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Corporate R&D: A policy target looking for instruments

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***IPTS WORKING PAPER on
CORPORATE R&D and INNOVATION - No. 01/2009***

Corporate R&D: A policy target looking for instruments

Pietro Moncada-Paternò-Castello and Keith Smith



IPTS Working Papers on Corporate R&D and Innovation shed light on economic and policy questions related to industrial research and innovation. Mainly addressed to policy analysts and the academic community, these are scientific papers (policy relevant, highlighting possible policy implications) and proper scientific publications which will be typically issued at the moment they are submitted to peer-reviewed scientific journals. The working papers are useful to communicate to a broad audience the preliminary research findings of the work we develop, to generate discussion and to attract critical comments for further improvements. The working papers are considered works in progress and are subject to revision.

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. These kinds of papers take a position on a sharply focused policy issue based on the most compelling empirical evidence available. 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 main authors of this introductory issue are Pietro Moncada-Paternò-Castello (JRC-IPTS) and Keith Smith (Australian Innovation Research Centre). The work has benefitted from the review of and input from Alexander Tuebke, Andries Brandsma and Michele Cincera (JRC-IPTS) to earlier versions of the present paper.

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Abstract

R&D intensity indicators are increasingly used not only for international comparisons, but also as targets for policies stimulating research. The two are of course intimately linked: it makes little sense to set a quantitative policy target when not knowing whether it is high or low compared to economies at similar stages of development. This paper reflects upon the (Barcelona) target to lift R&D spending to 3% of GDP, set by the EU as a key part of its (Lisbon) strategy for growth and jobs. The paper provides empirical evidence showing the target of 3% of GDP for R&D expenditures in the EU as a whole to be overly ambitious, even though some Member States are above. It also argues that the EU's strategy is short on policy instruments to reach this target. In fact, what appears a simple target actually sums up public R&D, over which decision makers have direct control, and private R&D, which may be partly publicly funded but which can be influenced only indirectly. In this respect, it is clear that national policy-makers have to take into account that the bulk of R&D is conducted by relatively few companies that mostly operate on a global scale.

This paper – the first of the *IPTS Working Papers on Corporate R&D and Innovation* – is a precursor to further analytical work on topics raised by the Commission's industrial R&D monitoring and analysis. Future issues will study such issues as the relationship between R&D and business performance at the micro level, the link between R&D and growth at the macro level, the location of R&D within the context of internationalisation, and the increasing role of services and R&D in small and medium-sized enterprises.

JEL Classification: O33

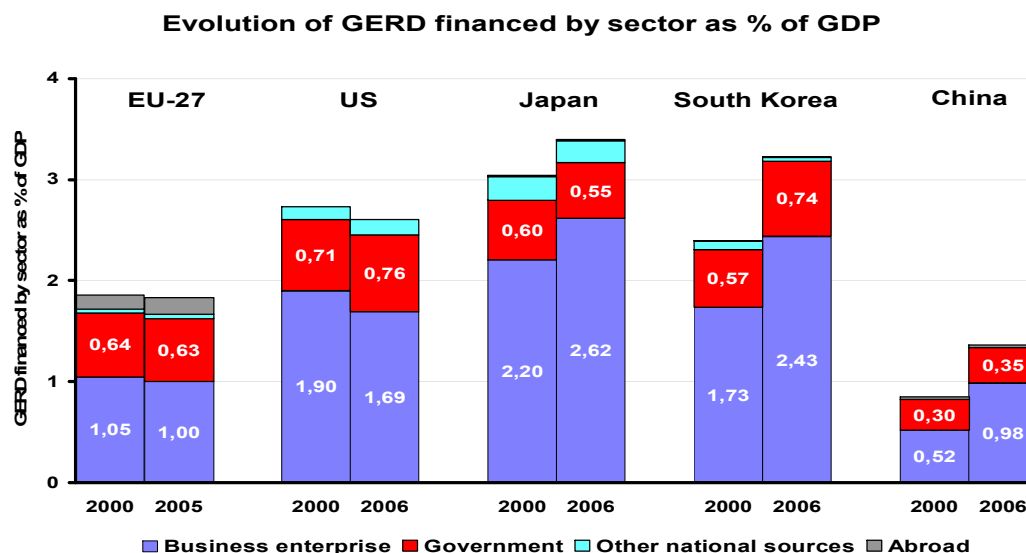
Keywords: Research and Development, policy targets, international comparison, economic and policy analysis of industrial research

1. Introduction

Measures of R&D intensity are among the most commonly used indicators for science and technology policy. They normally take the form of R&D to GDP ratios, either for sectors or whole economies, with R&D to sales ratios sometimes used at company level. Over recent decades intensity indicators have not simply been used for making international comparisons in R&D performance, but have increasingly been deployed as policy targets. The two purposes for using intensity indicators are of course linked: their validity as targets depends on their international comparability, because for any country a particular R&D/gross domestic growth (GDP) ratio can only be regarded as high or low after making an international comparison. So, in many countries the targets for R&D intensity take the form of increasing R&D intensity to the - e.g. - OECD or EU average, obtaining a particular position in the ranking of OECD/EU countries or achieving a level close to that of a group of similarly endowed competitors.

In the EU, remedying the alleged ‘deficit’ of European R&D spending is a key element of the ‘Lisbon strategy’, which seeks a radical improvement in the innovation performance of the EU as a whole. A comparison of R&D to GDP ratios, particularly between the EU, the US and Japan, has led to a specific Lisbon policy target: that 3% of European GDP should be spent on R&D by 2010, and that two-thirds of this spending should come from the corporate sector. Table 1 shows the evolution of the gross domestic expenditure in R&D (GERD) to the GDP of the triad from 2000 to 2005/06.

Table 1. *Evolution of the Gross Domestic Expenditure in R&D (GERD) to of Gross Domestic Product (GDP) for EU-27, US, Japan South Korea and China (%)*



Source: DG Research
 Data: Eurostat, OECD

STC key figures report 2008

Data in Figure 1 show that EU R&D intensity gap mainly due to the private sector R&D expenditure.

In the overall, this target implies major increases in R&D expenditure and in the employment of researchers in the EU. R&D targeting is not merely an EU phenomenon: a majority of OECD economies have some kind of R&D/GDP target as a centrepiece of their research and innovation policies.

The widespread use of R&D/GDP targets has bemused researchers and analysts that have explored the relationship between R&D and growth. On the positive side, it has triggered major efforts to develop new data sources that permit a deeper understanding of R&D investment trends, drivers and impacts. This has enhanced the role of R&D in economic and policy analysis. The relations between R&D and growth, and the policy objectives based on them, are of far greater complexity than suggested by the targeting of R&D intensity, which raises serious questions about its usefulness in policymaking.

The paper discusses the usefulness of the 3% R&D intensity target for policymaking in the next section. The subsequent sections look into structural effect (section 3), at company demographics (section 4), the return on private R&D investment (section 5), at the issues of time & economic cycles (section 6), at the efficiency aspects of R&D investment (section 7), at the socio-cultural aspects that influence it (section 8) and at the consequences of the internationalisation of R&D for the setting of policy targets (section 9). The tenth section of the paper focuses on the lack of appropriate data and analyses for international comparisons. The final section (section 11) offers some further thoughts to policy-makers.

2. The 3% R&D intensity target as a policy trigger

Policy makers need to set clear objectives and targets that can be understood, achieved and measured. It is common place that they use indicators to mobilise an effort towards achieving targets, and to use them for monitoring the progress. It is also perfectly reasonable that further analysis and evaluation permit adjustment and modification of the targets. It should be noted, however, that monitoring and benchmarking are rarely combined with policy evaluation. The results are merely used to determine a country's position vis-à-vis competing

countries and to motivate different or more intense policy efforts (OECD, 2005).¹ Good policy-making needs robust and up-to-date information to monitor and benchmark national socio-economic performance, but also policy measures and instruments to improve that performance.

There is no doubt that the 3% target has helped mobilising support to R&D in the Member States. It has put research and innovation at the heart of the policy debate. There is now a fairly common understanding that R&D (as a support for innovation) is one of the key elements that can push the EU towards a more knowledge-based, competitive economy with more and better jobs. This in turn has led to more ambitious national R&D investment targets, including the private sector, accompanied by an array of policy measures to improve R&D governance, fiscal incentives, and framework conditions. The European Commission's ERAWATCH project – which monitors R&D policy in all of the EU Member States and a number of other economies - has shown that many Member States have enacted policies that seek to contribute towards reaching the targets of the Lisbon agenda.²

But the 3% target has always been a contentious one, with a number of analysts (for example Gassler *et al.* 2005³, van Pottelsberghe de la Potterie, 2008⁴) arguing that it has never addressed the right issues. These arguments for 3% being a mistaken target generally take three forms. Firstly, there are criticisms of the 3% target in terms of its underlying meaning and significance: these criticisms essentially boil down to the idea that the R&D/GDP ratio is not at all a good indicator of R&D effort. Secondly, there is the criticism that the 3% target focuses excessively on the level of R&D, and neglects its content and organisation (especially in terms of key science fields). Finally, there are those who argue that the real problem is innovation, and that this is a much more complex issue than simply R&D effort.

¹ OECD, (2005), "Governance of Innovation Systems", vol 1., p. 64 - OECD Paris

² ERAWATCH provides information on national and regional research policies, actors, organisations and programmes. It supports evidence based policy making in Europe and to contribute to the realisation of the European Research Area (ERA). ERAWATCH is jointly carried out by the European Commission Joint Research Centre/IPTS and Directorate-General for Research in collaboration with CORDIS. See <http://cordis.europa.eu/erawatch/>

³ Gassler H., Havas A., Polt W., Schibany A., Steyer F. (2005), "New frontiers in European RTD policy – A Response to Europe's Disappointing Growth Performance?" - A report for the Six Countries programme on innovation. Joanneum Research Institute. p 21.

⁴ van Pottelsberghe de la Potterie B., (2008) "European R&D: Missing the wrong target?", Bruegel policy brief - Issue 2008/03

The criticism of the significance of the R&D/GDP ratio in terms of its basic meaning tend to focus on two core issues: namely the way in which the indicator is pre-conditioned by the industrial structure, and the way in which company demographics, i.e. the entry and exit of firms among the top R&D investors, affect the indicator.

3. Structural aspects

The advanced economies of the world may be similar in terms of income levels, productivity etc: there has been considerable convergence between them in terms of basic economic indicators. But they differ significantly in terms of their technological specialisations and hence industrial structures. The importance of this lies in the fact that industries have very different R&D intensities, and so the particular mix or composition of industries possessed by any country will have big effects on the aggregate R&D intensity. Simply taking a raw R&D/GDP ratio for comparison purposes leaves aside the effects of industrial specialisation. Yet the differences in R&D intensity between countries are drastically reduced if technological specialisation is taken into account (Mathieu and van Pottelsberghe de la Potterie, 2008).⁵

According to O'Sullivan (2007)⁶, the R&D intensity deficit appears to be a symptom, rather than the cause, of weakness in the EU's capacity to innovate. The cause of the EU gap is rather due to the economic structure (industrial sectors) than to the region's enterprises and industries; most of the structural difference is due, in particular, to the ICT sector (Lindmark, Turlea and Ulbrich, 2007)⁷. Moreover, the structural aspect is strongly linked to globalisation in many sectors. A recent survey (EC-JRC, 2008)⁸, highlights that the sectors with the highest R&D intensities, are the most internationalised sector in terms of the execution of R&D investment, firms in pharmaceuticals & biotechnology sector being the most prominent

⁵ Mathieu A. and van Pottelsberghe de la Potterie B. (2008)- "A note on the drivers of R&D intensity"- CEB Working Paper N° 08/002 - January 2008

⁶ O' Sullivan M. (rapporteur) (2007), "The EU's R&D Deficit and Innovation Policy", report based on contributions of the members of the EU Commissioner J. Potočník's Expert Group on "Knowledge for Growth".

⁷ Lindmark S., Turlea G. and Ulbrich M. (2007), 'Corporate R&D in the ICT sector' Paper presented at the first European Conference on Corporate R&D – Seville / 7-8 October 2007.

⁸ European Commission – Joint Research Centre (2008), "2007 EU Survey on R&D Investment Business Trends" - EUR 23416 EN; ISSN 1018-5593 - <http://iri.jrc.ec.europa.eu/research/docs/survey/2007/JRC44432.pdf>

in this path. This phenomenon occurs mainly because the knowledge-intensive industries have high propensity to entry new markets, to locate R&D activities in proximity to companies operations and to access to specialized knowledge worldwide.

It is broadly known that corporate R&D has undergone considerable change in structure since 1985, in the US and in Europe at a more modest pace. According to Foray and Lhuillery (2008)⁹, this has also occurred because of the greater reliance on market relationships for the governance of the innovation process. In the future, market mechanisms can be expected to play a greater role in the process of knowledge dissemination. But many failures remain to be fixed on the markets for technologies. There are other important structural differences between the foremost competing economies that are not taken into account by the R&D intensity target, as for example market size and barriers, and company size. Some of these issues are addressed in the sections that follow.

4. Company demographics

The aggregate R&D intensity indicator is affected not only by the industrial structure but also by the pool of firms that make up that structure. The distribution of different size classes of firms, and their different propensities to perform R&D also have an impact. Ortega-Argilés and Brandsma (2007)¹⁰ show that the size of R&D-intensive firms plays a role in explaining the overall R&D intensity gap between EU and US. Smaller firms tend to have larger R&D intensities in both economies, but the effect is more significant in the US than in the EU. One reason for the high R&D intensity of the USA is its large SME population in strongly R&D-performing sectors, notably those concerned with ICT. This has led some to believe that SMEs in Europe (which are numerous, yet not very R&D intensive) have a high potential for reducing the intensity gap because of potential growth in R&D investment within that part of the firm population. Around 99% of all EU companies are SMEs, but only 3% of them are doing research. So, even if the present SMEs were to double their R&D investment, this cannot be expected have a significant impact on the private sector R&D intensity in the EU. This does not take away that increasing the number of SMEs involved in R&D could help to improve the dynamism of the EU economy.

⁹ Foray D. and Lhuillery S. (forthcoming), "Structural changes in corporate R&D: US and Europe" - Paper to appear in 2009 in Science and Public Policy Journal.

¹⁰ Ortega-Argiles R. and Brandsma A. (2009) - 'EU-US differences in the sizes of R&D-intensive firms: do they explain the overall R&D intensity gap?' Paper presented at the first European Conference on Corporate R&D – Seville / 7-8 October 2007. Published as *IRMA Working Papers Series* No. 02/2009 – European Commission.

SMEs have the potential to affect overall R&D intensity if they grow on the basis of innovation, becoming larger companies, particularly if R&D investment contributes significantly to their growth. Unfortunately the EU appears to be less successful in this dynamic than the US where entry of new firms is easier and there is stronger growth of surviving firms after entry (O'Mahony and Van Ark, 2003)¹¹. If one looks at simple statistics, such as the age of the world's largest companies, it can be observed that EU companies are by far older on average than in any other region in the world¹². More recently Veugelers (2009)¹³ analysed a sample of 226 companies, obtained from matching firms in the FT Global 500 (2007) with the 2007 European Commission's JRC-IPTS and DG Research top 1000 R&D investment scoreboard companies. She concluded that there is evidence on Europe's missing young firms among leading innovators (as defined both by the size of market capitalization and R&D investment).

Therefore, we can conclude by supporting O'Sullivan (2007) findings which suggest that there is a European weakness in making successful smaller-sized companies grows. This phenomenon is certainly more evident in knowledge intensive sectors of the European economy, where the greater investment for the development of new knowledge, the higher risk associated to difficulty of access to capital and high cost of protection of intellectual property, among others factors, are relevant barriers for a smaller firm to grow.

5. Return on private R&D investment

Companies cannot be expected to raise R&D intensities much above their main competitors. Individual companies may lose competitiveness if they invest below the sector average, but it is by no means clear that there are positive returns for any investment above the sector average, especially in the short term. Thus, companies can actually over-invest in R&D without gaining market share. The question that remains is whether investing in research would enable EU-based companies to increase their market shares at the expense of their

¹¹ O'Mahony M. and B. van Ark, Editors (2003) – "EU Productivity and Competitiveness: An Industry Perspective - Can Europe Resume the Catching-up Process?" - Office for Official Publications of the European Communities, Luxembourg, ISBN 92-894-6303-1

¹² Gongol B. (2005), "The ages of the world's largest companies" – work based on "Forbes Global 2000" dataset <http://www.gongol.com/research/economics/companyage/>.

¹³ Veugelers R., (2009) "A lifeline for Europe's young radical innovators", Bruegel Policy Brief No. 2009/01

competitors elsewhere in the world. At the heart of these questions lies the debate on the effects of R&D on corporate performance (Brandsma *et al.*, 2007) ¹⁴.

As far as the relationship between company economic performances, R&D investments, and employment is concerned, the following observations can be made. In EU companies from most major Member States there is evidence for a direct relationship between the annual growth rate of employment and net sales over the last years' period (2000-2007)¹⁵. A similar direct link between firm's R&D investment and employment growth rates cannot be observed. These arguments underline that, although R&D represents an important, strategic element for companies' performance, it is not the only one. Global, national and sector-specific economic cycles and/or framework conditions, as well as market shares, margins, profits, dividends, physical assets, are other relevant factors that have an impact on companies' performance.

Therefore, to spur a knowledge intensive economy for attaining both the expected private and societal returns, the public-private policy nexus should carefully address the framework conditions that make effective the investment of the private (and public) sector in the knowledge triangle.

It is not surprising that efficient market conditions (e.g. product market entry barriers) play a prominent role resulting in the EU-US gap of the private sector R&D. According to a recent study (European Commission, 2008)¹⁶, the EU entry barriers for innovative companies explain three-quarters of the deficit in private sector R&D spending between the EU and the US.

6. Issues of time & economic cycles

There are issues concerning the interpretation of R&D intensity indicators over time, when countries are entering or leaving business cycles at different points, and growing at different

¹⁴ A. Brandsma *et al.*, (2007), "Industrial R&D Economic and Policy Analysis Report 2006" – Report for the Industrial Research Monitoring Analysis project - European Commission, JRC and DGRTD - EUR22695 EN.

¹⁵ European Commission, (2004-2008 editions), "The EU Industrial R&D Investment Scoreboard" <http://iri.jrc.ec.europa.eu/research/scoreboard.htm>

¹⁶ European Commission, (2008), "Macro-Economic Policies to Foster R&D and Innovation – A Model Based Approach" ECFIN/52056/08-EN.

but fluctuating rates (see for example Meister and Verspagen, 2006)¹⁷. It is not surprising that the (global or country-specific) fluctuations in growth together with the structure of the national economies and their different abilities to reduce the undesired effects of economic downturn, or different national economic priorities (as in developing economies, or in some new EU member States) could lead to some turbulence of the R&D/GDP ratio. Such economic evolutions could either hamper or facilitate the capacity of a given country - more than another one - to continue to invest in R&D; it could also result in a higher or lower intensity ratio simply because the value of the denominator falls or rises. Therefore, comparison between R&D/GDP ratios belonging to different economies (also within the EU) especially if related to a relatively short time-span should be handled with care, particularly with respect to the policy measures that result from such comparisons.

7. Efficiency aspects

The 3% target does not consider the complex issues of efficiency and the effectiveness of R&D investment (see for example Cincera *et al.*, 2009)¹⁸. GDP accounts for economic output and the GERD/GDP measures effort (the part of economic activities devoted to R&D) not R&D efficiency or effectiveness (Godin, 2007)¹⁹. Furthermore there are real concerns about future research investment in key basic R&D knowledge-using sectors in EU, like pharmaceuticals, while there are opened questions about the meaning of the EU R&D intensity deficit and the effective role of R&D investment to innovation and competitiveness (e.g. there are indications that EU companies sell - much more than those from competing economies - products and services with high quality premium high embedded technology content which do not necessarily comes from R&D implemented by EU firms (CEPEII, 2004)²⁰. In fact, it could be that until now R&D targeting has discouraged measures to improve the efficiency of R&D and has encouraged moving more resources to science and technology.

¹⁷ Meister Ch. and Verspagen B. (2006) "European Productivity Gaps: Is R&D the Solution?" – Paper in the book titled "Competitiveness and growth in Europe: lessons and policy implications for the Lisbon strategy", Edited by Susanne Mundtschenk, Michael H. Stierle, Ulrike Stierle-von Schütz - Published by Edward Elgar Publishing, 2006 ISBN 1845426622, 9781845426620

¹⁸ Cincera M., Czarnitzki D., Thorwarth S. (2009), "Efficiency of public spending in support of R&D activities" - *European Economy*, Economic Papers 374, March 2009, 111p.

¹⁹ Godin B., (2007), "Science, accounting and statistics: The input–output framework" - *Research Policy* No. 36, 1288 – 14003.

²⁰ CEPEII (2004) – "European industry's place in the international Division of Labour: situation and prospects" – CEPII-CIREM- European Consortium for Trade-Policy Analysis (ECTA) - Report prepared for the Directorate-General for Trade of the European Commission, July 2004

But how can the R&D investment be maximised? In a recent study, Ortega-Argilés *et al.* (2009)²¹ used both European sectoral OECD data over the period 1987-2002 and a unique micro longitudinal database consisting of 532 top European R&D investors over the six-year period 2000-2005 for analysing the same relationship. One of the main conclusions of their study is that the R&D stock has a significant positive impact on labour productivity in high-R&D intensity sectors, the other relevant result of the investigation is that the same significant impact was not found in the low-R&D intensive ones. While these results cannot readily be generalised to the overall economy, they do not support the idea that "low R&D" is "more efficient R&D", but rather the opposite view.

There is also a case for R&D policy addressed to SMEs: the results of a recent scientific workshop (2008)²², for instance, clearly indicated that among newborn firms R&D is a crucial growth asset only for the tiny minority of the so-called NTBFs, and that R&D is crucial in transforming an SME into a *gazelle* only in the technologically-advanced countries. Overall, SMEs are very varied²³ and R&D policy for SMEs should not be general but be extremely cautious, selective and tailored in terms of country, sector and technology specificities, i.e.: in this case the public support, but very selective and targeted at specific categories of SMEs to get out the most from public support measures.

8. Socio-cultural aspects

There are successful R&D-based industrial agglomerations in which community and firms tend to merge (Becattini 1990)²⁴, and where district success relies heavily upon the socio-cultural context in which it is rooted. The 'Californian school' generalised about the growth of new industrial spaces emphasising vertical disintegration of production chains in a new era

²¹ Ortega-Argilés R., Piva M.-C., Potters L. and Vivarelli M. (2009) "Is corporate R&D investment in high-tech sectors more effective? Some guidelines for European Research Policy", European Commission, JRC-IPTS and DG-RTD – "IRMA Working Papers Series", No. 03/2009

²² Workshop on "Drivers and impacts of corporate R&D in Small and Medium-sized Enterprises" - European Commission, JRC-IPTS, Knowledge for Growth Unit Seville / Spain, 19 September 2008. Selected papers of this workshop have been accepted in the *Small Business Economics Journal* (SBEJ) and are to appear in the second half of 2009 as a Special Issue on the subject edited by Raquel Ortega-Argilés, Marco Vivarelli and Peter Voigt (guest's editors).

²³ While some SMEs are potentially innovative and ready to grow, others are revolving-door firms which stay for a while in an industry fringe with no chance of entering its core, rather being doomed to exit the market.

²⁴ Becattini, G. (1990). "The Marshallian Industrial Districts as a Socio-Economic Notion", in F. Pyke, G. Becattini and W. Sengenberger (eds.). *Industrial Districts and Inter-Firm Co-operation in Italy*. Geneva: International Institute for Labour Studies.

of ‘flexible accumulation’ of knowledge. Although initially mainly structural approaches were referring to universal causal mechanisms and circumstances, attention soon shifted to examining the role of culture, institutions and governance in the creation of new, R&D and innovation intense industrial spaces (Lagendijk 1997)²⁵.

General targets (and the horizontal policies associated to these targets) often do not suitably address significant differences in countries' present socio- economy and its perspectives. There should be a focus not only on economic outcomes but also on the social implications of the world regions' deficit in generating new knowledge.

Therefore, the nature of the R&D deficit, its causes and its implications need to be better appreciated if it is to serve as a useful guide in contemporary policy discussions in the EU.

There are two further issues that seem particularly relevant when using R&D targets in policy making. These are i) the internationalisation/globalisation of the R&D activities and ii) the availability of statistics upon which policy-making relies. These two issues are briefly introduced in the following sections.

9. Internationalisation of R&D and the policy targets

The *internationalisation of R&D* is an issue which is having a strong impact on the policy agendas. In fact, the proportion of R&D undertaken abroad in some region of the world is increasing rapidly. Between 1995 and 2003, the R&D activities of foreign affiliated in the OECD countries have grown much faster than those of indigenous companies (OECD, 2006)²⁶. The UNCTAD survey (2005) highlights that the trend will continue as almost 70% of all companies responding to it indicate the intention to increase their R&D activity abroad. More recent surveys (e.g., EC-JRC, 2008)²⁷ confirm this trend.

²⁵ Lagendijk, A. 1997. “From New Industrial Spaces to Regional Innovation Systems and Beyond. How and from whom should industrial geography learn?” Working Paper. Centre for Urban and Regional Development Studies, University of Newcastle upon Tyne.

²⁶ OECD, (2006), "Recent Trends in the Internationalisation of R&D in the Enterprise Sector, Special Session on Globalisation" -Working Party on Statistics, DSTI/EAS/IND/SWP

²⁷ European Commission – Joint Research Centre (2008), "2007 EU Survey on R&D Investment Business Trends" - EUR 23416 EN; ISSN 1018-5593
<http://iri.jrc.ec.europa.eu/research/docs/survey/2007/JRC44432.pdf>

There is a fear that the more firms locate R&D activities outside a given country or region, the more the loss will be for that country or region's economic and overall welfare. Therefore the main objective from a policy view-point in dealing with internationalisation of R&D is twofold: to get the beneficial returns from foreign knowledge (both located at home and abroad) and to attract companies (and not loose the present) to invest in knowledge intensive activities in a given region/country (Foray 2006)²⁸.

From a company view-point, in order to remain competitive, firms must find the outstanding, creative and enriching knowledge across a range of technology fields either in domestic market and abroad. Still, the bulk of R&D activity is generally implemented in nations where the company originated but that depends on access to knowledge, infrastructures, market share and in which sector these companies operate. Nonetheless, the tendency in which companies are more and more operating in the internationally/globally for market, R&D/technology, and people is strong. This phenomenon raises the question whether domestic corporate R&D targets are appropriate in an increasingly globalised world. Given the interconnectedness of research in the world, and given that large R&D-spending companies are global in their outlook and approach, will such EU private R&D investment target (i.e. 2% of GDP) indeed contribute in full to build a competitive, knowledge based economy in Europe?

10. Needs for appropriate data and analyses for international comparisons

The international comparisons should be based on *appropriate indicators and statistics* leading to solid evidence-based policy-making. As an example, in a number of countries business-sector R&D expenditures have increased, very probably thanks in large part to the R&D spending of affiliates under foreign control. However, to analyze the effects of R&D internationalisation one should be able to rely on existing indicators which are all produced on the basis of statistical macro-data (at national level) or meso-data (at sectoral level). Unfortunately, the statistical coverage of the financial and knowledge flows managed by

²⁸ Foray D. (Rapporteur), (2006), –"Globalization of R&D: linking better the European economy to foreign sources of knowledge and making EU a more attractive place for R&D investment" Reporteur - Knowledge for Growth" Expert Group - http://ec.europa.eu/invest-in-research/pdf/download_en/foray_report.pdf.

multi-national enterprises (MNEs) involved in R&D outsourcing/off-shoring is very poor or practically non-existent (Perani and Cozza, 2006)²⁹.

The international comparison at sector and micro-level is not always possible: for example, within the sectors, whether R&D is invested by the firm or by other firms cannot be distinguished. However, if the International Accounting Standard for R&D and other intangible assets (i.e. IAS-38) would have incorporated criteria for the distinction between intramural and extramural R&D, leading to a unique identification of R&D invested by each firm, it would have relevant applications for the analysis of the sectors of performance. Of course, these criteria would provide even richer information if, within the extramural R&D category, they distinguished national from foreign investment, allowing for a geographical distribution of the data (Azagra-Caro and Grablowitz, 2008)³⁰.

Another example is provided by Duchêne *et al.* (2009)³¹ who confirm the results of NSF (2005)³² and 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. However, the author assert that this is almost entirely the result of a statistical artifact: i.e. the fact that R&D reported in the services sector is in the EU to a much larger extent redistributed by statistical offices to the corresponding manufacturing sectors (for which R&D has been executed) than in the US. Therefore, according to these authors, the EU R&D deficit does not originates in a large extent from the service sectors, as commonly believed.

Of course, more should be done to rely on and use *appropriate indicators and statistics* as several authors suggest (Leydesdorff and Meyer, 2006³³; Veugelers, 2006³⁴; Cooper and Merrill, 1997³⁵). Before looking for improved or new indicators and statistics, it should be

²⁹ Perani G. and Cozza C., (2006), "A proposal for developing new indicators on the internationalisation of R&D by matching micro-data from national R&D surveys" – Paper presented at the International Conference [Blue Sky II 2006: What indicators for Science, Technology and Innovation Policies in the 21st Century](#)

³⁰ Azagra-Caro J., Grablowitz A. (2008), "Data on Business R&D: Comparing BERD and the Scoreboard" – European Commission - EUR 23364 EN -

³¹ Duchêne V., Lykogianni E. and Verbeek A. (2009), "Sector-specific R&D and R&D in Services" - European Commission, JRC-IPTS and DG-RTD – "IRMA Working Papers Series", No. 04/2009

³² National Science Foundation (2005), "National Patterns of Research and Development Resources 2003", NFS 05-308, Brandon Shackelford

³³ Leydesdorff L. and Meyer M., (2006) "Triple helix Indicators of Knowledge-Based Innovation Systems" - Research Policy - Volume 35, Issue 10, December 2006, Pages 1441-1449

³⁴ Veugelers R., (2006), "Assessing innovation capacity: Fitting strategy, indicators and policy in the right framework" - *Advancing Knowledge and the Knowledge Economy*, MIT Press - pages: 43-59

³⁵ Cooper R.S., Merrill S.A. (eds.) (1997) "Industrial Research and Innovation Indicators: Report of a Workshop" - National Research Council.

made clear what is the policy information needed. Then, we should begin with improving the existing basic indicators in S&T and Innovation (human and financial resources, scientific output, technological and economic output/performance); secondly develop new indicators (knowledge flows, including public-private, international R&D and flows of R&D investment); thirdly we should go beyond national aggregate (sector specific, regional and micro- statistics).

11. Some further thoughts relevant to corporate R&D policy-making

Within the perspective of industrial competitiveness and the policy context set by the Lisbon and Barcelona councils, setting the target for the EU R&D investment of 3% of the EU GDP of which two thirds should be financed by the private sector, a number of conclusions relevant for policy can be drawn:

a- Corporate R&D investment in Europe lasting recent years (2000-2008) has grown slowly and the gap with US and Japanese companies has been widening over the period under consideration.

Consequently, to continue focusing on its Barcelona targets, ways to support and accelerate increases in industrial R&D and innovation should be identified to help companies become more competitive in the world economy. The key support to companies would be in cases where increased R&D investment can lead directly to significantly increased value added and enhanced company performance.

b- Corporate R&D investment among top R&D-investing companies worldwide is highly concentrated in a small number of companies, by sectors of activity and by countries. At the very top of the ranking, the concentration of R&D investment is much higher among EU companies than among the US ones. EU companies are lagging behind in terms of depth (i.e. many companies operating in a given sector with significant R&D investment induce a lower degree of concentration in that sector) and strength (i.e. a larger proportion of companies operating in those sectors with intrinsic high R&D investment/sales ratio) of R&D activity, especially R&D performed by middle-sized companies and particularly in emerging sectors.

Besides, middle-sized companies are potentially key ones to future economic development, due to their potential for growth and for opening new sectors.

One potential area of policy attention is centred on the means for encouraging middle-sized R&D-active companies by making improvements to the business environment and proposing policy initiatives aimed at R&D-led organic growth of smaller and middle-sized companies.

c- Industrial competitiveness manifests itself critically in global markets. Corporate R&D investment is an element of competitiveness, and so it should be viewed in a strategic business prospective, especially for the top R&D investing companies which mostly operate in international markets.

In particular, when considering the sectors of specialisation of EU companies and the promising markets, a similar conclusion to the one already made for medium-sized companies can be formulated for large-size companies:

For policies and strategies aimed at the development of national research, an interesting issue will be to investigate the opportunity of supporting emerging and promising sectors. In doing so care attention should be paid to implement measure that have not the side effect to penalise the areas where companies already show strength on world markets (such as – in the EU - Automobiles & parts, Pharmaceuticals & biotechnology).

Furthermore, if a particular region cannot compete in terms of market potential, cost, and sheer demographics, policy undertaking should be tailored at exploiting the potential competitive advantage in terms of research and innovation and management excellence, full market integration and demand sophistication as ways to equal or better the best conditions elsewhere in the world for private R&D investment.

d.- As far as the relationship between company economic performances, R&D investments, and employment is concerned, the following observations can be made. In EU companies from most major Member States there is evidence for a direct relationship between the annual growth rate of employment and net sales over the last years' period (2000-2007). There does not seem to be a direct link between R&D investment and employment growth rates. This is one more element that confirms the R&D investment decision is a more strategic (long-term) undertaking. In fact, successful companies make good strategic choices, show operational excellence and make wise and balanced investments in the future (such as R&D investment, capital expenditure, brands, market development). The corollary to this is that a positive link would be expected between R&D investment and company performance

for R&D active sectors and between investment intensity and wealth creation efficiency and/or productivity provided that the majority of companies have good strategy and operations so that they can take full benefit from successful R&D giving new products, processes and services. There are studies (for example, European Commission, 2005)³⁶ which also show that in both the US and Europe the sectors with the highest R&D/Sales ratio (such as pharmaceuticals & biotechnology and software & computer services) have the highest ratio of market capitalisation to sales.

For companies to grow further and to increase their R&D investment there is a permanent need for maintaining a supportive business environment (such as lower barriers, improved macro-economic framework conditions, enhanced outputs as well as benchmark input)

Additionally, industrial R&D investment of companies operating in different sectors induces different effects on the overall economy.

Further attention needs to be paid to identify those sectors where previous experience shows that increased R&D investment is most likely to lead to substantial increases in overall economic growth.

Finally, the US followed by Japan and the EU have maintained for many years their economic advantage by being better and faster than any other country at inventing and exploiting new technologies. Today, however, their dominance is starting to slip, as Asian countries and other emerging economies' limited resources investment into R&D will increase and challenge the triad's traditional role in the global economy.

³⁶ European Commission, (2005), "The 2005 EU Industrial R&D Investment Scoreboard" – EUR 21851 EN, p 78-79

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Technical Note

Abstract

R&D intensity indicators are increasingly used not only for international comparisons, but also as targets for policies stimulating research. The two are of course intimately linked: it makes little sense to set a quantitative policy target when not knowing whether it is high or low compared to economies at similar stages of development. This paper reflects upon the (Barcelona) target to lift R&D spending to 3% of GDP, set by the EU as a key part of its (Lisbon) strategy for growth and jobs. The paper provides empirical evidence showing the target of 3% of GDP for R&D expenditures in the EU as a whole to be overly ambitious, even though some Member States are above. It also argues that the EU's strategy is short on policy instruments to reach this target. In fact, what appears a simple target actually sums up public R&D, over which decision makers have direct control, and private R&D, which may be partly publicly funded but which can be influenced only indirectly. In this respect, it is clear that national policy-makers have to take into account that the bulk of R&D is conducted by relatively few companies that mostly operate on a global scale.

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