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New insights on EU-US comparison of corporate R&D

Pietro Moncada-Paternò-Castello

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These *IPTS Working Papers on Corporate R&D and Innovation* can take the form of more *policy oriented notes*, mainly addressed to EU policy-makers. They present policy implications derived from our own research and the views of the most prominent authors in the field, making the appropriate references.

The present Working Paper (No. 01/2010 – [March 2010) is issued in the context of ***the Industrial Research Monitoring and Analysis (IRMA)***[1] activities that are jointly carried out by the European Commission's Joint Research Centre (JRC) – Institute for Prospective Technological Studies (IPTS) and the Directorate General Research - Directorate C, European Research Area: Knowledge-based economy.

IRMA activities aim to improve the understanding of industrial R&D and Innovation in the EU and to identify medium and long-term policy implications. More information, including activities and publications, is available at: http://iri.jrc.es/ and http://ec.europa.eu/invest-in-research/

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Abstract

Policy-makers have become increasingly aware that corporate R&D and innovation are the main drivers of an economy's competitiveness and growth. The widespread adoption of R&D targets has led researchers and analysts to pursue a deeper understanding of corporate R&D investment trends, drivers and impacts. This paper focuses on the main differences between the EU and the US in corporate R&D performance, especially in the following three main aspects: (i) dynamics of the economic structures and the cause of the R&D intensity gap; (ii) R&D performance and company demographics and (iii) financial availability and corporate R&D investment. Based on the literature review, the paper concludes that (a) there have been more dynamic changes in the structure of the US economy than in the EU in the last two decades which in turn have favoured the growth in the US of higher R&D-intensity sectors to a larger extent than in the EU; (b) younger and smaller-sized US companies are more present - and show a higher capacity to grow - in high-R&D intensity sectors than similar companies in the EU; (c) financial markets, especially in the last decade, have hampered EU firms' R&D investment more than that of US firms. The paper concludes that policy measures to stimulate corporate R&D and innovation activities should be expressly conceived according to the typology of companies, sectors and countries.

Keywords: Corporate R&D, EU-US comparison, industrial dynamics, technological change, innovation process, government policy

JEL Classification: O31; O32; O33; O38.

1 Introduction

Private-sector research and development (R&D) and innovation are crucial for economic growth, productivity, employment, competitiveness and social welfare in general. Indeed, there is a wide consensus on the contribution of competitive R&D/innovation-led enterprises on socio-economic returns. The positive role of R&D and innovation (capability to generate, acquire and diffuse new knowledge) on long-term economic growth and welfare has been highlighted already in 1945 in a pioneer report by Vannevar Bush, and taken up by many other authors since then (Sapir et al., 2004; Archibugi and Coco, 2005). The positive social rate of return to industry from R&D conducted by firms in the same industry, and in other parts of the economy has been estimated by a number of authors (see for instance Jones and Williams, 1998).

In particular, technical change is considered as the major source of productivity growth in the long run (Solow, 1957) while R&D is regarded as a major source of technical change (Romer, 1990) and a key element in increasing the knowledge base and - with it - the growth, productivity and competitiveness of a given economy (Coccia, 2008; Mowery and Rosenberg, 1989).

In the last few decades, and with the aim of fostering investment in knowledge as a base for competitiveness and social prosperity, policy-makers have paid more attention to R&D levels and quality, not only in the public sector but also in the private one. The underlying assumption is that there is a close link between R&D spending, and micro- and macro-economic performance (Kafouros, 2008; Griffith et al., 2004; Mitchell, 1999).

Therefore, considering that the investment in knowledge, measured in particular by industrial R&D, is a vital element for maintaining competitiveness and achieving sustainable growth, policy makers obviously benchmark R&D of a given economy against the best performing ones. The 2002 EU Council in Barcelona, following the 2000 EU Lisbon Council objective of making the EU the most competitive knowledge-based economy, set a target for the R&D investment of 3% of EU GDP by 2010, of which two thirds should be financed by the private sector. This target was set taking into consideration that at that time the EU was investing only 1.9% of its GDP in R&D whereas Japan invested 2.7 % and the US 2.98% of their respective GDPs (European Commission, 2003).

Despite many efforts, the latest statistics referring to the year 2007 show R&D intensity (R&D expenditure as a percentage of GDP) in the EU-27 of 1.83%, i.e. about the same level as in 2002. It remains significantly lower than in the United States (2.61 %) and in Japan (3.32 %). Therefore, it is still below the 3% goal set within the Lisbon Strategy, while its relevance is still central to the "EU2020" strategy (European Commission, 2009a, and 2010).

The gap between the EU and the US has not narrowed noticeably in last decade: in 1998 the R&D intensity was 1.13% in the EU and 1.9% in the US, while in 2007 it was 1.19 % and 1.88 % respectively (see Figure 1 in the Annex).

A closer look at the differences in the private sector R&D between EU and US in the light of new research work allows for a better understanding of the features of such a R&D intensity gap and the factors which hamper the EU's ability to reduce the persistent difference in R&D performance vis-à-vis the US.

This paper focuses on the comparison between the structure and the dynamics of R&D performance in the EU and the US (intended as intensity, and as capacity to translate R&D investment into competitiveness gains). It aims to broaden the knowledge - thanks to the results of recent investigations - on particular aspects of this central issue, thus addressing the following main questions:

Have there been noticeable differences in the dynamics of structural change in the EU and US economies, and therefore in the composition of their respective R&D-intensive sectors? Is the cause of the corporate R&D intensity gap between the EU and the US largely due to underinvestment or to the industrial structure of both economies? And in, in particular, do the

differences in the size and dynamics of R&D intensive firms in the ICT sector have a relevant role in such an overall R&D intensity gap?
Are there statistics reliable enough to provide an indisputable picture of the comparison between the EU and the US in R&D performance available? And do scientists and policy-makers have all the data they need for monitoring and analysing corporate R&D appropriately?
What are the main "framework conditions" that could foster private-sector R&D performance? And, in particular, do financial constraints affect EU and US companies differently in their propensity to invest in R&D?
Focusing on the comparison between the EU and the US on corporate R&D, this paper is structured as follows: Section 2 is devoted to examine the relevant literature, especially in the following three main aspects: (i) dynamics of the economic structures and the cause of the R&D intensity gap; (ii) R&D performance and company demographics and (iii) financial availability and corporate R&D investment while Section 3 provides conclusive remarks and possible implications for policies.

2 Literature review

This section aims at positioning the central theme of this article i.e. the "comparison between EU and US in corporate R&D" within the literature.

There is quite an extensive literature which has studied such a comparison, and in particular the reasons for the difference (or gap) between the R&D performance in these two economies. Out of the different issues addressed in these studies we would like to concentrate on the following:

(i) Dynamics of the economic structures and the cause of the R&D intensity gap

Advanced economies of the world may be similar in some economic indicators as income levels and productivity growth, but they can significantly differ in terms of their technological specialisation and hence in their industrial structures.

If one assumes that the structure of an economy influences its overall average R&D intensity and with it the speed of achieving a knowledge-intensive society, it is interesting to look at changes in this structure over time in the EU and the US (in terms, for example, of value added to R&D intensive sectors in a given economy).

Whilst the share of high R&D-intensive manufacturing sectors in total value added is relatively low, their role for technological development and competitiveness is essential. As a result of spillovers and other forms of knowledge transfer, R&D has a considerable positive impact on growth in the economy as a whole (Guellec and van Pottelsberghe de la Potterie, 2001; Audretsch and Feldman, 2005).

As can be seen in Figures 2a and 2b of the Annex, the composition of the manufacturing sector in terms of value added has hardly changed over the years. In the EU, the composition of the manufacturing sector in 2003 is strikingly similar to that of 1979, i.e. 32% in the low, 26% in the medium-low, 37% in the medium-high and 5% in the high R&D intensive sectors. On the other hand, the US economy shows more dynamism and the share of the medium-low R&D intensive sectors has decreased between 1979 and 2003 from 27% to 21% in favour of the medium-high (34% to 37%) and high (7% to 9%) sectors.

Foray and Lhuillery (2007) show that corporate R&D has undergone considerable change in structure since 1985 in the US and in Europe at a more modest pace and also analyse the

extent and the cause of this different trend and argue that this has also occurred because of the greater reliance on market relationships for the governance of the innovation process.

According to a study by the European Commission (2009b), US corporate R&D growth is dominated by the high-tech sector, while that of the EU is spread across all sectors. Furthermore, between 2005 and 2008 the US has reinforced its corporate R&D investment in the high R&D-intensity sectors, while the EU has strengthened the medium ones. These findings are confirmed by other authors, as for instance Mowery (2009) who demonstrates that the US industrial R&D has considerably changed its structure over a period of 30 years.

The more modest speed of industrial structure change in Europe has been documented in the literature (e.g. Gambardella *et al.,* 2007). However, in the last two decades the greatest structural changes in industrial R&D have occurred in a set of new industries and services in the US (but also in Japan). These countries are clearly more specialised than others in the world, but also more able to shift, maintain and reinforce their specialisation over time (European Commission, 2010).

The importance of technological specialisation lies in the fact that industries have very different R&D intensities, and so the particular mix or composition of industries within a country will be reflected by its aggregate R&D intensity. Simply taking a raw R&D/GDP ratio for comparison purposes leaves aside the effects of industrial specialisation. The differences in R&D intensity between countries are largely accounted for if technological specialisation is taken into consideration (Mathieu and van Pottelsberghe de la Potterie, 2008).

Recent studies (Veugelers, 2006a; Ciupagea and Moncada-Paternò-Castello, 2006; GFII, 2007; Moncada-Paternò-Castello *et al.,* 2009) found that the lower overall corporate R&D intensity in the EU compared to the US is the result of sector specialisation (*structural effect*). The US has a stronger sectoral specialisation than the EU in high R&D intensity sectors and most of the structural difference is due, in particular, to the ICT sectors.

It should be noted, however, that other authors who have addressed this issue conclude that the EU R&D deficit is mainly due to companies' underinvestment in R&D (*intrinsic effect*). This is the case of Van Ark, Inklaar and McGuckin (2003) and Erken and van Es (2007) who concluded that the contribution of sector composition to the R&D funding gap between the EU and the US was very low, whereas the *intrinsic effect* was by far more responsible for the corporate R&D gap. Nonetheless, they also argue that, if only manufacturing sectors are taken into account, corporate R&D intensity does not differ much between the US and the EU.

Lindmark, Turlea and Ulbrich (2007) found that the ICT sector is the main responsible for the overall EU vs. US R&D intensity gap, and that there are fewer EU companies in such a sector compared to the US. But the higher relevance either of the *intrinsic* or of the *structural* effect to explain the overall R&D intensities gap in the ICT sector depends on whether aggregate private-sector data or micro-level data are used. In fact, differences in the nature of the datasets, the sample used – including whether only manufacturing or also service sectors are taken into account – and the methodological approaches may explain partly the reason for contrasting results between some studies (Moncada-Paternò-Castello *et al*., 2009). Possible distortions caused by the use of different statistical methodologies when comparing EU and US R&D performance can be relevant. The international comparison at the sector- and micro-level is not always possible or appropriate (Leydesdorff and Meyer, 2006; Veugelers, 2006b; Cooper and Marrill,1997). When pointing out the R&D intensity comparison between the EU and the US, the literature often disregards some important aspects of the statistical basis: B. Shackelford (2007) has, for example, already signaled some caveats when comparing statistics of R&D intensity between the EU and the US. For instance, the service sectors' R&D has different data collection and sectoral classification approaches in the US compared to the EU. Drawing conclusions by a simple comparison done with these EU and US data can lead to an imprecise picture. As there is a general positive growth in R&D investment in the service sectors and in service-related manufacturing sectors both in the EU and in the US (European

Commission 2009a and 2009b).), even with different magnitudes (higher in the US than in the EU), such a statistical issue seems quite relevant but scarcely investigated in the literature. Similarly, Duchêne, Lykogianni and Verbeek (2009) argue that the analysis of the official statistics (BERD/ANBERD) induces to grant a relevant role to service R&D to explain nearly the entire EU-US R&D intensity gap in such sectors. The authors assert that this is due to the fact that R&D reported in the services sector in the EU is to a much larger extent redistributed by statistical offices to the corresponding manufacturing sectors (for which the R&D has been executed) than in the US.

BOX 1. Excursus on corporate R&D investment and productivity

The overall lower European performance can be explained not only by a lower level of private R&D investment, but also by a lower capacity to translate R&D investment and innovation into productivity gains, which in turn foster competitiveness and economic growth. With regard to this explanation, European economies may still be affected by a sort of paradox (Solow, 1987), i.e. by a difficulty to translate investments in technology into increases in productivity and competitiveness. Such an important argument has been investigated and documented extensively (Verspagen, 1995; Dosi *et al*. 2006, Erken and Van Es, 2007).

The review of recent literature indicates that new R&D-based companies in the EU are experiencing greater difficulty in raising their R&D intensity to a level at which they would be competitive enough to become market leaders. Recent analysis (Ortega-Argilés *et al*. 2010) clearly shows that private sector R&D investment is most effective in raising productivity in sectors where R&D intensity is high, whereas technological change embodied in the physical capital stock is crucial for productivity increases in the low-tech and services sectors, where many new jobs are created. These results, lead to the conclusion, that there could be some R&D investment strategies and policies that are more effective than others, coinciding in such conclusion with Cincera *et al.* (2009).

There are other important differences between the EU and the US economies that influence R&D performance, for example company demographics and framework conditions, including access to finance. These aspects are referenced and discussed in the two following sub-sections

(ii) R&D performance and company demographics

A common characteristic of worldwide corporate R&D investment is its concentration: in a relatively few large-sized companies, in a relatively few sectors and countries (Ciupagea and Moncada-Paternò-Castello, 2006; Eurostat, 2005). Therefore, an important element to understand the business R&D performance difference between the EU and the US is the size distribution of firms and its concentration. Although about three-quarters of EU business expenditures on R&D is carried out by firms with 500 or more employees, the share of business R&D performed by SMEs in the EU (23%) is substantially higher than in the US (14.1%) (Veugelers, 2006a). Nevertheless, according to Moncada-Paternò-Castello *et al.* (2009) there is a larger population of US companies that are smaller R&D investors, compared to the EU, and such US companies are concentrated in sectors that are intrinsically R&D intensive, thus raising the overall R&D performance of the US vis-à-vis the EU. This has led some to believe that SMEs in Europe - which are numerous, yet operating in lower R&D intensity sectors - have a high potential for reducing the intensity gap if in the future the higher R&D intensity sectors see new firms start up and able to grow .

Another fundamental aspect related to the R&D intensity gap is the capacity of smaller companies to grow, which in turn depends on country, sector and technology specificities (Ortega-Argilés *et al*., 2009). The distribution of different size classes of firms and their different propensities to perform R&D also have an impact. Ortega-Argilés and Brandsma (2009) show that the size of R&D-intensive firms plays a role in explaining the overall R&D intensity gap between the EU and the US. Smaller firms tend to have larger R&D intensities in both economies. Size has a significant and negative effect on R&D intensity in the US, which

is robust against variation in sectors definition. This is also the case for the EU, with a slightly smaller negative coefficient. In fact, it seems there are large companies with high R&D intensities based in the US but also that the smaller companies with high R&D intensities are gaining weight more rapidly than in the EU. They conclude by pointing out that policy-makers should therefore focus on a sound overall distribution of R&D volumes rather than on underinvestment by individual companies.

Besides, and considering that around 99% of all EU companies are SMEs, but only 3% of them are doing research (Potočnik, 2009), even if the present SMEs were to double their R&D investment, this cannot be expected to have a significant impact on private sector R&D intensity in the EU.

This, again, does not take away the fact that increasing the number of SMEs involved in R&D could help to improve the dynamism of the EU economy. SMEs have the potential to affect the overall R&D intensity, particularly if R&D investment contributes significantly to their growth, as the empirical evidence demonstrates (Stam and Wennberg, 2009; Coad and Rao, 2010). Unfortunately, the EU appears to be less successful in this respect than the US, where entry of new firms appears to be easier (Cincera and Galau, 2005) and where after entry, the growth of surviving firms is stronger (O'Mahony and Van Ark, 2003; Cohen and Lorenzi, 2005). There is no doubt that US is more able to renew its demography of companies active in R&D and innovation than the EU. For instance, a recent analysis by Reinhilde Veugelers (2009) based on a selected sample from matching firms in the 2007 Financial Times Global 500 with the firms in the 2007 EU Industrial R&D Investment Scoreboard, shows that the share of the most R&D-intensive young enterprises (i.e. established less than 35 years ago) is lower in the EU than in the US: about 3% vs. 22% respectively.

Some authors have identified that one of the main causes of the EU difficulties, compared to the US, in shifting sectors within the manufacturing and services production is its smaller and less dynamic scientific base (Adams and Clemmons, 2006; Bonaccorsi, 2009).

Others have put much more emphasis on the fact that the EU-US difference in R&D performance is due to more general differences in 'framework conditions' in the respective economies, and that it is unlikely to expect that larger investment in R&D 'in itself' can make a substantial difference to the rate and direction of technical change in a given economy (e.g., Pavitt, 1998; Polt *et al*., 2001). Relevant "framework conditions" for a given practice of R&D and innovation represent the features of the overall economic and social "system".

Box 2. Excursus on corporate R&D investment and the framework conditions

Among the most important "framework conditions" elements, we can find the regulatory frameworks, financial and labour markets, R&D and innovation demand, IPR regime, infrastructures, knowledge generation and the knowledge transfer capacity, and entrepreneurial activity.

The improvement of the 'framework conditions' in the EU should have two main objectives: a homogeneous, stable, and favourable market, accompanied by a better culture of R&D innovation and entrepreneurship. Relevant positive factors are, for example: the availability of skilled workers, easy access to financial sources (availability of capital); labour market flexibility, un-fragmented market, stable regulatory framework, and exploitation of technology transfer/spillover capacity. These factors should be considered and discussed also in the EU through major reforms (e.g., university reform and market reform - services in particular).

The US economy has for several years enjoyed economic growth led by technological change. This virtuous dynamic evolution has been possible thanks to a "system" that has favoured a strong reliance on trade and the integration of knowledge. We would evocate here two relevant elements: abundant skilled /highly-educated workers (Chellara *et al*., 2006) and a strong collaboration between university and industry (Hall *et. al.* 2003). Other equally important elements of the positive US evolution have been the favourable market conditions for innovative products and services and adequate S&T and innovation policy support. This support in the US has been vertically organized with complex networks of crossing disciplines, technologies as well as industrial sectors but with user interests in the public and

private sector driving and defining the policy (Lundvall and Borrás, 2005). It should not be forgotten, in fact, that the generation and adoptions of new knowledge do not depend only on the level of investment in R&D and innovation. There are other relevant factors determining the level and the impact R&D and innovation could have in the competitiveness of the economy: The "Silicon Valley" phenomenon in the XX century did not arise in a vacuum (Saxenian, 1996): it was also the result of a series of government policies (e.g. tax schemes - but not only!) that created an outstanding R&D infrastructure and a business environment that attracted innovative engineering industries.

Due to its relevance, and as one specific 'framework condition', the availability of financial resources for R&D investment in the EU vs. the US is addressed in the following sub-section.

(iii) Financial availability and corporate R&D investment

The issue of financial resources available for private sector R&D investment deserve particular attention as they determine the R&D and innovation investment of companies. This is especially the case in situations of economic downturn. On one hand companies' liquidity is typically scarce and access to external financial resources becomes far more difficult (Shleiffer, 1986; OECD, 2009; Voigt and Moncada-Paternò-Castello, 2009). On the other hand, countercyclical corporate R&D investment behaviour would allow companies to position themselves in a favourable competitive advantage when the economic and financial turnaround comes about (Canton and Uhlig, 1999; Francois and Lloyd-Ellis, 2003).

Studies on the financial constraints in R&D investments have mainly given different results according to the countries examined. For example, in a paper which explores the determinants of corporate R&D for US, Canadian, British, European, and Japanese firms, Bhagat and Welch (1995) found that the U.S. firms' debt is significantly negatively correlated with their R&D expenditures. Hall (2002) found that small and new innovative firms in the US experience high costs of capital that are only partly mitigated by the presence of venture capital. Moreover, evidence for high costs of R&D capital for large firms is mixed, although these firms do prefer internal funds for financing these investments. Carpenter and Petersen (2002) analysed an unbalanced data panel of publicly-traded US high-tech companies over the period 1981 to 1998. Most small high-tech firms obtain little debt financing. New equity financing, in the form of the initial public offering, is very important and permits a major increase in firm size. Ortega-Argilés *et al.* (2005) found, for a sample of Spanish manufacturing firms, that the probability of incurring R&D costs is lower in the presence of high debt ratios. Their results are in agreement with the transaction cost and agency theories, which predict that firms' indebtedness tends to decrease the high risk investments projects, because R&D expenditure can evaporate in financial distress. Their conclusions are in line with previous empirical evidence on the subject (Hall, 1990 and 1992; Giudici and Paleari, 2000).

Studies that address the issue of financial constraints and R&D investment find that in the EU, firms' cash-flow limitations generally have a large and significant impact on R&D investment (Tiwari *et al*., 2007). However, there are considerable differences between EU countries. For example, financial constraints affect companies in the UK much more than in Germany, probably due to differences in financial markets (Bond *et al.* 1999).

Ravet and Cincera (2010) have examined the financial data of large R&D investors both in the EU and in the US over a period of eight years (2000-2007). Their work leads to an interesting result: the sensitivity of R&D investments to companies' cash flow variation is considerably higher for EU firms than for US ones. As this result provides a different perspective compared to previous literature analysing time series, it seems that the different conjectural and structural changes in the financial systems between the EU and the US that have occurred especially since 2000 have led to a shift in the comparison of such firms' behaviour.

O'Sullivan (2006) concluded that, although the common findings of empirical analyses of the relationship between finance and R&D investment is that R&D investment is indeed positively

correlated with cash flow, such empirical studies have so many methodological limitations that one cannot be fully confident on their findings.

The most recent studies however have not exhaustively compared EU vs. US companies in their R&D investment behaviour under financial constraints by using comparable, recent micro-data sets.

3 Conclusions & implications for policy

The literature examined and referred to in this paper indicate that the difference between the EU and the US in corporate R&D is due to three main interlinked factors.

1. Economic structure. There have been more dynamic changes in the structure of the US economy than in the EU in the last two decades. These changes occurred in the US in favour of higher R&D-intensity sectors to a larger extent than in the EU. It follows that the difference in average R&D intensity between the EU and the US emerges mainly because of the share that high R&D intensive sectors have in their respective economies (i.e. it is greater in the US than in the EU), in particular the share of the information and communication technology sectors plays a major role in the difference in overall R&D intensity between the EU and the US.
2. Company demographics. There is not a large underinvestment gap by individual EU companies with respect to the US ones for companies at the very top of the R&D ranks (i.e. the largest firms in the EU and the US in terms of the volume of R&D investment). Actually, a relatively small number of EU firms carry out a substantial proportion of business R&D compared to US ones. However, the younger and smaller-sized US companies are more present - and show a higher capacity to grow - in high-R&D intensity sectors than similar companies in the EU. This is one of the factors that has made the US more dynamic in terms of changing the structure of its economy (point 1 above) compared to the EU in the last two decades, therefore reinforcing its technology base.
3. Access to financial resources. Other factors that influence the gap between the EU and the US R&D intensities stem from the 'framework conditions' vis-à-vis corporate R&D and innovation. Among them the characteristics of financial markets, especially in the last decade, have hampered EU firms' R&D investment more than that of US firms.

In addition to the above, it appears that dissimilar statistical practices and methodological approaches (i.e. in the EU the R&D the services sector is redistributed to the corresponding manufacturing sectors) compared to the US have amplified the difference in R&D intensity gap in service sectors between the two economies, at least as perceived by the analysts.

Changes in the R&D and innovation strategies of global companies place several *common* topics on the policy agenda of both the EU and the US. This involves the improvement of the following: (a) human and financial capital: formation, availability, collaboration and mobility; (b) attractiveness to foreign R&D investment together with increasing absorptive capacities of R&D organizations at home; (c) a stronger integration and co-ordination of different policy areas and means which rely on better statistics.

But what could be the relevant specific policy strategies in the EU to reduce the present corporate R&D intensity gap? We propose the following ones - some of them could also be appropriate for the US to reinforce its leadership.

I) Shift the EU economic structure towards high R&D intensity-sectors. From the above, one could be inclined to hurriedly conclude that the EU should only shift the structure of its

economy towards a new one with a larger importance of high-tech sectors where, for instance, R&D investment is most effective in raising productivity. But this policy recipe would be not enough to close the business research investment gap between Europe and the US. It should be underlined, in fact, that a *radical* and *rapid* shift in the structure of the economy has some limitations in terms of success rate (which sectors?), time (results are hardly achievable in the short-term) and the intrinsic characteristics of the system (availability of skilled workforce and capital, labour market flexibility, infrastructure, etc.). Clearly this structural shift should not be pushed only for the sake of raising the R&D intensity at the aggregated level. In fact, what really matters is the competitiveness and the capacity of transferring innovation into creation of more value added.

II) Modernise the present economic structure. We believe that the EU economy should also evolve and succeed by "modernising" itself though enhancing its capacity to create and absorb new knowledge in order to (a) remain competitive in existing well-established sectors (e.g. traditional sectors in the EU like automobile, mechanical engineering, textile), and (b) reposition itself with regards to products and services generated (in adjacent or even in very different markets / sectors) which can also present perspectives of higher and sustainable long-term economic returns. It should be underlined that technological change embodied in the physical capital stock is crucial for productivity increases in the lower-tech and services sectors where many new jobs are created.

III) Favour a positive dynamism of firms' demography. Policy initiatives should allow for the creation of new companies and new sectors with high economic and social values (e.g. those that are related to the main social challenges such as sustainable energy or nanotechnology for health applications) and help them to grow.

Overall, the diversity of economic activity is more conducive to knowledge spillovers and better promotes technological change and subsequent economic growth than the specialization within a narrow concentrated set of economic activities, as largely documented in the economic literature (for instance, by Audretsch and Feldman, 1999).

It follows that it might be advisable to undertake a policy which combines measures for stimulating corporate R&D investment in medium- and high-tech sectors, while implementing incentive schemes to reinforce the capacity absorption of its results in low-tech sectors, and supporting firm formation and growth. In doing so, measures that favour an efficient market for technologies and easier access to tailored financial resources should be considered. We advocate, in fact, that policy measures to stimulate corporate R&D and innovation activities should be expressly conceived according to the typology of companies, sectors and countries. For instance, means of public support for high R&D-intensive sectors (e.g. through temporary tax incentives, fostering public procurement, setting up international cooperation agreements) should be different from those addressed to low R&D-intensive sectors (e.g. stimulating capital expenditure in innovation by offering companies better and more targeted financial measures, including stimulating bank investments, public funds injection in risk capital formation, alternative stock markets).

The promotion of corporate R&D should be part of a broader innovation and competitiveness policy strategy allowing companies to respond to the changes in demand within the context of sustainable production and consumption.

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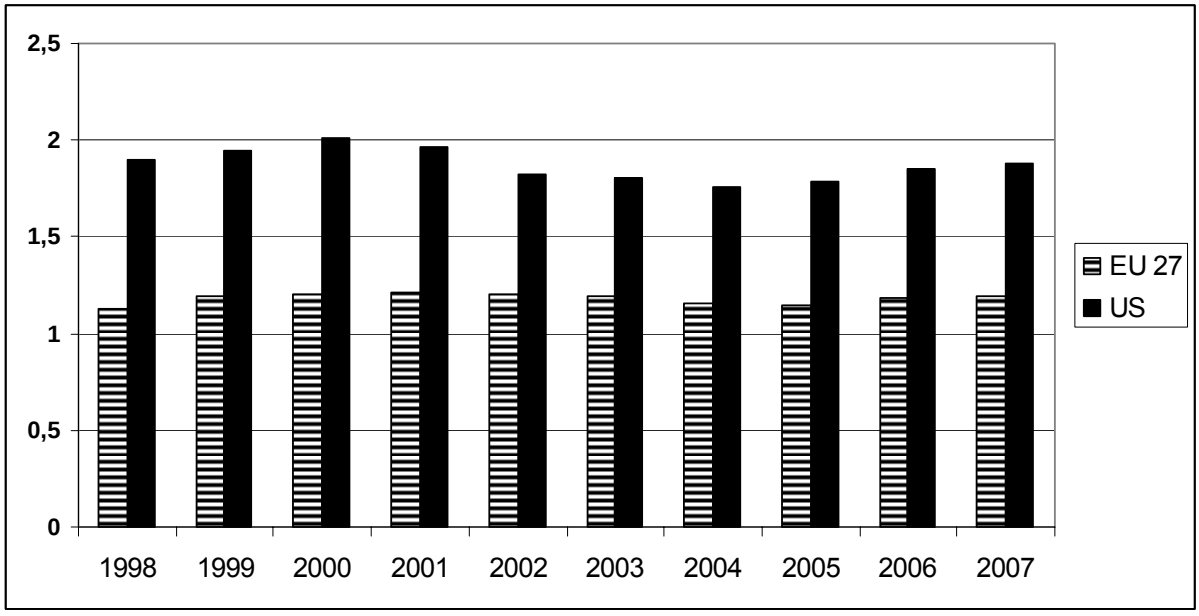
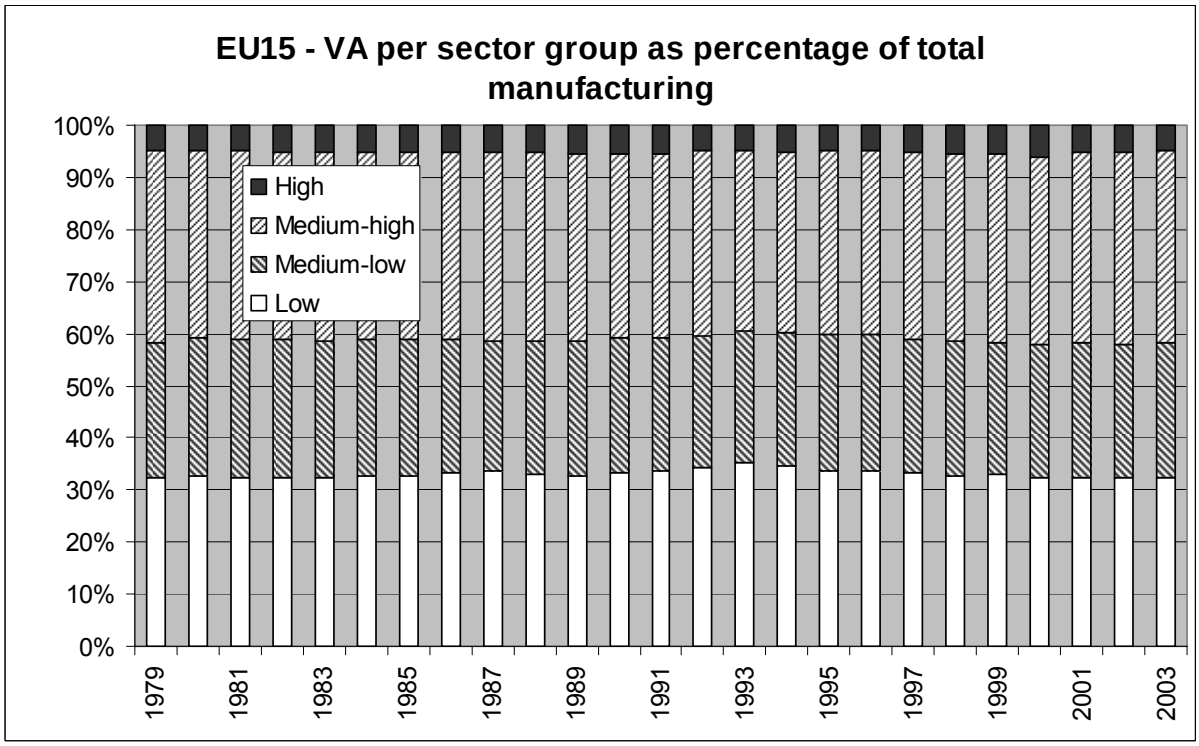
Annex

Figure 1. Research and development expenditure, by business enterprise sector % of GDP (1998-2007)



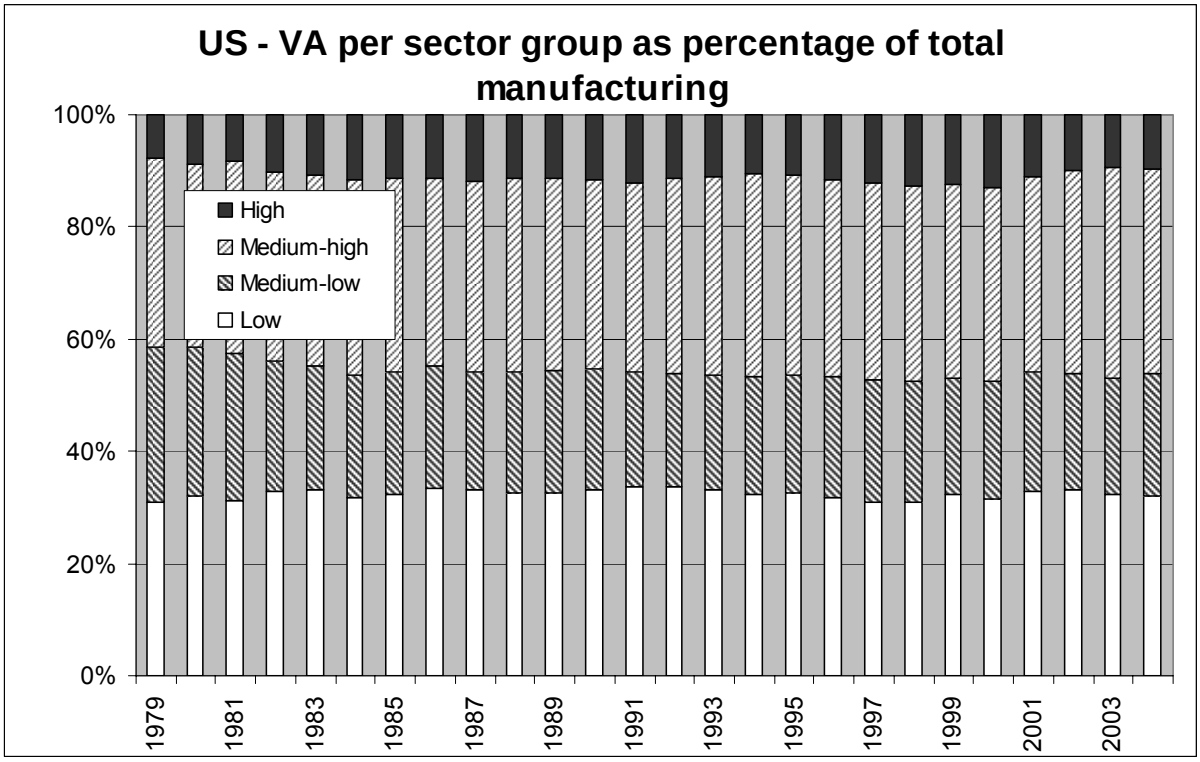
Source: Own elaboration based on European Commission - Eurostat, Newcronos (2010) data

Figure 2a. Value added by sector group in % of total manufacturing in the EU



Source: European Commission (2009c) calculations based on Groningen's 60-Industry Database, September 2006.
Note: Sectors according to International Standard Industrial Classification (ISIC), revision 3

Figure 2b. Value added by sector group in % of total manufacturing in the US



Source: European Commission (2009c) calculations based on Groningen's 60-Industry Database, September 2006.
Note: Sectors according to International Standard Industrial Classification (ISIC), revision 3.

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Abstract

Policy-makers have become increasingly aware that corporate R&D and innovation are the main drivers of an economy's competitiveness and growth. The widespread adoption of R&D targets has led researchers and analysts to pursue a deeper understanding of corporate R&D investment trends, drivers and impacts. This paper focuses on the main differences between the EU and the US in corporate R&D performance, especially in the following three main aspects: (i) dynamics of the economic structures and the cause of the R&D intensity gap; (ii) R&D performance and company demographics and (iii) financial availability and corporate R&D investment. Based on the literature review, the paper concludes that (a) there have been more dynamic changes in the structure of the US economy than in the EU in the last two decades which in turn have favoured the growth in the US of higher R&D-intensity sectors to a larger extent than in the EU; (b) younger and smaller-sized US companies are more present - and show a higher capacity to grow - in high-R&D intensity sectors than similar companies in the EU; (c) financial markets, especially in the last decade, have hampered EU firms' R&D investment more than that of US firms. The paper concludes that policy measures to stimulate corporate R&D and innovation activities should be expressly conceived according to the typology of companies, sectors and countries.

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