Technological performance of Belgium: is it really so bad?

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Summary

Some measures of technological performance indicate that a number of mainly small open EU economies have performed rather well in the 1990s, compared to the US, especially when considering exports in high-tech products. Whereas the strong performance of the Nordic EU countries will not come as a surprise, the strong growth in high-tech export shares of Belgium seems in contrast with some gloomy reports on its technological competitiveness. Market reforms and macroeconomic policies, though undoubtedly necessary to shield the European Social model from increasing global competition and the ageing of the population, may not have to be as sweeping as some suggest.

Keywords : EU-US technology gap, R&D investment, productivity, high-tech exports.

1. INTRODUCTION

In Sapir (2003) it is pointed out that GDP per capita of the European Union stagnated at about 70% of the level in the US, since the beginning of the 1980s. Europe's unsatisfactory growth performance is viewed by the authors of the report as a serious threat to the sustainability of the European (social) model. A reorientation of European micro-and macroeconomic policies towards a more innovation-oriented and a more flexible economy is advocated as the best way to proceed.

The EU aims to become the "most competitive and dynamic knowledge-based economy in the world by 2010", e.g. by raising R&D expenditures to 3% of GDP, to close the reported widening gap in R&D spending between the EU and the US and by focusing on key technologies such as nanotechnology and biotechnology (EC (2003)).

According to O'Mahoney and van Ark (2003) the earlier adoption and diffusion of IT in the US accounts for the country's recent superior productivity performance more than the competitive and regulatory environment.

In a response to the Sapir report, Blanchard (2004) objects that Europe has performed better in the last three decades than is typically perceived. Productivity levels in Europe are rather similar than in the US. Europe however, contrary to the US, used productivity growth to increase leisure time instead of income. In a similar vein, OECD (2004) states that the GDP per capita edge of the US over the EU can for the greater part be explained by an increase in hours worked per capita rather than by higher output per hour worked. This would suggest that the difference in growth performance is not so much a result of technological progress but rather of a different income-effort trade-off.

The Third European Report on Science and Technology Indicators clearly reveals that the US, despite its high investment level, on average still invests more in a knowledge-based economy than the EU but performance growth in the period 1995-1999 was better for most EU-15 countries than for the US. A composite indicator of technological performance suggests that all European countries, except the UK, Italy and Spain, had higher growth rates than the US (EC, 2003). Though it is pointed out that this higher growth is not sufficient to close the EU-US gap by 2010 it seems to call for a more carefully balanced appraisal of the EU's technological performance than some inauspicious tidings suggest and some consideration of the link between investment and performance that exceeds an obstinate clinging to arbitrary criteria such as the 3% of GDP rule.

In this paper the technological performance of Belgium is compared to the performance of other OECD countries. Belgium is often considered as a good example of a European country that lacks the innovative capabilities to close the technology gap with the US (e.g. Federal Planning Bureau, 2005).

Section 2 briefly shows trends in investment in innovative capabilities. In section 3.1 the technological performance is discussed in terms of intermediate output (e.g. publications and patents), in 3.2 in terms of productivity and in section 3.3 the performance is analyzed in terms of export performance in high-tech goods. Conclusions are formulated in section 4.

2. INVESTMENT

At the 2002 Barcelona Summit, the EU member states decided to set the amount to be devoted to R&D at 3% of European GDP, as one of the instruments to reach the Lisbon strategy objective of transforming the EU into the most competitive and dynamic knowledge-based society in the world by 2010 (Biatour et al. (2005)). Although investing more in R&D is probably a recommendable policy measure for most EU countries, the economic rationale of 3% seems less clear and the EU scarcely adduces arguments in support of this specific benchmark.

Insert table 1 here

As shown in table 1, of all OECD countries, Sweden and Finland invest most in R&D, as a percentage of their GDP, and already exceeded the 3% objective in 2001. Japan also spends more than 3% of its GDP on R&D, but the US not. Overall, the other EU countries are still rather remote from the Barcelona objective.

Table 2 shows, for the OECD countries in the 1990s, the average growth rates in Gross Domestic Expenditure on R&D (GERD), Expenditures on R&D in the Business Enterprise Sector (BERD) and GOVERD (Government Intramural Expenditure on R&D (GOVERD).

Insert table 2 here

The three Nordic EU countries, Belgium, Ireland and Spain had higher growth than the US in Gross Domestic Expenditures (GERD) as well as in R&D expenditures in the Business Enterprise Sector (BERD) in the period considered. In terms of Government Intramural Expenditure only Belgium and Japan appear to have witnessed an increase and most other countries witnessed a substantial decrease.

Since 1995 Belgian R&D investment increased more that the EU-15 average as well as the US. In Belgium, institutional reforms have gradually handed over competencies with respect to science, technology and innovation from the national (federal) level to the Communities and Regions. The 2.17% of GDP spent on R&D in Belgium in 2001, hides substantial differences between regions. The Brussels-Capital Region spent only 1.29%, the Flemish Region 2.49% and the Walloon Region 2.11%. Despite the very substantial catch-up in the second half of the 1990s, R&D expenditures will have to increase at an annual average rate of 7.7% for Belgium to reach the 3% objective by 2010 (Biatour et al. 2005: pp. 21-23).

The macroeconomic impact of raising R&D intensity from the 2002 EU average level of 1.9% of GDP to the 3% objective in 2010 has been estimated, using the macro-econometric NEMESIS model[1]. By 2010 GDP is estimated to increase by 1.7%, by 4.2% in 2015, by 7% in 2020 and by 12.1% in 2030. By 2015, 3.1 million jobs would be created in the EU and 10 million by 2030. If the total required increase in R&D expenditures were to be financed with public funds the impact on economic growth and employment is estimated to be even larger, obviously at the expense of a deterioration of public budgets (Brécard et al. (2004); EC (2005)).

Running the NEMESIS model for Belgium suggests that if the 3% objective is reached by 2010, Belgian GDP would rise by 7.52% in 2030 (Biatour et al. (2005)).

Meister and Verspagen (2004) pointed out that when considering R&D spillovers, e.g. through international trade, the increase in European R&D will also benefit Europe's trade partners, e.g. the US. Accounting for these spillovers they find that the net effect of raising R&D intensity on the EU-US productivity gap is positive but rather small compared to the size of the gap. The authors therefore argue that a policy that solely aims at increasing R&D expenditures, without paying attention to the institutional context of the European innovation system is not likely to succeed in transforming the EU into the world's most competitive knowledge-based economy.

1 The model, co-financed by the European Commission, was developed by the Federal Planning Bureau of Belgium, Laboratoire ERASME and Chambre de Commerce et d'Industrie de Paris (both in France) and the Greek ICSS/NTUA

EC (2003) provides a more comprehensive analysis of investment in a knowledge-based economy by considering the following indicators: total R&D expenditures per capita, number of researchers per capita and new Science and Technology PhDs per capita, total education spending per capita, life-long learning, e-government and gross fixed capital formation.

Summarizing the different indicators into one composite indicator it is concluded that the Nordic countries Finland, Sweden and Denmark have high levels of investment at the end of the 1990s as well as an overall investment growth above the European average. Austria, Belgium, France, Germany, the Netherlands and the United Kingdom have both an overall level of investment and growth rate close to or above the European average, with Belgium having relatively high levels of capital formation, educational spending and research expenditures. Greece, Portugal and Ireland have the highest growth in investment, well above the EU average and well above US growth. Italy seems to be doing badly both in terms of the investment level and in terms of investment growth. Except for Science and Technology PhDs per capita, the EU as a whole is lagging behind the US in terms of investment level and growth but this again does not hold for all EU countries, with especially Finland and Sweden investing as much or even more in knowledge activities than the US and Japan and a number of other EU countries being close to the US in terms of investment growth.

3. TECHNOLOGICAL PERFORMANCE

In figure 1 the level of technological performance and the growth rate in 1995-1999 of performance are shown for the EU-15 countries, Japan and the US.

*****Insert figure 1 here ******

Five indicators have been considered to construct a composite indicator of technological performance: GDP per hour worked, European and US patents per capita, scientific publications per capita, e-commerce and schooling success rate (EC (2003): p. 27).

Although the average EU level of technological performance was below the US level in 1999, except for Italy, Spain and the UK, all EU-15 countries witnessed higher performance growth than the US in the second half of the 1990s. Moreover, seven EU countries are close to or even in front of the US, with respect to the 1999 level of technological performance.

3.1 Scientific publications and patents

The European Union overtook the NAFTA countries as the world's largest producer of scientific knowledge in 1997. The well-known "European Paradox" poses that many European countries fail to convert their scientific expertise into viable economic products and services. The share of EU-15 in US patents fell from 19% in 1992 to 16.9% in 2001 whereas the US' share in European patents increased from 28.2% to 32.4% over the same period, which seems to support this view.

However, eight EU countries had an annual growth in both their shares of European and US patents in the period 1992-2001 exceeding the growth of the US: Denmark, Ireland, Greece, Portugal, Sweden, Belgium, Spain and Finland (EC (2003): pp. 329-332). Moreover, despite the strong performance of Asian countries like Singapore, South Korea, Taiwan and Hong Kong, for a number of technology domains Belgium (instruments), Denmark (mechanics, consumer goods), Finland (electricity, consumer goods) and Spain (mechanics) are actually in the top 5 of countries worldwide in terms of average annual US patent share growth in the period 1992-1999.

Overall the EU is leading the US in patents in materials technology but lagging in IT, pharmaceuticals and biotechnology though the situation varies substantially between EU member states and a number of the smaller EU countries are performing rather well in terms of patenting.

The EU increased its number of European patents and US patents per unit of R&D expenditure at a faster growth rate than the US, suggesting higher efficiency of EU research efforts (EC (2003): pp. 351-352).

A question that arises when considering the latter finding is whether there is a clear-cut link between R&D expenditures and technological performance. A policy focusing on how to transform research efforts into results may prove more efficient than a policy that consists in raising R&D expenditures relative to GDP, to a level that is considered to be a benchmark.

3.2 Productivity

A measure that is most often put forward to point out the substantial gap between the EU and the US is productivity. GDP per capita in the European Union (in purchasing power parity prices), for instance, is only 70 percent of GDP per capita in the United States, with this ratio having hardly changed over the last three decades. However, in terms of GDP per hour worked the EU-15 seems to have closed the gap from 65 % of the US level in 1970 to 91% in 2000 (Blanchard (2004): pp. 4-5).

In 2002, GDP per hour worked in Belgium, France, Germany, Ireland and the Netherlands exceeded GDP per hour worked in the US (O'Mahoney and van Ark (2003): p. 20).

From 1995 onwards, GDP per hour worked increased more substantially in the US than in the US, increasing the EU-US gap or decreasing the apparent lead of the five aforementioned high productivity EU countries.

There is yet no overwhelming evidence that the productivity slowdown of the EU is of a structural nature. It could simply reflect that the EU is lagging the US in the adoption of new technologies. With a greater potential in terms of underutilized resources and the adjustment to a new technological environment still to crystallize out, the EU may witness higher productivity growth in the next decade (O'Mahoney and van Ark (2003): p. 21). The overall strong growth in the composite indicator of technological performance of most EU countries (figure 1) suggests that there is some prospect of improvement.

An alternative explanation for the poor productivity growth performance of a number of EU countries in the second half of the 1990s may be a macroeconomic trade-off between employment and productivity growth, as suggested by the negative cross-country correlation for OECD countries between the increase in the employment to population ratio during the 1990s and the increase in labour productivity (OECD (2003)). Policies promoted by the OECD in its 1994 Jobs Study to raise the low employment rates in many EU countries may have resulted in a (short-term) decrease of labour productivity.

So, if productivity is measured as GDP per hour worked rather than as GDP per capita (which could be biased by the hours worked) recent data indicate that five EU countries still outperform the US, with yet no clear evidence to state that the slowdown in productivity witnessed in the EU is structural and cannot be overturned by lagged rents on investment in new technologies or the positive long term impact of (labour market) policies on productivity growth.

3.3 High-tech exports

Exports of high-tech goods can be considered as a good indicator of a country's competitiveness in a knowledge-based economy, as they reflect a country's ability to perform R&D and create knowledge that can be exploited in global markets. In 2000 both the EU and the US had a trade deficit in high-tech goods (i.e. R&D intensive goods) whereas Japan had a structural surplus. The EU's trade deficit increased from 9 billion euro in 1995 to 48 billion euro in 2000. In 1999, the US trade surplus turned into a deficit that further widened in 2000. A trade deficit in high-tech goods is not necessarily an indication of decreasing global competitiveness as it could indicate that a country (region) is catching up in terms of investment (e.g. in IT and telecommunications equipment). The deterioration of the EU's high-tech trade balance can to a large extent be explained by growing deficits in *computers* and *electronics* (EC (2003): pp. 354-361).

In table 3 the growth in high-tech export shares between 1981 and 2002 is given for a number of OECD countries[2]. The OECD Main Science and Technology Indicators provide data on exports in five highly R&D intensive industries: *Aerospace industry* (ISIC 3845), *Electronic industry* (ISIC 3832), *Office Machinery and computer industry* (ISIC 3825), *Pharmaceutical industry* (ISIC 3522) and *Medical, precision and optical instruments, watches and clocks industry* (385). The data have been converted by the OECD from the Standard International Trade Classification (SITC) to the International Standard Industrial Classification (ISIC).

Insert table 3 here

In three out of five high-tech industries Belgium is in the top 4 as to highest growth in export shares.

Considering the size of the five high-tech industries table 4 shows the growth in the export shares for the aggregated high-tech sector between 1980 and 2000.

Insert table 4 here

[2] Given a lack of sufficient data this analysis does not consider some of the strong performing Asian countries and therefore focuses on a comparison between the 'traditional' Industrialized Countries.

Belgium holds the fourth position, which is predominantly due to its strong performance in *pharmaceuticals* which of the five high-tech industries expanded most.

The data on exports are given in current $ US. Changes in price levels can obviously blur the analysis. Therefore table 4 also reports the growth in export shares with exports measured in constant prices purchasing power parities, using data provided by the OECD Main Economic Indicators. The third and fourth column show the ranking by descending growth rate between 1990 and 2000 with exports measured in terms of country-specific volume indices. Belgium is now in second place[3]. The US is actually performing rather badly.

Using data on trade in a more broadly defined group of high-tech products (including *chemistry*, *electrical* and *non-electrical machinery and armaments*), EC (2003) reports that Greece, Finland, Ireland, the Netherlands, Belgium-Luxembourg and Sweden all had higher average annual growth than the US in high-tech exports in the period 1995-2000, with the EU average growth being close to the US level.

Taking exports in high-tech products as an indicator of technological competitiveness, there is actually little evidence that suggests that the US is outperforming the EU overall. Moreover, a number of small open economies like the Nordic EU countries, Belgium and the Netherlands have actually done better than the US in the 1990s.

To have some indication of the link between R&D investment and growth in high-tech exports, the growth of the share in total high-tech exports has been regressed on the average R&D

[3] Given a lack of information on PPP Ireland and Switzerland cannot be considered in this ranking.

intensity in the 1980s (to account for the level) and the average growth rate in R&D intensity[4]. To account for the possibility of international R&D spillovers through international trade, trade openness (imports + exports relative to GDP) and growth in trade openness has also been considered in the regression. For openness data are retrieved from the Penn World Table 6.1 (Heston et al. (2002)).

The four variables considered explain some 56% of variance in growth in high-tech export shares. Only growth in R&D expenditures and the level of openness are significant at any reasonable error level, with the expected positive sign.

More than 40% of high-tech export performance is not explained by investment in R&D and international R&D spillovers. Cross-country institutional, policy and cultural differences undoubtedly play an important role and should be accounted for when formulating the appropriate innovation policy.

4. Conclusions

The aim of this paper is not to pretend that all is well in the European Union. The ageing of most EU countries' populations and the increased competition of Newly Industrialized Countries poses severe problems. Reforms in product and factor markets and in macroeconomic policies seem unavoidable in order to obtain an economic growth rate that permits to shield the European Social model from increasing global competition. The more flexible and competitive nature of the US economy undoubtedly lends it some advantage in terms of innovation and technological change.

However, in promoting policy reforms some seem all too eager to paint an immoderately gloomy picture of the technological strength of the EU and to focus on the US as a universal benchmark.

[4] The results of this regression are not reported but available upon request.

A realistic reading of the data does not provide overwhelming evidence that the technological lead of the US over the EU is extensive and insurmountable. As pointed out by Blanchard (2004) and OECD (2004), the structural gap in GDP per capita between the US and the European Union can for the larger extent be explained by differences in the number of hours worked. Considering GDP per hour worked, which seems a more reliable indicator of technological performance, five EU countries actually do better than the US, with yet no evidence that the recent EU productivity slowdown is of a structural nature and that the lagging investment in new technologies may start to pay off in the near future.

In terms of scientific publications, patents and exports in high-tech products there is no clear evidence that the EU is overall performing far worse than the US

Especially some smaller EU countries, i.e. Belgium, Denmark, Finland, Sweden and the Netherlands are performing rather well. This could indicate that small open economies, by investing in absorptive capacity can benefit from international R&D spillovers that result from international trade or international factor mobility. A simple regression indeed suggests that the level of openness to international trade has a statistically significant positive impact on the growth of a country's share in total high-tech exports, as does an increase in R&D expenditures relative to a country's GDP. Framework conditions should however be accounted for in formulating the appropriate innovation policy.

Policy makers and scholars should provide the broad public with all the information necessary for a balanced view of what is actually at stake. As pointed out by Blanchard (2004), the measures to be taken could result in the European Union converging to a more efficient European model rather than to a US model. There is no compelling reason to consider the US model as a benchmark. If given all relevant and unbiased information, a majority of the EU population opts for a different trade-off point between the level of effort (working hours) and the income level there would be no economic rationale that outweighs the decision of a democratic majority.

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Table 1: Gross Expenditures on R&D as percentage of GDP (2001)

Sweden	4.27
Finland	3.41
Japan	3.07
US	2.74
Germany	2.51
Denmark	2.4
France	2.23
Belgium	2.17
Netherlands	1.89
UK	1.86
Norway	1.6
Ireland	1.15
Italy	1.11
Spain	0.95

Source: OECD Main Science and Technology Statistics.

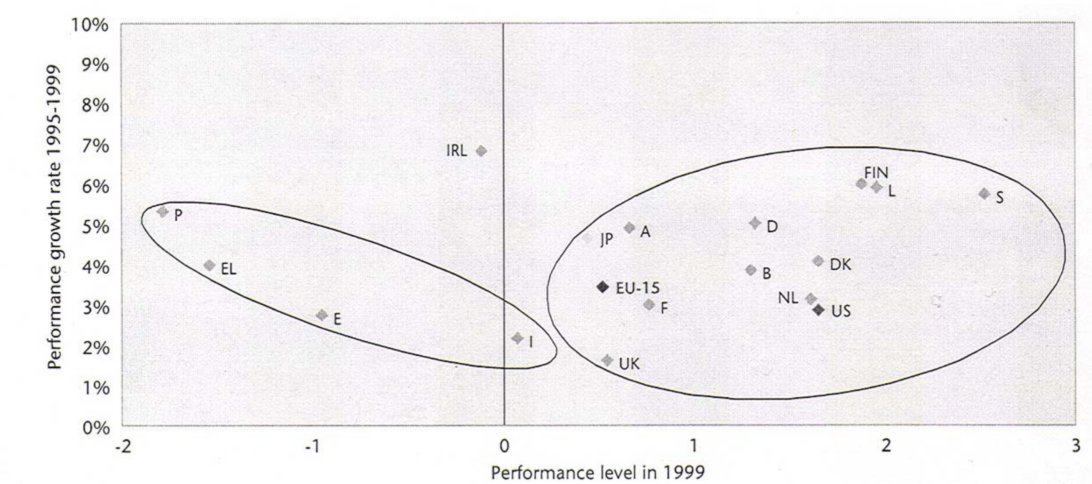
Table 2: Growth of relative R&D Expenditures between 1990-1994 and 1998-2002

	GERD		BERD		GOVERD
FI	0.56	FI	0.83	BE	0.67
DK	0.38	DK	0.59	JP	0.22
SW	0.34	SW	0.49	SW	0.00
BE	0.21	BE	0.28	DE	-0.02
IE	0.13	IE	0.24	DK	-0.08
ES	0.11	ES	0.14	FI	-0.13
JP	0.05	JP	0.10	ES	-0.14
US	0.03	NL	0.09	IT	-0.17
DE	0.01	US	0.06	NL	-0.19
CH	-0.01	NO	0.05	US	-0.20
NL	-0.02	CH	0.04	NO	-0.23
NO	-0.02	DE	0.02	FR	-0.26
FR	-0.08	FR	-0.06	IE	-0.28
IT	-0.09	UK	-0.11	UK	-0.30
UK	-0.10	IT	-0.18	CH	-0.59

Note: GERD (Gross Domestic Expenditure on R&D), BERD (Expenditures on R&D in the Business Enterprise Sector) and GOVERD (Government Intramural Expenditure on R&D). All three measures are related to GDP and the numbers reported give the growth rate of the average in the period 1998-2002 compared to the period 1990-1994. The widening gap in R&D expenditures between the EU average and the US clearly conceals the fact that six EU countries increased their R&D investment at a faster pace than the US.

Source: OECD Main Science and Technology Statistics.

Figure 1: Level of technological performance (1999) set out against growth performance (1995-1999)



Source: EC (2003), Third European Report on Science and Technology Indicators, p. 29.

Table 3: Growth in share of exports in five high-tech domains: average (1998-2002) compared to average (1981-1985)

Aerospace		Electronics		Pharmaceuticals		Computers		Instruments	
Norway	0.80	Finland	0.80	Ireland	0.83	Netherlands	0.66	Finland	0.59
Ireland	0.78	Ireland	0.74	Norway	0.65	Ireland	0.53	Ireland	0.47
Japan	0.70	Spain	0.72	Belgium	0.41	Finland	0.36	Spain	0.40
Sweden	0.64	UK	0.27	Spain	0.26	Belgium	0.33	Belgium	0.38
Spain	0.50	Sweden	0.19	Sweden	0.20	Denmark	0.25	Netherlands	0.18
Denmark	0.46	US	0.18	Japan	0.10	UK	0.03	US	0.15
France	0.34	France	0.11	Italy	0.01	Japan	-0.04	Italy	0.13
UK	0.02	Denmark	-0.08	Netherlands	-0.03	Spain	-0.27	Sweden	0.04
Germany	0.01	Belgium	-0.17	Switzerland	-0.12	France	-0.40	Denmark	-0.02
Finland	0.00	Germany	-0.38	Germany	-0.12	Germany	-0.51	Germany	-0.06
US	-0.25	Netherlands	-0.38	Denmark	-0.16	Switzerland	-0.51	Norway	-0.07
Switzerland	-0.57	Italy	-0.38	UK	-0.20	US	-0.58	France	-0.15
Italy	-0.58	Norway	-0.39	France	-0.21	Norway	-0.84	Switzerland	-0.27
Belgium	-0.62	Japan	-1.25	Finland	-0.41	Italy	-1.96	UK	-0.29
Netherlands	-1.00	Switzerland	-1.35	US	-0.52	Sweden	-4.35	Japan	-0.52

Source: Own calculations based on OECD Main Science and Technology Statistics.

Table 4: Growth of share in total high-tech exports

Country	Growth (2000-1980)		Growth PPP (2000-1990)
Finland	3.00	Finland	2.51
Ireland	2.39	Belgium	0.80
Spain	0.97	Spain	0.76
Belgium	0.61	The Netherlands	0.53
The Netherlands	0.52	UK	0.45
Sweden	0.22	France	0.27
Denmark	0.19	Germany	0.21
France	0.17	Norway	0.19
UK	0.13	Denmark	0.17
Norway	0.12	Switzerland	0.03
US	-0.03	Italy	-0.02
Germany	-0.08	US	-0.17
Switzerland	-0.12	Japan	-0.30
Italy	-0.17		
Japan	-0.34		

Source: see table 3.