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Innovation, jobs and growth in Europe: tackling deficiencies in EU's innovation capacity

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Innovation, Jobs and Growth in Europe:

tackling deficiencies in EU's innovation capacity

by

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1. Introduction

With the adoption of the Lisbon Strategy in March 2000, to make Europe a competitive knowledge-based economy by 2010, and the Barcelona objectives agreed upon in 2002 to increase R&D investment in the EU to approach 3% of GDP, the European leaders acknowledged the need for profound reforms in the EU in view of the challenges of ageing, enlargement and globalisation. EU Heads of State and Government were well aware that such policy endeavour could only be effectively undertaken by a concerted approach involving all Member States and involving many policy areas where competence lies at both national and EU level. These objectives and orientations were confirmed and strengthened in the renewed Lisbon strategy launched in 2005.

To date, one of the most disappointing aspects of the Lisbon strategy is the performance on R&D and Innovation. While there are examples of good performance in particular sectors and particular Member States, overall the EU innovation environment remains weak This is all the more remarkable taking into account that the Lisbon European Council rightly recognised that Europe's future economic development would depend crucially on its ability to create and grow high value, innovative and research-based sectors.

This contribution tries to provide some insight into the issue by first assessing (section 2) and identifying the causes (section 3) of EU's growth and innovation problem. It then discusses how policy should be designed to tackle EU's innovative capacity (section 4), to continue with a discussion of EU's actual policy agenda (section 5). We conclude with suggestions for moving policy forward (section 6).

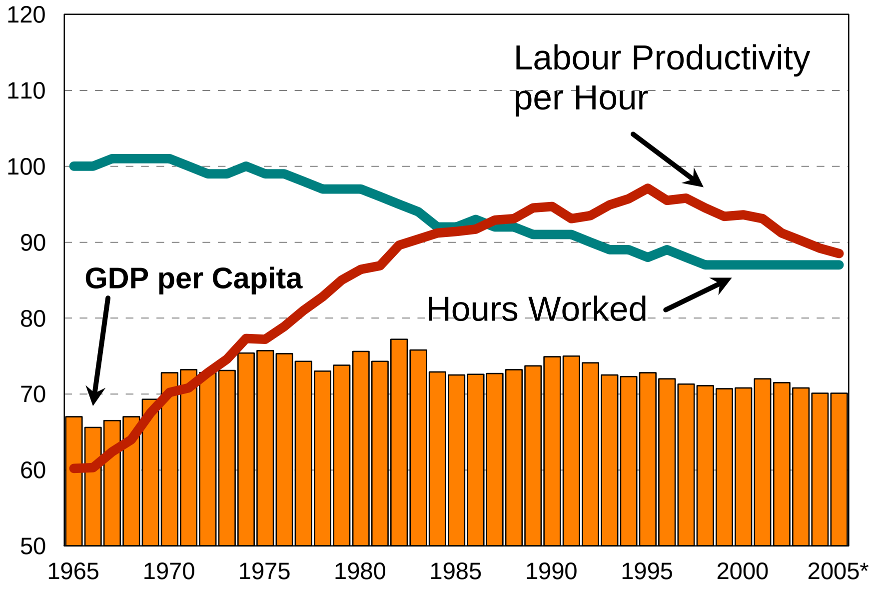
2. Assessing the problem: EU's relative productivity performance

2.1. The EU-US growth gap: the importance of the hourly labour productivity growth trend

Europe's growth performance has been the subject of increasing scrutiny over recent years. The underlying GDP growth rate has been trending downwards and the medium to long term outlook points to a continuation of these trends.

The break in Hourly Labour Productivity Trend: EU-15 versus US (=100)

Source: EU, Ecfin, Ameco



The gap in terms of GDP per capita between the EU and the US can be explained both by lower productivity per hour and by a lower total number of hours worked. The EU has witnessed a lower labour productivity growth as compared to the US and hence the gap in labour productivity is increasing. With respect to employment, the EU has expanded employment (both in terms of number of persons employed and hours worked per person), while the US witnessed a negative employment growth in the late nineties. The EU hence has been able to reduce the employment gap.

While the growth in employment in the EU is undoubtedly welcome and whilst accepting that there is a link between the employment / productivity changes, the essential problem is that only a relatively small proportion of the decline in productivity for the EU average can be attributed to the higher employment content of growth. These concerns explain the strong focus in this contribution on the basic productivity patterns. The EU is now, for the first time in decades, on a trend productivity growth path which is lower than that of the US, as the chart shows.

- Since 1999, the productivity gap with the US has widened: the EU labour productivity per hour decreased from 89.2% of the US level in 1999 to 86% in 2003.

- This recent EU performance marks a serious downgrading relative to the situation in the early 1990s, when annual EU labour productivity growth was averaging nearly 2 ½ per cent, compared with 1 per cent for the US. Since that time, the EU's labour productivity growth rate has declined by a full 1 percentage point to 1½ per cent, compared with an acceleration of ¾ of a percentage point in the US to 1¾ per cent.

2.2. Decomposing the EU Labour Productivity Trend into capital deepening versus Total Factor Productivity growth

Should the EU be worried about the ongoing decline in its productivity performance? What are the drivers for productivity growth and which factors explain the difference in productivity growth between the EU and the US? This question is at the hart of many policy reports from the European Commission [1].

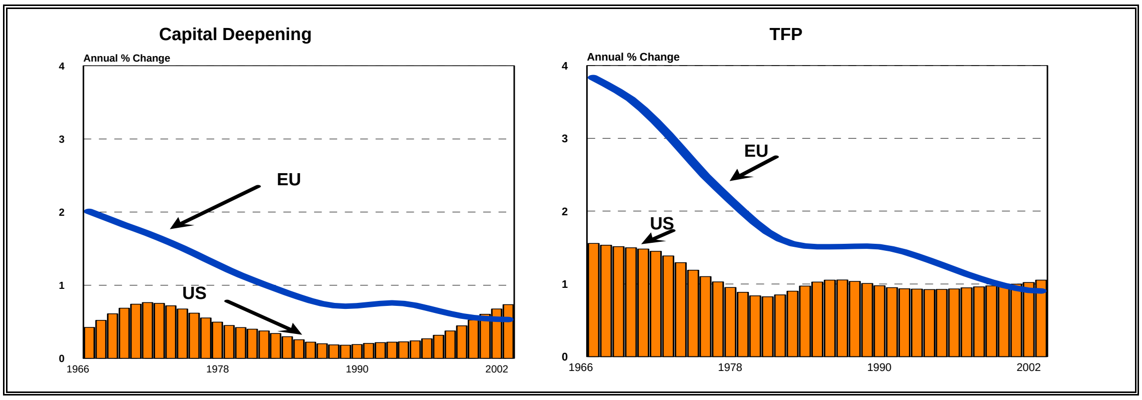
Various factors can explain the decline in labour productivity. Firstly, and as discussed supra, the decline may be explained by expansionary employment policies, if they involve integration of workers with lower skill levels. Secondly, there may have been a decline in overall efficiency levels.

From a purely growth accounting perspective, the 1 percentage point decline in labour productivity experienced over the period 1996-2002, compared with the first half of the 1990s, appears to emanate from the following two factors (ECFIN 2004)).

- Firstly, roughly 50 per cent of the decline can be attributed to a reduction in the contribution from capital deepening i.e. lower investment per employee in the complementary input factor, namely, capital. Investment in IC technologies was contributing positively to productivity growth (albeit less than in the US) but the rest of investment performed poorly.

- Secondly, the remaining 50 per cent of the decline in labour productivity growth appears to emanate from a deterioration in total factor productivity. i.e. in the overall efficiency of the production process generally attributed to technological progress, resulting from investments in human capital, R&D and information technology, and to an enhanced market efficiency; This should be seen as the greater source of concern for policy makers.

BREAKDOWN OF TREND LABOUR PRODUCTIVITY INTO CAPITAL DEEPENING AND TFP



SOURCE: EC-ECFIN, ANNUAL REVIEW 2004

Total Factor Productivity is a concept that relates output to all measured inputs and hence, having eliminated the impact of increasing use of inputs, is assumed to measure the "pure" influence of technology. It is however constructed as a residual factor and as such includes the impact of measurement error, changes in quality and the composition of inputs. Nevertheless, it is the economist's most often used instrument for technological progress. As such, the deterioration in the relative TFP performance of the EU versus the US, direct policy makers to

[1] See among others, ECFIN's 2003 & 2004 Annual Review, ENTR, Annual Competitiveness Reports and RTD, Key Figures 2005.

examining the forces driving technological progress and more particularly to examine the possibility that differences in innovation capacity may be at the hart of the continuing EU-US growth gap.

2.3. The EU-US R&D deficit

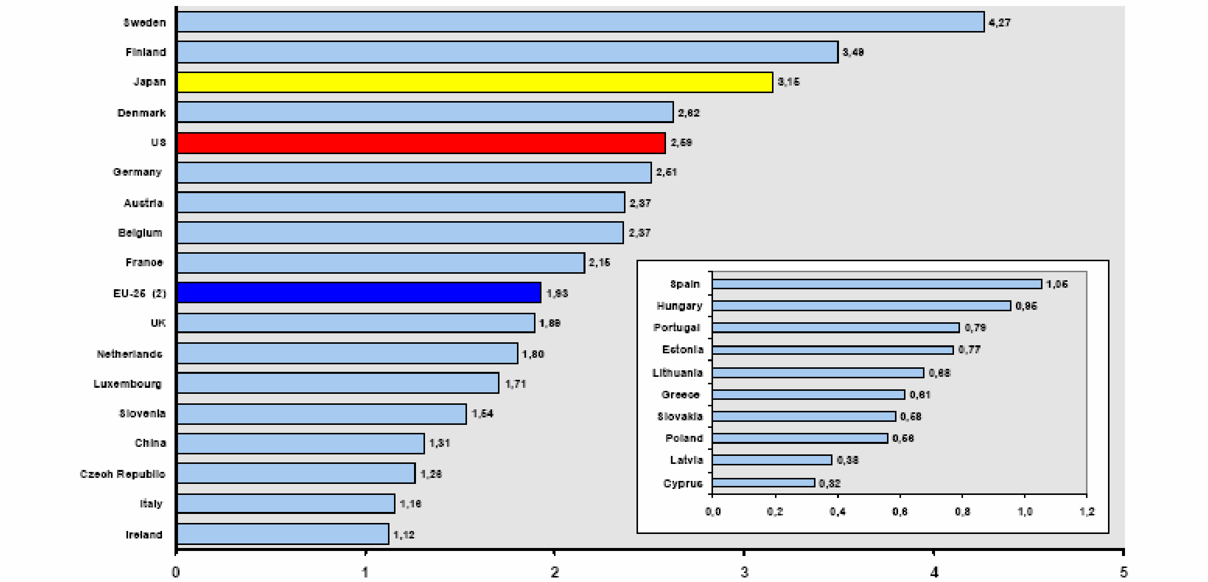
Contemporary concerns about the EU's innovative performance are often expressed with reference to a deficit in research and development (R&D) spending. Since the launch of the Lisbon Strategy in 2000 total R&D spending in the EU has been stagnating at around 1.9% of GDP (and even slightly falling since 2002). In 2004, R&D spending in the EU lagged well behind that in the US (2.6% of GDP) and Japan (3.2%), but remained above that of China (1.2% of GDP).

At EU-25 level, the rate of growth of R&D intensity did not significantly decrease after 2000. However, an annual growth rate of 0.7% (average annual growth between 2000 and 2003) is far from sufficient to reach the 3% objective by 2010. If this trend remains unchanged, the EU's R&D intensity will be only about 2.20% in 2010. On the contrary, China experienced a very strong growth of its R&D intensity since the end of the 1990s, with annual growth rates above 10% (total R&D expenditure grew, in real terms, by almost one fifth each year). In this regard, China is growing faster than any other economy in the Triad. If current trends for both China and the EU continue in the coming years, China will have caught up with the EU by 2010 in terms of GDP allocated to R&D. The EU's R&D intensity, however, grew at a higher rate than that of the US. As a result, the EU as a whole has been catching up with the US since 2000. The growth of R&D intensity is higher in Japan than in both the EU and the US, although this seemingly good performance can be partially explained by the low growth rate of Japan's GDP (denominator) over recent years.

R&D intensity varies significantly between EU Member States. While R&D intensity in Finland and Sweden exceeded that in the US, it was less than 1% in countries such as Greece, Hungary, Malta, Poland, Portugal and Slovakia. R&D intensity was relatively low in Cyprus, Estonia, Lithuania and Spain as well, but these countries appear to be catching up with the EU average.

R&D intensity, Gross Expenditures on R&D as % of GDP, 2003

Source: Key Figures, 2005



Source: DG Research — Key Figures 2005

Data: Eurostat, OECD

Notes: (1) LU : 2000; SE : 2001; IE, IT, NL : 2002; BE : 2004; AT : 2005.

(2) EU-25 was estimated by DG Research and does not include LU and MT.

In line with expenditures on R&D, the pool of researchers is much smaller in the EU than in the US and Japan. In 2003, the number of full-time equivalent (FTE) researchers per one thousand labour force was only 5.4 in the EU, compared to 10.1 in Japan and 9 in the US. In addition, the share of population with tertiary education in the EU-15 (23.8%) is considerably smaller than that in the US (38.2%) or in Japan (40.5%)[2]. Despite this gap between the EU and its main competitors, the number of researchers per one thousand labour force has been growing at an average annual rate of 2.8 % in the EU over recent years, much higher than the growth in R&D intensity.

[2] Share of tertiary graduates in total employment, 2003 (OECD, 2005)

3. Better identifying the problem: industrial structure, ICT and innovation

Enhancing productivity growth and innovation is fundamental to realising the Lisbon ambition of making Europe the most competitive, knowledge based, economy in the world by 2010. It is also fundamental to sustain and possibly increase future living standards in a context of an ageing population, an accelerating pace of technological change and continued globalisation. Yet, productivity growth and innovation is the result of the interplay of a host of factors. Policy makers can only influence some of them and often only in an indirect way. The present section focuses on the nature and source of the deterioration in the EU's productivity growth and innovation performance relative to that in the US since the mid-1990's. It will serve the discussion in later sections on the approach to be adopted in order to remedy this situation. More particularly, this section will address the following questions:

- Firstly, in explaining recent EU-US divergences in productivity trends, to what extent is the EU's relatively poor performance linked with its particular industrial structure and its difficulty in re-orientating its economy towards the newer, higher productivity, growth sectors such as ICT ?
- Secondly, what is the contribution of ICT towards explaining the productivity trends, both as a high-tech, high-productivity-growth sector and in its role as a General Purpose Technology increasing the productivity growth in other sectors?
- Thirdly, in the context of delivering on the EU's longer term ambitions of progressively moving towards a more knowledge-based economy, the analysis focuses on the specific role to be played by the production and absorption of new technologies in any overall strategy.

A precise understanding of the nature of the growth and innovation deficit is vital to an analysis of the causes of this deficit. If the deficit is indeed a general one, that is, if it is found across countries, across industries and across types of firms within the EU, then we should look to general explanations for its causes.

3.1. Differences in EU-US Industrial Structure

In explaining the EU-US productivity growth performance, a first factor to consider is the differential industrial structure. Zeroing in on the sectoral productivity growth structure of the EU and US economies, reveals a number of interesting findings.

- The EU has been doing reasonably well compared with the US in a wide range of manufacturing and service industries over the second half of the 1990's. However the problem for the EU is that most of these industries, not being the high-growth sectors, are not making big contributions to overall productivity growth or do not have a large enough share of EU output to alter the EU's overall productivity performance. In addition, for most of these industries not only are productivity growth rates low but they have been declining over the course of the 1990's.
- Regarding manufacturing, two sectors dominate the overall productivity patterns, namely semiconductors and office machinery. These are the two industries where the US is clearly ahead, with semiconductors contributing 5 times more to US productivity growth compared to the equivalent gains for the EU and with office machinery contributing more than twice as much.
- The US is dominant in the private services industries category. Of the service industries which individually contributed significantly to overall productivity growth, the US is dominant in the financial services area, and wholesale and retail trade. Only, in communications industry the EU holds the advantage.
- For the EU, the productivity improvements which have been achieved in a number of the network industries took place when liberalisation efforts were most evident. The size of these industries is, however, not large enough to alter the overall EU picture in any significant way.
- Finally, regarding the primary industries and public services, the striking feature is the vastly different performance of the EU and the US in health, education and social services where the US experienced

large negative contributions compared with a positive / broadly unchanged position for the EU. Obviously, measurement problems could blur the picture here.

Insert graph here

3.2. The contribution of ICT to EU-US growth differentials

One of the most popular explanations for the diverging productivity fortunes of the EU and the US has been the relative exposure of both areas to ICT (Information and Communication Technologies).

As section 3.1 has demonstrated, a primary source of US productivity acceleration in the 1990s has been the increasing share of ICT production in the US, combined with extraordinary gains in productivity. However, given the General Purpose Technology characteristics of ICT, one should also see productivity gains from *using* that technology, further sustaining the ICT effect on aggregate productivity. In fact, both the ICT producing manufacturing and intensive ICT-using private services categories are causing the 1996-2000 divergences in EU-US productivity growth rates. It is precisely in these two areas of the economy where the EU fares most poorly relative to the US either in terms of the size of the respective industries (i.e. small shares of overall EU output) or having relatively low productivity growth rates.

Breakdown of Total Economy into 3 categories – 2 ICT categories (ICT producing + Intensive ICT-Using) and 1 category of Less Intensive ICT using (i.e. more traditional) Industries

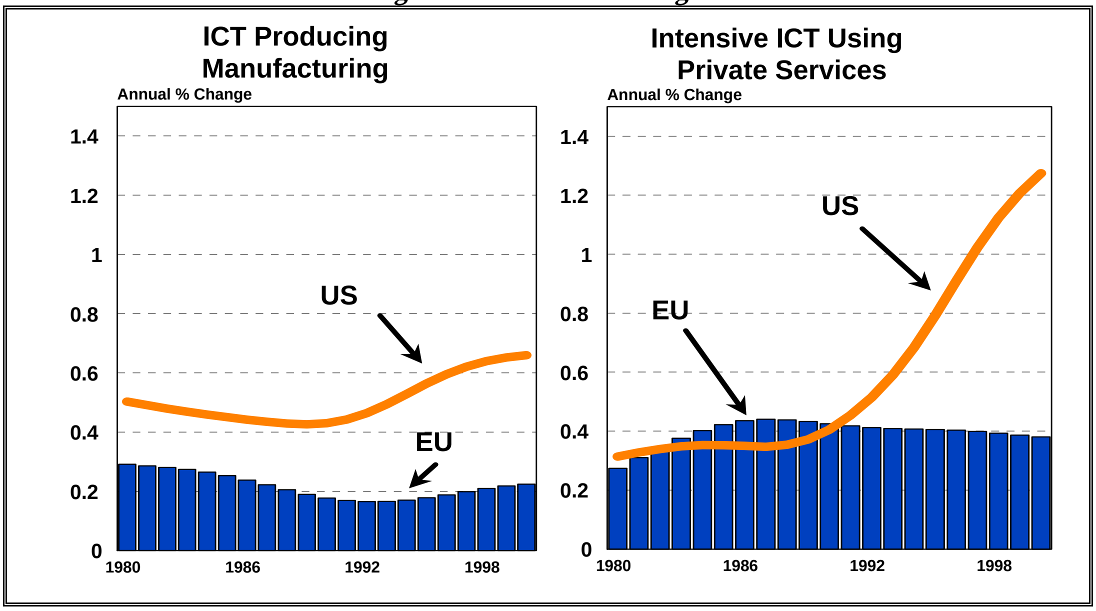
	Hourly Labour Productivity (Average % Change)		**Value Added Share**		**Contribution to Total Change in Hourly Labour Productivity**	
	1991-1995	**1996-2000**	**1991-1995**	**1996-2000**	**1991-1995**	**1996-2000**
Total Economy (1+2+3)						
EU	**2.3**	**1.6**	**1**	**1**	**2.3**	**1.6**
US	**1.1**	**2.3**	**1**	**1**	**1.1**	**2.3**
1. Manufacturing Sector						
EU	**3.7**	**2.6**	**0.23**	**0.21**	**0.9**	**0.5**
US	**3.6**	**4.6**	**0.19**	**0.18**	**0.7**	**0.8**
1(a) ICT-Producing Manufacturing Industries						
EU	(9.6)	(17.1)	0.02	0.01	(0.2)	(0.2)
US	(16.4)	(26.0)	0.03	0.03	(0.4)	(0.7)
1(b) Intensive ICT-Using Manufacturing Industries						
EU	(2.6)	(2.0)	0.07	0.06	(0.2)	(0.1)
US	(-0.6)	(1.4)	0.06	0.05	(0.0)	(0.1)
1(c) Rest of Manufacturing (Less-Intensive ICT using)						
EU	(3.6)	(1.6)	0.14	0.13	(0.5)	(0.2)
US	(2.6)	(0.6)	0.10	0.11	(0.3)	(0.1)
2. Private Services Sector						
EU	**1.9**	**1.4**	**0.52**	**0.54**	**1.0**	**0.7**
US	**1.0**	**2.7**	**0.53**	**0.54**	**0.5**	**1.5**
2(a) ICT-Producing Service Industries						
EU	(4.8)	(6.8)	0.03	0.03	(0.2)	(0.2)
US	(2.4)	(0.8)	0.03	0.04	(0.1)	(0.0)
2(b) Intensive ICT-Using Service Industries						
EU	(1.8)	(2.1)	0.20	0.21	(0.4)	(0.4)
US	(1.6)	(5.3)	0.23	0.25	(0.4)	(1.3)
2(c) Rest of Services (Less-Intensive ICT using)						
EU	(1.7)	(0.2)	0.29	0.30	(0.5)	(0.1)
US	(0.2)	(0.3)	0.27	0.26	(0.1)	(0.1)
3. Rest of Economy (Primary Industries + Public Services) (Less Intensive ICT-Using)						
EU	**2.0**	**1.1**	**0.25**	**0.25**	**0.5**	**0.3**
US	**-0.3**	**-0.1**	**0.28**	**0.27**	**-0.1**	**0.0**

SOURCE : ECFIN ANNUAL REVIEW 2004

Beyond the diffusion of ICT in the narrow sense (ICT capital deepening), the EU has not been able to reap the same benefits as the US in terms of TFP gains in the ICT using sectors (ICT diffusion in the broader sense). It must be emphasised that the most important gains occur in a very narrow segment of the economy and here especially in service sectors (Retail & Wholesale Trade, Financial Services) where productivity is difficult to measure. In ICT using manufacturing, the relative TFP gains in the US are much smaller.

The fact that TFP accelerations in ICT using industries are not observed in the EU could be –beyond measurement issues- either due to adjustment costs (EU is in an earlier stage of the transition) or it could be the result of institutional constraints in specific industries (e.g. land use regulations in wholesale and retail trade, less entry of new establishments) which prevents firms to reap the full benefits of the new technology in EU countries. It is important to keep in mind, however, in terms of the ongoing acceleration in ICT usage (or diffusion of ICT in a narrow sense in both WT and RT i.e. the actual purchases of ICT investment goods and services by these industries), there is no big difference between the EU and the US. It is the TFP gains in these two industries where the more important difference appears to be located.

Contribution to the total change in Trend Labour Productivity per Hour from ICT-Producing Manufacturing and intensive ICT-using Private Services



Source: Denis et al (2005)

3.3. The importance of knowledge production and diffusion

An important question to examine is the extent to which the example of ICT is an isolated case or is likely to be replicated in other high-growth, high-tech industries. [3] If this is a credible risk then the key question is whether the EU has specific problems in relation to its innovation infrastructure (in terms of the resources devoted, rates of return, industry focus) and whether the US has specific features / framework conditions which make it more likely to be the locus for the future breakthroughs in technology. The wider issue is why is it that the US seems to be better in creating and exploiting new (general purpose) technologies in general ? This requires broadening the discussion beyond ICT to understand better the EU's R&D deficit compared to the US.

The business sector accounts for the largest part of the total R&D intensity gap between the EU and the US (Table 2). Following a modest growth in the late 1990s, the share of the business enterprise sector in the funding of total R&D in the EU decreased between 2000 and 2003. In 2003, the share of R&D

[3] This is a pertinent question if one accepts the contention of Gordon (2004), amongst others, that the US's lead in ICT is not an isolated case. The US holds a comparative or absolute advantage also in other general purpose technologies, like its initial leadership in the electricity industry and in its exploitation of the internal combustion engine (Gordon 2004)).

financed by the business sector was 55.8 % in the EU as compared to 63.7 % in the US. Within the EU, the more innovative countries ranked highest in terms of the share of R&D expenditure funded by the business sector. Conversely, the government sector was still a large source of R&D funding in less innovative countries such as the southern European countries and the new Member States.

R&D intensity gap and the contribution of the public versus private sector to this gap, 2003

	R&D intensity (GERD as % of GDP)	**GERD funded by business enterprise as % of GDP**	**GERD funded by government as % of GDP**
EU-25	1.90	1.04	0.66
US	2.67	1.70	0.82
EU-25- US gap	0.77	0.66	0.16

Source: Eurostat, OECD
Note: All values are based on estimated or provisional data

Since the R&D intensity gap between the EU, on the one hand, and the US and Japan, on the other, is mostly due to low levels of R&D spending in the business sector, the gap may be associated with a different industrial structure. A recalculation of EU R&D intensity based on the assumption that the industrial structure in the EU in 2002 was identical to that of the US reveals a marginal decline in the EU figure[4]. A closer analysis reveals that R&D expenditure in the EU tends to be more concentrated in traditional manufacturing industries, while the US spends substantially more in ICT producing industries and in ICT using services sectors such as software and computer related services[5]. On this latter point, it is striking that the share of the services sector in the business R&D is 40% in the US, as opposed to only 15% in the EU.

In overall terms when one assesses the evidence in relation to the manufacturing sector, as the following table does, it is fair to conclude that the overall R&D infrastructure of the US seems to dominate that of the EU's. Not only does the US display a higher R&D intensity overall, it also has a larger weight of is production concentrated in R&D intensive sectors and it realizes a better growth performance in R&D sectors. Hence, differences in innovative capacity are a prime candidate to explain the EU-US differences in productivity growth performances, particularly in high-tech manufacturing industries

Comparison of EU-US differences in R&D spending and Productivity Growth
(US=1)

	EU-US Gap in R&D Spending		EU-US Gap in Specializsation		EU-US Gap in Productivity Growth Rates	
	91-95	96-99	91-95	96-00	91-95	96-00
Total High Technology Manufacturing	0.85	0.81	0.825	0.826	0.48	0.41
(ICT)	0.59	0.49	0.45	0.42	0.23	0.27

4 Key Figures (2005)
5 EU Economy 2004 Review

(Non-ICT)	1.02	1.05	0.98	1.01	1.15	2.81

(Source: DG ECFIN, 2004 Annual Review)

Within high-technology industries, we have to make a distinction between ICT and non-ICT high-tech sectors. As discussed in section 2, the US is more specialized in ICT industries as compared to other high-tech sectors and it has a higher productivity growth in these sectors. This higher productivity growth can be related to a higher spending in total on R&D; and getting a higher leverage out of its R&D investments. For non-ICT high-tech sectors, the picture is less devastating for the EU, particularly in the second part of the nineties. There is no difference in specialization in these industries, nor a productivity disadvantage. The gap in total expenditures on R&D is also minimal, with the EU having a higher R&D intensity. Unfortunately, these sectors, often being only medium to high-tech, have far less scope for productivity growth than the ICT industries.

Overall, the R&D deficit seems to primarily manifest itself in the production of ICT goods and services. This is both because of a lower specialization of the EU economy in these R&D intensive, high growth sectors, but also because of a lower R&D intensity of firms within these sectors. In terms of firm behavior, based on the limited evidence available, the deficit in ICT may reflect constraints on the rapid growth of new, technology-based entrants in the EU as compared with the US. These problems may also be an obstacle to EU success in other sectors, such as biotechnology, even if they do not as yet show up in statistics based on highly aggregated industrial classifications.

Also important in understanding the business R&D deficit is the size distribution of firms and its concentration: The share of business R&D performed by SMEs in the EU (23%) is substantially higher than in the US (14.1%) and Japan (7.0%). Nevertheless about three quarters of EU-Business Expenditures on R&D is done by firms with 500 and more employees. In addition, these expenditures are heavily concentrated in few hands, particularly in the most R&D intensive sectors (Source: Eurostat 2005);

On top of this, most of these large firms are multinational firms with a foreign locus of control. The share of foreign controlled firms in total Business Expenditures on R&D ranges from 12% in Finland to 80% in Ireland. This foreign presence is particularly high in pharmaceuticals. For instance in Sweden, almost all Pharma R&D is foreign controlled (OECD (2006)).

Overall, the conclusion seems that the EU's economy has a lower share of most innovative sectors and firms; What is impeding firms to innovate in the EU? Survey evidence can provide some insights here. The EUROSTAT CIS (Community Innovation Survey asks what firms identify as **major impediments for innovation** (both who do not innovate and those whose innovations are hampered). These results show that the major obstacle to innovation is **high innovation costs** and **excessive economic risks** and tied to this a lack of **appropriate sources of finance.** ***Lack of qualified personnel*** comes as close second tier of barrier (Source: Eurostat 2005);

Furthermore, there are no major differences in types of perceived barriers across sectors and services, and surprisingly also not across size classes. The only difference is that large firms in general are more likely to complain (ie experience barriers); For small firms, access to finance and regulations are somewhat more of barrier for innovation than for large firms.

This "twinning" of demand and supply side factors, is also confirmed from survey results on motives for R&D location decisions; Most studies show both market access and availability of researchers as important drivers for R&D location (ECFIN, Annual Review 2005). More recently companies replying to JRC-EU2005 Survey of R&D trends indicated that market demand for new products and services is the most important factor influencing the level of R&D investment, while market access is the most important factor influencing R&D location decisions abroad. Beyond market motives, availability of researchers (not necessarily cost of researchers) and access to specialized R&D are important too;

4. Designing policy for tackling the EU R&D and growth deficiencies

Singling out R&D targets as the primary policy instrument is problematic because it addresses the symptom of a problem rather than its root causes. Investing more public funds for R&D does not necessarily ensure more innovation. This is not to argue that an increase in R&D is unnecessary: rather that increased expenditure on R&D is a necessary but not sufficient condition for successful innovation. Failing to address the structurally-rooted problems entails the risk that we may end up with socially-unproductive expenditures on R&D if we attempt to, and succeed in, forcing the R&D numbers up. Innovation policy in the EU should therefore focus more on the underlying causes of the EU's innovation deficit and seek to redress them.

4.1. The need for a broader perspective: innovation capacity

Innovation capacity requires more than the ability to produce new ideas. It also includes the capacity to bring new products and process to market. In this perspective, developing an innovative capacity involves not only the creation of new knowledge, but also the capacity to absorb new knowledge, to transfer and diffuse knowledge, and the ability to learn by interaction. It also suggests a double perspective in looking for causes of any deficit: capabilities for innovation may be low but also incentives or rewards for innovation may be low.

Using the insights from both macro and micro models (eg Aghion & Howitt, 1992), applied economic theorists (e.g., Furman, Porter & Stern 2002) have synthesized what determines an economy's "***national innovation capacity***" defined as the ability of a nation to not only produce new ideas, but also to commercialize a flow of innovative technologies over the longer term. From this perspective a range of factors are deemed to be important for effective innovation effort. A sufficiently developed 'supply' side of R&D (as reflected in the amount of R&D investment carried out, the number of skilled researchers and S&T infrastructure) is a necessary condition for successful innovation. They are however insufficient. Broader framework conditions are important as well, including a sufficient 'demand' for innovation to reward successful innovators. This requires sophisticated lead users willing to pay early on for innovations, effective intellectual property rights (IPR) schemes, a favorable macro-economic environment and effective competition in output markets. With well functioning product markets, firms will have incentives to innovate to improve their competitive position, while new firms, embodying new ideas, can flow into the market. Furthermore, new business opportunities can only be taken advantage of if appropriately educated and skilled workers can be hired under the right conditions. This requires flexible labour markets providing innovators access to researchers and skilled human capital. Similarly, well functioning risk capital markets assure innovators access to financial capital to finance their risky projects. Especially high-tech start-ups, often an important source of breakthrough innovations, need open product markets with low entry barriers and access to capital, especially early stage financing of high risk ventures.

But perhaps the most critical element in an innovation system is the interconnectedness of its agents. Through networking among firms, researchers and governments, the supply of new ideas diffuses through the economy. This requires looking at interactions among, or interfaces between, various elements of that innovation system in seeking to locate the causes of the R&D deficit. From this perspective, innovation deficits can reflect systemic, rather than market, failures. Of particular importance is the public-private interface, that is, the relationship between elements of the public sector, such as the educational and research system, and the industrial base.

National Innovation Capacity: An integrative framework

- Common Innovation Infrastructure: cross-cutting institutions, resources and policies
    - Existing Stock of Technological Know-how
    - Supporting Basic Research and Higher Education
    - Overall Science and Technology Policy

- Technology/Cluster Specific Conditions:
  - Technology specific know-how : specialized R&D personnel
  - Incentives for innovation : lead users, appropriation (IPR) and output market competition: (local) rivalry, openness
  - Presence of related/supporting industries (clusters)
- Quality of Links bt clusters & common factors
  - Industry-Science Relationships
  - Efficient labour & capital markets

Source: On the basis of Furman et al (2002)

In the Innovative Capacity perspective, country differences with respect to innovation and growth might reflect not just different endowments in terms of labour, capital and the stock of knowledge, but also the varying degrees of the "knowledge distribution power" or the efficiency of the innovation system. In this perspective, three types of deficits can arise (i) deficits in resources and capabilities for innovation (ii) deficits in incentives for innovation and (iii) systems failures.

4.2. Diagnosing the EU's innovation deficit problem

As discussed in section 3.3, the EU innovation environment remains weak in a number of key 'input' indicators, such as the amount of public and private R&D investment and the stock of S&T researchers. The proportion of the population in tertiary education in the EU is smaller compared to the US and Japan, funding allocated to education is lower and there is a net outward migration of the best of researchers. General weaknesses of the higher education system are often mentioned to explain weaknesses on the capabilities' side, with poor governance of universities and research centers, rigid structures and lack of rewards, autonomy and accountability in a non-integrated education and research market. This compares to the US with an openly competitive system of private and public universities and government funding through peer-reviewed research grants.

But in addition to input deficiencies, market pull conditions and knowledge networks are key areas of EU weakness. Often the EU does not exploit its available knowledge inputs and expertise for social and economic needs (the 'European paradox'). In the private sector there is often too little incentive to innovate: European product and services markets remain too fragmented, lacking a sufficiently dynamic competitive and lead user friendly environment. Again this compares to the US, offering a large integrated market unencumbered by differences in language, customs and standards; a clearer and stronger US Intellectual Property Rights system; better industry science links, more flexible financial markets, making available venture capital finance to innovating firms; and more flexible labour markets, affecting both internal migration and the international immigration of highly skilled people.

As for the public sector, it is on the whole larger than in the US, yet both balkanised between the Member States and at the same time dominant in each MS as the purchaser/regulator of potentially innovative techniques in key fields for the future of innovation such as health, (public) transport systems, security, environment conservation and energy saving. The US holds a better public procurement and R&D subsidies process in government-funded military, space and health programmes, For example, the policy of "second sourcing" pursued by the US military, the insistence on the availability of a second source of supply, is generally seen as playing an important role in contributing to the diffusion of technology in the formative stages of the US semiconductor industry and other lead sectors in the ICT complex.

All this confirms the analysis of a persistent innovation deficiency of the EU, going beyond the deficit in R&D spending, but covering all three areas identified. Tackling the deficient EU innovative capacity requires a longer-term, broad, systemic policy framework. Going beyond stimulating the research inputs from the public and the private sector, it is important that other structural reforms are part of the policy agenda to improve the EU's innovative and growth capacity. No single action will deliver higher growth. Rather, a series of interconnected initiatives and structural changes are needed.

4. 3. EU policy reaction: the Lisbon agenda: a "systemic approach" ?

At the European Council of March 2000 in Lisbon, the EU launched a ten-year long comprehensive set of integrated structural reforms geared towards the general objective of becoming "the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" as well as "an increasing respect for the environment". The scope of the Lisbon strategy has been wide from the outset in terms of the policy tools to be used. The Lisbon reforms (Source: EC-ECFIN (2005)) can be classified into five categories: product and capital market reforms; investments in the knowledge-based economy; labour market reforms; social policy reforms; and environmental reforms.

Structural Reforms in the Lisbon Agenda

Product and capital market reforms	**Investments in knowledge-based economy**	**Labour market reforms**	**Social policy reforms**	**Environmental policy reforms**
Improve the functioning of the Internal Market for goods and services	Invest in education and training	Improve incentives to participate and remain in the labour market	Modernisation of social protection systems	Improve understanding of environmental problems
Improve the business environment	Invest in R&D and innovation	Improve matching between human resources and vacancies	Improve working conditions and skill levels	Increase use of cost-benefit analysis
Promote EU financial integration	Encourage production and use of ICT	Increase labour market flexibility		Increase use of market-based instruments

The Lisbon strategy embodies the idea that to yield maximum synergies from structural reforms, they are best implemented in a comprehensive and co-ordinated way (the 'systemic' view). As the previous sections have documented, this holds a fortiori for tackling the deficiencies in the innovative capacity, most notably, given the fragmentation of the research activity, the lack of mobility of researchers, induced by labour market fragmentation and rigidities and the difficulty to bring innovations into the marketplace. Investment and innovation are likely to benefit from a more competitive and entrepreneurial environment, fostered by structural reforms on product, capital and labour markets that improve market functioning and thus the transfer of resources from low-productivity to higher productivity use. Therefore, beyond the research inputs from the public and the private sector, it is important that other structural reforms are part of the Lisbon agenda aiming at the development of a genuine European Research Area, a better connectedness of science and industry and better framework conditions, establishing

- well functioning product markets, such that firms have an incentive to innovate and that new ideas can flow into the market through new firms entering
- flexible labour and capital markets, such that innovators have access to financial and human capital .

One of the challenges to implement the Lisbon Strategy is to get the Member States involved. Since the structural reforms touch upon sensitive areas of national competence, the EU member states need to be incentivated and policies coordinated. This is done through the "open method of coordination" which involved inter alia:

- Agreements of targets with timetables
- Use of indicators and benchmarks
- Periodic evaluation of progress made.

4.4 The renewed Lisbon strategy: Partnership for Growth and Jobs

The mid term review of the Lisbon Strategy (Kok report (2004)) made it clear that the Lisbon strategy had not delivered what was expected, particularly with respect to the knowledge economy. While the worldwide and particularly European macroeconomic climate may have contributed to this situation, the slow pace of policy reforms and of their implementation by the Member States has held back economic growth. The major weakness of the Lisbon strategy identified by the reviewers was the governance of the policy process, with a lack of peer pressure at the level of the Member States and poor communication about the benefits. This is why the mid-term reviewers called for more focus on employment and productivity growth.

In the renewed Lisbon Strategy, with its focus on Growth and Jobs, R&D and innovation have been recognised as a key priority. The Partnership for Growth and Jobs provides the European Union with a governance structure to improve the EU's innovation performance and to influence the key drivers of the R&D and innovation system.

All Member States (except Malta) identified R&D and innovation as a key challenge in their 2005 National Reform Programmes (NRPs). It is encouraging that basically all Member States have or are in the process of putting in place more comprehensive R&D and innovation strategies. Member States appear to recognise the need for a more systemic approach to R&D and innovation. The policy measures proposed in the NRPs to improve national R&D and innovation systems vary from Member State to Member State depending on the state of development of the R&D and innovation system. There are important differences, but also many similarities in policy responses between highly, moderately and less innovative countries (see ECFIN (2006) for an overview).

At the Community level, the European Union has focused its financial support of R&D and innovation activities. The 7th Framework Programme will boost funding of collaborative research in Europe, in particular, the Joint Technology Initiatives (JTI) will realise strategic research and technology agenda that offer significant potential for boosting Europe's innovative capacity and bring together industry, research community, and the financial world. Potential Joint Technology Initiatives have already been identified in six areas. The new European Research Council (ERC) will focus on competitive funding for research excellence. The Competitiveness and Innovation Programme (CIP) will - in close coordination with the 7th Framework Programme - support innovation and entrepreneurship. In addition, the Commission will launch a Risk Sharing Finance Facility (RSFF) in order to finance SME growth. In cooperation with the EIB, the RSFF will approve loans and guarantees to support investment in high-risk research, technological development and demonstration projects. The Commission and Members States agreed to earmark parts of the Structural funds, Cohesion policy programmes, and the European Agricultural Fund for Rural Development (EAFRD) for knowledge and innovation. This will enable regions across Europe to improve their R&D and innovation system.

In addition, in order to leverage the funding of R&D and innovation by Member States, the Commission has adopted new Guidelines on State Aid for risk capital with the aim of facilitating access to finance and risk capital. It has also adopted new Guidelines on State Aid for R&D and innovation, stressing the importance of redirecting State aids to address market failures in order to increase economic efficiency and to stimulate research, development and innovation. The Commission has made recommendations to modernise universities and developed with Members States a strategy to create an open, single and competitive European labour market for researchers which needs to be implemented. In this context, the Commission intends to put forward a proposal to establish a European Institute of Technology (EIT), operating in the triangle of education, research and commercialisation.

5. Conclusions: The way forward for the Lisbon Agenda

The Lisbon strategy embodies the idea that to yield maximum synergies from structural reforms, they are best implemented in a comprehensive and co-ordinated way. The problem is, however, that the Lisbon strategy and its renewed version Partnership for Growth and Jobs are not sufficiently connected to be understood as a truly 'systemic' endeavor. Lisbon remains a collection of policy initiatives, rather than a truly integrated view. What follows are some suggestions to improve the Lisbon Policy Framework, to unleash its potential as a systemic policy approach, capable of tackling Europe's innovation deficit.

More attention to measures aimed at enhancing demand for innovation

Traditionally, S&T policy both at EU level and in most Member States have focused mostly on using public funding to build R&D capacities. Lacking incentives for firms to innovate have received less attention. The Ahö report (2005) has put the need for markets that are friendly to innovation at the core of its proposals for reviving the Lisbon Agenda. This demand-focus has been taken up in recent EU innovation policy documents[6]; The Commission is currently carrying out a review of the Internal Market with the aim to make it more innovation friendly. Moreover, the Commission has launched a dialogue with industry and other interested parties to provide European industry with a sound framework for Intellectual Property Rights (IPR). In addition, the Commission will propose a comprehensive "lead-markets"-strategy , including public procurement practices aiming at the removal of barriers that would lead to the uptake of new products and services.

More attention to differences in technologies, sectors and forms of innovation
There is a great deal of diversity amongst sectors and technologies in terms of innovation processes, innovation inputs and outputs. Technological opportunities differ across sectors with ICT as a prime example of a high growth sector with huge opportunities for technological advance. There is also a great deal of diversity amongst the sources of innovation ranging from in-house R&D laboratories over supplier, users, to public research institutes for the industries using science-based technologies. Policy should at least recognize these idiosyncracies.

For example, innovation policies are still industry and technology centered, despite the fact that services constitute the majority of European economic activity. Particularly in services there are also other forms of non-technological innovation which are less recognised, while their potential for contributing to the Lisbon objectives is potentially huge. These types of innovations are mostly embedded in organisational structures and processes and can be important complementary forces to leverage technological innovations.

More attention to policy governance: enhancing horizontal policy coordination Increasing the efficiency of STI policies implies improving co-ordination among various policy makers. Within STI policies, the triangle of research, innovation and education policies should not be designed in isolation from each other. At the same time, this triangle should be in close interaction with other policy areas (financial markets, labour markets, product markets, macro-economic stability, environmental policies). Close co-operation among decision-making instances or even integration should be explored to guide prioritisation processes and to better exploit synergies.

More attention to policy governance: enhancing vertical policy coordination
The Lisbon strategy and the ERA should not be thought of as a harmonization process: innovative and productive structures' differ across countries and regions. A decentralized policy approach implies more possibilities of adaptation to local specific needs in order to better align the various complementary local actors. Nevertheless, coordination among the various policy levels is important. The idea is to facilitate co-operation and to boost diffusion and uptake of knowledge, increasing the efficiency of the resources used. European level policies and national policies as well as regional policies should form a coherent mix, in which all policies focus on those market and systemic failures best solved at each level.

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[6] Framework Communication on Innovation (2006); See also Georghiou (2006)

More attention to policy governance: improving policy monitoring and evaluation STI policies need to be supported by monitoring and evaluation practices, which then feed back into the policy process. In the set of indicators currently being collected and monitored in the Lisbon process to evaluate progress, the area of indicators that is least represented relates to the diffusion capacity. Especially the lack of Industry Science Link Indicators is disturbing since this is one of the particular deficiencies of the EU innovative capacity.

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Graph 1 : Contributions of the 56 Industries to Overall Labour Productivity Growth in the US + EU15 (1996-2000) (Source: ECFIN (2004), Annual Review)