD20	Wood and of products of wood and cork	-2,2	4,6	1,9	1,8	4,9	-2,5	2,6	3,6	4,1	0,1	1,6
DE21	Pulp, paper and paper products	0,2	6,5	-0,1	5,1	4,5	-0,8	5,1	3,6	4,4	1,3	2,7
DE22	Publishing, printing, reproduction of recorded media	0,0	3,6	3,5	1,6	1,6	-1,5	1,6	1,8	3,4	1,9	1,4
DF23	Coke, refined petroleum products and nuclear fuel	0,9	3,2	9,3	-6,3	4,5	2,4	1,0	3,5	5,7	1,9	2,9
DG24	Chemicals and chemical products	4,2	7,8	4,3	6,3	6,8	3,0	5,5	3,2	4,2	3,5	3,9
DH25	Rubber and plastic products	0,2	3,8	0,9	2,8	2,7	-1,4	0,5	0,9	2,0	1,0	0,6
DI26	Other non-metallic mineral products	0,2	5,0	1,6	3,9	4,4	0,0	0,1	3,3	3,9	1,4	1,7
DJ27	Basic metals	-0,3	9,1	1,5	-0,4	10,3	0,5	3,3	2,9	6,6	-0,8	2,5
DJ28	Fabricated metal products	-0,7	4,1	2,5	-0,4	4,4	-0,4	1,5	1,1	2,4	0,7	1,1
DK29	Machinery and equipment n.e.c.	1,7	3,7	2,2	-0,3	6,8	1,2	0,5	1,6	5,7	3,3	2,4
DL30	Office machinery and computers	10,3	4,5	9,2	6,4	16,4	-0,4	-6,5	7,3	5,2	4,4	1,9
DL31	Electrical machinery and apparatus n.e.c.	1,6	5,8	1,4	3,7	6,8	0,4	-0,6	2,0	4,3	3,3	1,8
DL32	Radio, television and communication equipment and apparatus	5,2	9,3	7,3	10,9	17,5	-10,5	-2,5	7,4	16,8	6,0	3,0
DL33	Medical, precision and optical instruments, watches and clocks	0,0	2,8	4,7	3,1	10,8	1,3	0,3	3,3	1,1	2,0	1,6
DM34	Motor vehicles, trailers and semi-trailers	2,1	6,8	8,0	3,1	5,4	0,7	2,0	1,5	4,7	3,2	2,4
DM35	Other transport equipment	5,1	11,8	5,5	7,5	2,5	3,0	-4,3	5,8	4,5	3,9	2,5
DN36	Furniture; manufacturing n.e.c.	-0,9	1,5	4,3	2,9	1,9	-0,6	-1,4	-2,9	2,6	1,5	-0,2
DN37	Recycling	n.a.	n.a.	n.a.	n.a.	n.a.	-3,5	3,2	-3,6	1,9	1,0	-0,2

Source: Eurostat

Table 5: EU-25 Unit Labour Cost annual growth rate (%)

NACE	Sector	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
D	Manufacturing	-3,5	-1,1	0,6	-2,1	2,5	1,5	0,5	-1,1	0,0	0,7
DA15	Food products and beverages	-1,8	0,7	0,4	0,8	1,6	0,0	2,0	-0,2	-1,1	0,5
DA16	Tobacco products	n.a.	n.a.	8,7	10,6	4,5	0,1	6,6	11,8	7,3	6,0
DB17	Textiles	-2,5	3,5	5,1	-0,1	2,8	3,6	2,0	3,0	3,0	2,8
DB18	Wearing apparel; dressing; dyeing of fur	2,6	2,8	10,0	4,1	1,4	10,8	2,1	5,2	8,7	5,6
DC19	Tanning, dressing of leather; manufacture of luggage	0,5	7,2	4,3	5,5	7,1	8,2	6,2	12,0	8,6	8,4
DD20	Wood and of products of wood and cork	-3,7	-0,6	-0,5	-3,2	4,1	-0,3	-1,1	-0,7	1,6	0,7
DE21	Pulp, paper and paper products	-3,5	0,7	-0,7	-0,7	4,5	-2,5	-1,7	-1,9	2,0	0,1
DE22	Publishing, printing, reproduction of recorded media	n.a.	n.a.	0,1	1,6	4,9	1,1	-0,4	-1,8	1,3	1,0
DF23	Coke, refined petroleum products and nuclear fuel	0,1	-5,7	6,6	0,0	2,8	3,5	1,9	1,1	2,5	2,4
DG24	Chemicals and chemical products	-6,1	-2,4	-3,9	-2,4	-0,4	-2,6	0,7	-0,9	-0,8	-0,8
DH25	Rubber and plastic products	-3,3	-0,7	0,8	-0,6	3,4	1,1	0,6	1,1	0,4	1,3
DI26	Other non-metallic mineral products	-3,2	-0,8	-0,7	-1,9	1,9	2,9	-0,1	-1,3	1,0	0,9
DJ27	Basic metals	-4,0	1,3	3,7	-4,9	-1,5	-0,7	0,0	-2,3	4,3	-0,1
DJ28	Fabricated metal products	-2,8	-1,4	2,3	-2,4	2,8	1,2	0,8	-0,6	0,2	0,9
DK29	Machinery and equipment n.e.c.	-2,1	0,3	4,5	-2,6	1,6	1,7	2,2	-1,0	-1,5	0,6
DL30	Office machinery and computers	n.a.	n.a.	-8,0	-15,2	5,0	6,9	-5,3	-6,4	-2,6	-0,6
DL31	Electrical machinery and apparatus n.e.c.	-5,8	-1,3	-1,7	-4,0	1,8	4,5	0,0	-1,8	-0,8	0,7
DL32	Radio, television and communication equipment and apparatus	-5,7	-2,9	-5,2	-13,2	15,4	7,4	-5,4	-11,9	-4,4	-0,2
DL33	Medical, precision and optical instruments, watches and clocks	-2,0	-2,5	0,0	-5,4	1,4	1,9	-0,3	1,1	1,3	1,1
DM34	Motor vehicles, trailers and semi-trailers	-4,9	-5,6	1,3	-2,9	1,7	1,4	1,3	-2,4	-0,4	0,3
DM35	Other transport equipment	n.a.	n.a.	-3,0	1,9	1,9	9,9	-0,8	-2,9	0,1	1,5
DN36	Furniture; manufacturing n.e.c.	-1,4	-3,3	-0,2	-1,0	3,0	5,0	1,4	-1,2	0,1	1,6
DN37	Recycling	n.a.	n.a.	n.a.	n.a.	5,3	-2,1	8,1	-2,0	3,3	2,4

Source: calculated from Eurostat data

Table 6: EU-25 Relative trade balance (X-M)/(X+M)

Product	1999	2000	2001	2002	2003	2004
Food products, beverages and tobacco	0,09	0,09	0,07	0,09	0,07	0,07
Textiles	-0,10	-0,08	-0,08	-0,07	-0,07	-0,10
Wearing apparel; dressing; dyeing of fur	-0,49	-0,50	-0,47	-0,48	-0,50	-0,52
Tanning, dressing of leather; manufacture of luggage	-0,13	-0,12	-0,13	-0,16	-0,20	-0,20
Wood and of products of wood and cork	-0,20	-0,19	-0,14	-0,07	-0,09	-0,11
Pulp, paper and paper products	0,14	0,11	0,15	0,21	0,24	0,17
Publishing, printing, reproduction of recorded media	0,27	0,26	0,30	0,31	0,32	0,31
Coke, refined petroleum products and nuclear fuel	-0,07	-0,06	-0,13	-0,12	-0,09	-0,07
Chemicals and chemical products	0,21	0,22	0,23	0,25	0,25	0,25
Rubber and plastic products	0,03	0,04	0,06	0,09	0,09	0,10
Other non-metallic mineral products	0,40	0,36	0,34	0,36	0,34	0,30
Basic metals	-0,18	-0,20	-0,19	-0,18	-0,18	-0,19
Fabricated metal products	0,21	0,15	0,18	0,22	0,20	0,21
Machinery and equipment n.e.c.	0,31	0,29	0,33	0,37	0,37	0,40
Office machinery and computers	-0,47	-0,44	-0,41	-0,42	-0,44	-0,45
Electrical machinery and apparatus n.e.c.	0,04	-0,01	0,06	0,07	0,07	0,08
Radio, television and communication equipment and apparatus	-0,14	-0,18	-0,16	-0,18	-0,20	-0,19
Medical, precision and optical instruments, watches and clocks	-0,04	-0,04	-0,02	0,04	0,06	0,12
Motor vehicles, trailers and semi-trailers	0,28	0,36	0,40	0,42	0,41	0,40
Other transport equipment	0,00	0,01	0,05	0,01	-0,02	-0,01
Furniture; manufacturing n.e.c.	-0,05	-0,06	-0,04	-0,06	-0,10	-0,13

Source: calculated from COMEXT

Table 7: EU-25 Revealed Comparative Advantage index

Product	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
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
Textiles	0,73	0,72	0,73	0,74	0,73	0,72	0,71	0,68	0,69	0,71
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
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
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
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
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
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
Chemicals and chemical products	1,27	1,29	1,33	1,39	1,45	1,47	1,44	1,53	1,45	1,42
Rubber and plastic products	0,91	0,90	0,93	0,91	0,91	0,91	0,89	0,89	0,93	0,95
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
Basic metals	0,82	0,86	0,84	0,76	0,74	0,86	0,81	0,78	0,73	0,76
Fabricated metal products	1,17	1,16	1,14	1,13	1,15	1,09	1,08	1,07	1,10	1,12
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
Office machinery and computers	0,46	0,42	0,43	0,45	0,48	0,49	0,49	0,45	0,44	0,41
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
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
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
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
Other transport equipment	1,42	1,33	1,17	1,25	1,34	1,35	1,28	1,35	1,24	1,22
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

Source: calculated from COMTRADE data

ANNEX 2:
List of background studies to the European Competitiveness Report 2006

Some parts of the European Competitiveness Report 2006 are based on, or use, material prepared by a consortium led by WIFO, the Austrian Institute for Economic Research:

– *Chapter 3 – Liberalisation of European Energy markets:* challenges and policy options is based on "Liberalisation of European Energy markets: challenges and policy options", by Machiel Mulder, Victoria Shestalova, Mark Lijesen and Gijsbert Zwart, from the Netherlands Bureau of Economic Policy Analysis (CPB), (2006).

– *Chapter 4 – The Regulatory Environment in the Context of the Strategy for Growth and Jobs*, uses material from "The Regulatory Environment in the Context of the Strategy for Growth and Jobs", by Mari Kangasniemi and Ana Rincon-Aznar, National Institute for Economic Research (NIESR), (2006).

– *Chapter 5 – The Financing of Innovation*, uses matterial from "The Financing of Innovation", by Michael Peneder, from WIFO (2006).

– *Chapter 6 – The "Lead Markets" approach to Innovation policy*, is based on "The Concept of "Lead Markets": A Literature Overview", by Rian Beise-Zee and Christian Rammer, Centre for European Economic Research (ZEW), (2006).

Finally, *Chapter 8 – Competitiveness in the Pharmaceutical industry*, is based on "Industrial Competitiveness in Pharmaceuticals: A European Perspective", by Fabio Pammolli, IMT, Institute for Advanced Studies, Lucca, University of Florence, CERM and Massimo Riccaboni, University of Florence, CERM (2006).

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