

Knowledge for Growth
Prospects for the knowledge-based economy

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Policy Briefs are based on reports delivered by the "Knowledge for Growth" Expert Group advising the Commissioner for Science and Research, Janez Potočnik. The full report on which it is based can be downloaded at:

http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

Catching-up Member States and the Knowledge Economy of the European Union

Reinhilde Veugelers¹ and Mojmir Mrak²

The report assesses the performance of the so-called “Catching-up Member States” of the EU with respect to their transformation towards the knowledge economy. “Catching-Up Member States” are ten “new” MS and four former cohesion Member States Greece, Portugal, Spain and Ireland. The catching-up process does not follow a simple new Member States (MS) versus old Member States divide. Some new MS, especially Slovenia and the Czech Republic, are catching-up on the knowledge performance dimension and perform better than some of the former cohesion countries, like Portugal and Greece. The report suggests strengthening the research infrastructure in the catching-up countries in order to allow the growth of the knowledge economy in support of economic convergence.

The Report (i) provides empirical evidence on economic and knowledge economy convergence of the “catching-up MS” inside the EU-27, (ii) analyses factors/drivers that are important in these processes, and (iii) discusses policy implications and proposes recommendations to support convergence of the “catching-up MS” towards the knowledge economy.

I. Empirical evidence on economic and knowledge economy convergence of the “catching-up MS”

Since the early 1990’s, catching-up Member States of the EU have made significant progress in reducing their economic development gap vis-à-vis the EU average when measured by per capita GDP. As shown in the matrix, all

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but one “catching-up MS” (Portugal) have reduced the development gap towards the EU average. Four of the “catching-up MS” - Greece, Ireland, Spain and Slovenia - have closed or almost closed the gap. The three Baltic States and Slovakia have a longer time to go to close their more sizeable gap, but they have recorded high growth rates in the past. The slower pace of growth in Romania, Bulgaria, Poland and Hungary predicts a long time to catch-up.

**Matrix of economic and knowledge economy convergence performance
of “catching-up MS”**

Time to catch-up to EU-27 average

GDP per capita / Innovation	Indefinite	Long	Medium	Short	Reached
Indefinite		Romania, Bulgaria	Slovakia		
Long		Poland, Hungary	Latvia		
Medium	Portugal		Lithuania, Czech Republic	Greece	Spain
Short			Estonia	Slovenia	Ireland
Reached					

Notes:

- *GDP per capita catching-up* is measured as the change in the gap in GDP per capita (in PPP) relative to EU-27.
- *Innovation catching-up* is measured as the change in the gap in innovation relative to EU-27.
- *Reached* implies the country is at or above EU-27 average in 2007; *Short*: less than 10 years for catching-up (extrapolating average annual growth rates from the past 93-07); *Long*: more than 30 years for catching-up. *Indefinite*: with given growth rates, no catching-up possible.
- *Former cohesion MS* are listed in the first line of the cell, *transition MS* in the second line.

For more information on how the matrix was composed, see Report.

In contrast to this overall positive real economic convergence, the performance of the “catching-up MS” with respect to their knowledge economy convergence, measured with the Innovation Performance Index, has been much slower. None of the catching-up countries has managed to close the gap with the EU-27 average. Ireland, Slovenia and Estonia are the three best placed countries at the end of the period, but are still at a considerable gap. Also Portugal and Lithuania have seen important advances in their knowledge economy catching-up, but still need a longer time to catch-up. The least successful MS in terms in knowledge economy catching-up are Poland, who made only marginal advancements, and Slovakia, Bulgaria and Romania, falling even further behind.

Linking knowledge economy catching-up to economic convergence suggests a positive correlation, but with considerable country specifics. Among the countries with a stronger innovation-growth nexus, Ireland stands out

among the former cohesion countries, and Slovenia and Estonia among transition countries. But the strong economic growth performance of Slovakia and Romania, and also the more modest growth performance of Bulgaria, Poland and also Greece are not related to KE growth, as these countries have witnessed no catching-up on KE dimensions. This lack of a KE basis to their growth questions the sustainability of their economic convergence, particularly when these countries will move further on their economic development path.

An interesting off-diagonal case is Portugal. Although Portugal has managed to improve its innovation gap, it nevertheless has failed to translate this into real economic convergence. The improvement in innovation is mostly a public sector component, with scoring on business innovation performance remaining low.

Overall, the analysis seems to suggest that for several catching-up countries their path to convergence is not built on knowledge-based convergence, and for those countries where economic growth is innovation based, there are still considerable vulnerabilities to the development of a robust knowledge-based economy. In particular, there is a concentration of economic and creative capacity in just a few sectors. Also their dependence on foreign markets, foreign investors and foreign know-how sources make their innovation-growth process more vulnerable, as the current crisis has made clear. The empirical evidence further suggests that the knowledge economy catching-up process does not follow a simple “old” – “new” MS divide. Some transition MS, especially Slovenia and Czech Republic, have made significant advancement in reducing the knowledge economy gap and have outperformed in this respect some of the former cohesion countries, like Greece.

II. Factors and drivers of knowledge economy convergence of the “catching-up MS”

Although there is a positive correlation between innovation and economic growth for all EU countries, the evidence shows there are important country to country heterogeneity in the innovation-growth link. To explain these differences, flanking conditions shaping the adaptive and innovative capacity of catching-up countries need to be factored in. The key flanking conditions for establishing a successful knowledge-for-growth nexus, particularly those relevant for catching-up countries, are identified as follows:

- (i) Institutional quality, financial market sophistication and macro-economic stability,
- (ii) Well functioning local product markets,
- (iii) International openness through foreign trade and FDI,
- (iv) Absorption of new technologies and ICT availability and use,
- (v) Education and human resource development, such as secondary & tertiary enrolment, quality of education and training, and
- (vi) Innovation capacity drivers, such as availability of scientists, quality of the public research institutes, university-industry links, venture

capital availability, IPR protection.

Analysing the empirical evidence on catching-up MS's scoring on these flanking conditions suggests that despite large variations between "catching-up MS", countries situated at the bottom ranking of a knowledge-based economic catching-up, (such as Bulgaria and Romania among the transition countries and Greece among former cohesion countries) score on average low on most flanking conditions. Similarly, the better performing countries, like Ireland, Estonia, Czech Republic and Slovenia typically have a good scoring on all or most of the indicators reviewed. The evidence from Portugal and Hungary suggests that doing well on some flanking indicators, but not on others, is not likely to lead to an overall good performance. All this indicates that systemic performance on all flanking conditions is needed for successful knowledge-based catching-up.

For the "catching-up MS" covered in the Report, there are a number of specific issues that have influenced the process of reducing the knowledge economy gap. First, a number of these MS have gone through a process of transition. Secondly, all the "catching-up MS" have undergone at different times the process of accession to the EU. The EU integration process has influenced and continues to influence the knowledge economy catching-up process of newcomers into the EU by

- (i) a continued commitment of new members to the reform process through transposition of the "acquis" and implementation of Lisbon strategy objectives;
- (ii) support from the EU budget, through pre-accession funds in the period prior to accession and through structural actions funds and other funding sources in the period of full membership of these countries and
- (iii) integration of new MS into the single European market.

Experiences show that the transition and EU accession process with clear commitments and precisely determined time-tables have contributed significantly towards speeding up reforms improving flanking conditions for an innovation-growth nexus, although progress achieved has varied not only across individual MS but also across different areas.

III. Policies aimed at strengthening knowledge economy convergence of the "catching-up MS"

Experience from the countries whose catching-up process has been the most innovation-based and successful indicates that systemic performance on all flanking conditions for an innovation-growth nexus is needed. Consequently, improving the knowledge-based content of catching-up for lagging countries requires a *systemic policy approach* addressing gaps on all flanking conditions, but especially so for those reforms needed to incite the private sector to adopt and create new technologies. Which mix of flanking conditions is to be encouraged by an individual country depends on the level of its development. Countries with large gaps will need to focus on those

drivers that are particularly important for improving technology absorption while more advanced catching up MS will have to start putting more efforts on how to sustain productivity growth through own innovations. Addressing the catching-up countries' vulnerability requires having the critical flanking conditions to develop a broader *domestic* capacity, promoting *local* spillovers and *local* absorptive and creative capacity. To this end, reforms aimed at improving (product and financial) market functioning are crucial, particularly as these are pivotal for structural change towards new areas of domestic strongholds. This is even more the case in the current crisis. With weaker financial markets and downturns in the economic cycle, new local innovators, who are pivotal "change" actors, are especially at risk, due to the low availability of credit.

Most of the competences and responsibilities for the design and implementation of appropriate policies needed to support the knowledge-based catching-up process are found at Member State level. But at the EU level there are some important policy levers which can complement Member State policies.

The major EU policy instrument for stimulating knowledge-based growth is the Lisbon Strategy, later relabelled as Growth & Jobs Strategy. When dealing with the idiosyncrasies of catching-up countries and improving convergence and cohesion inside the EU, a number of amendments should be made to the Lisbon strategy. As far as the governance of the Strategy is concerned, it should include improvements in the Commission's process of National Reform Programmes' evaluations through an improved methodology for assessing these programmes, taking into account catching-up specifics, and through more systematic benchmarking among catching-up countries and peer pressure.

Although implementation of the Lisbon strategy agenda is primarily the responsibility of MS and is consequently financed largely from national funds, the EU budget can also represent an important source of funding for knowledge-for-growth investments in the catching-up MS, particularly in the current crisis. The EU budget review currently under way and the forthcoming EU budget negotiations for the post-2013 period will be crucial for the success of the post-2010 Lisbon-type strategy of structural reforms in catching-up MS. The EU budget review should make a clear recommendation for a substantial increase of EU funding for knowledge economy measures. The review of the EU budget is also an opportunity to re-assess how EU budget funds should be allocated among the MS to support a knowledge-based growth in countries, taking into account their idiosyncrasies. The trend of a growing share of Lisbon-type expenditures in overall cohesion policy expenditures is a positive development and should be maintained.

The Report shows that there remains a long way to go for a knowledge-based catching-up process in the EU. Will the current crisis, which has hit all of the catching-up countries particularly hard, be a threat or an opportunity

for these countries to re-adjust themselves during the crisis and to put themselves on track for a post-crisis recovery path that will be more knowledge-based? As a knowledge-based development path provides a better capacity to adapt to global, changing, volatile environments, the more a country's development path is knowledge-based, the more sustainable this path will be in future.

Whilst the longer term benefits of this strategy are clear, the question in the short-term is whether the investments needed now (both public and private) can be found in the current crisis. The Report hopes to contribute to a better case being made for such investments.

Knowledge Economists Policy Brief n° 6

- Policy Debate Paper -

May 2009

The "Knowledge for Growth" Expert Group advises the Commissioner for Science and Research, Janez Potočnik, on the economic implications of research and innovation. In addition to providing Policy Briefs, the Group also puts forward issues for a more wide-ranging debate. The report on which the paper is based can be downloaded at:
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Corporate R&D returns

Bronwyn H. Hall¹ and Jacques Mairesse²

Europe as a whole spends a smaller fraction of GDP on R&D than the US and Japan. The Lisbon strategy calls for increased R&D spending in Europe. This policy debate explores the possible areas and causes of underinvestment. Is there too little public spending or business spending? Should large firms or SMEs be encouraged to do more or does the problem lie in the sectoral composition of European industry?

1. Why does European R&D intensity appear low?

In March 2000, the European Council in Lisbon set out a ten-year strategy to make the EU the world's most dynamic and competitive economy.³ One of the main priority areas in the Lisbon strategy or Lisbon agenda (as it is sometimes known) is to increase investments in knowledge, research, and education, both by governments and by enterprises. Achieving this goal has been widely interpreted as calling for increased R&D spending in Europe, in order to attain a target in the neighborhood of 3 % of GDP overall.

To make progress in moving toward this goal some questions need to be answered: In what areas does Europe have an R&D deficit? Why is this the case? Government policies, low expected returns, or high costs of capital?

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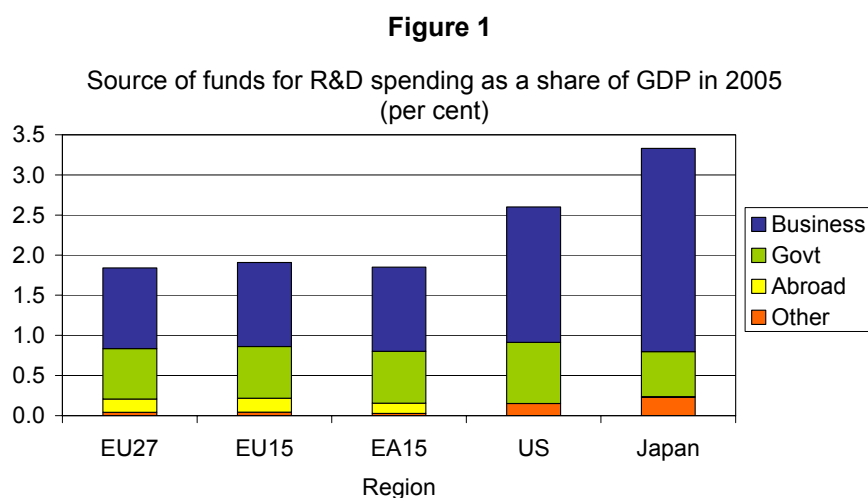
² Inspecteur General Honoraire at the "Institut National de la Statistique et des Etudes Economiques" (INSEE), and Professor of Applied Econometrics of Research, Innovation and Productivity at the University of Maastricht.

³ http://europa.eu.int/comm/lisbon_strategy/index_en.html

This “debate” considers these questions, provides some answers based on available evidence, and suggests areas where our knowledge is incomplete.

2. The gap is larger in business R&D

From Figure 1, which shows the composition of the R&D/GDP ratio in 2005 for three major EU regions (the 27 member countries, the 15 pre-accession member countries, and the 15 countries in the euro zone) along with the US and Japan, we can draw two conclusions: first, the 3% target lies somewhere between the performance of the US and Japan, and second, the shortfall is particularly striking for business R&D.



However, some would argue that because the share of the economy in the public sector is larger in Europe than in countries such as the US and Japan, the government share of R&D spending should also be higher, suggesting that the shortfall is not only in business-funded R&D but also in public sector support of R&D. But the differences across the three regions seem rather small to account for the differences in the composition of R&D expenditure across region: according to the Heston-Summers data, the share of government in GDP is 17% in the EU, 16% in Japan, and 11% in the US.⁴ Of course, the composition of government spending in the three regions also varies considerably, making precise comparisons difficult.

Mention should be made of another increasingly important phenomenon and its implications for Figure 1, the internationalisation of R&D performance. The data for the US and Japan in Figure 1 uses R&D sourced by business but performed within the relevant national borders. That is, US firm R&D conducted in Europe is counted as European R&D. Using some statistics on the top 1000 R&D performers worldwide available from a recent report by Booz & Co., it is possible to form an impression of the size of the discrepancy for the US and Japan (that for Europe is small, around 2% of total

⁴ See Heston, A., R. Summers and B. Aten, *Penn World Table Version 6.2*, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

spending).⁵ In 2008, adding in R&D performed by US firms outside the US and subtracting R&D performed by non-US firms in the US would increase US business R&D intensity from 1.65 to 2.2%. For Japan, the corresponding figures are 2.5 to over 4%. Note that these estimates are based only on the largest firms so that they are probably an overestimate, but the fact remains that correcting for this problem only increases the EU gap.

The larger question is whether increasing R&D spending in Europe to US and Japanese levels is the appropriate target for policy to improve European innovative performance. Although this brief does not take a position on this question, it deepens understanding of the reasons for the business R&D “deficit”, in order to inform us about the innovative process in which R&D does play a large part.

3. Looking inside the business R&D gap

In an earlier paper written for this group, O’Sullivan reviewed the evidence on the source of an R&D deficit at the EU level and concluded that the differing importance of the Information and Communication Technology (ICT) sector was responsible for the bulk of this deficit between the EU and the US. There was also evidence that this sector accounted for differences in the share of young fast-growing firms between the two economies. Here we look at the top-1000 R&D-doing firms in the EU and compare them with those outside the EU.⁶ We note that this comparison is different from that shown in Figure 1, as it focuses on R&D classified by the location of the firm’s headquarters, rather than by where it is performed.

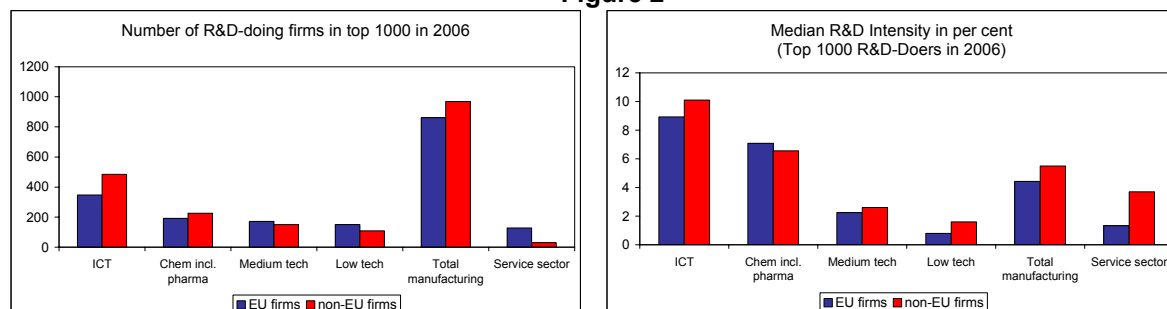
Figure 2 shows the composition and R&D intensities of the two groups of firms, EU and non-EU.⁷ The conclusions that emerge from this figure confirm the analysis in the earlier paper.

- 1) Among top-1000 R&D-doing firms, there are fewer ICT firms and more service firms in the EU in comparison with the rest of the world.
- 2) In the EU, the R&D intensity of the typical firm is also lower in ICT firms and much lower in service sector R&D-doing firms than in the rest of the world. When one examines the composition of these two broad sectors in terms of industry and individual firms, one can see that this is due to differences in firm strategy within particular sectors, with firms outside the EU being more high technology-oriented. For example, several of the US service sector firms provide electronic services to financial service firms (Fiserv, Convergys, Automatic Data Processing).

⁵ See Jaruzelski, B., and K. Dehoff, “Beyond Borders: The Global Innovation 1000,” *strategy+business magazine* issue 53: 53-67, Booz & Co., 2009.

⁶ European Commission (2008). *EU R&D Investment Scoreboard*. Luxembourg, Office for Official Publications of the European Communities.

⁷ In making these figures, we reclassified a few internet or technology-intensive firms such as WebMD, Expedia, Tivo, etc. into the ICT sector from the Service sector.

Figure 2

Overall, the median R&D intensities of these two groups of large firms are 5.4% outside the EU versus 3.7% in the EU.

Conventional wisdom in this area also says that Europe does not have enough small and medium-sized firms that perform R&D. Although this might be true, it does not account for the measured R&D deficit. A comparison of the R&D-weighted size distribution with that of US and the Japan shows that firms with fewer than 250 employees account for 19% of R&D in the EU15, 14% in the US, and 8% in Japan.⁸ This fact suggests that it would be worthwhile to focus a more careful analysis on the size issue – is this result real or a consequence of faulty measurement? If it is real, why is there a perception that European SMEs do too little R&D?

4. Private R&D returns are slightly lower than in the US

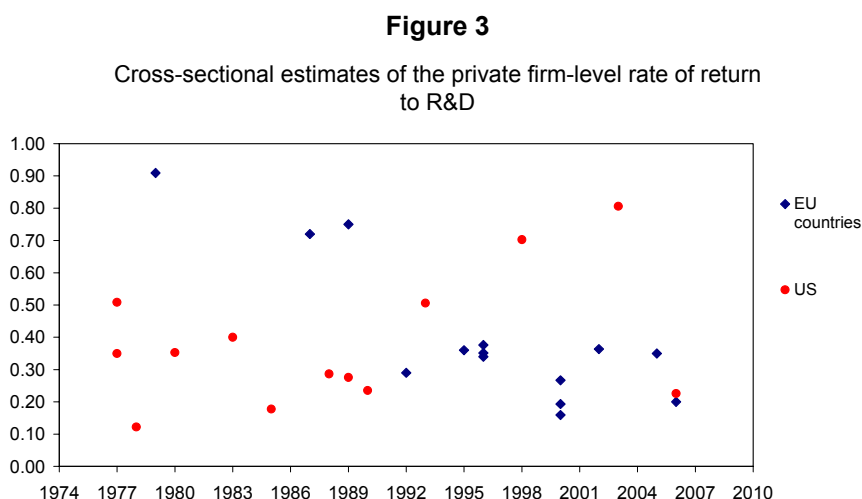
If business R&D spending is indeed “too low” in Europe, simple economic analysis tells us that this might be for two reasons, both of which can occur together: supply of funds problems (too high a cost of capital) and/or R&D demand shortfalls (firms do not find opportunities that are profitable enough, or they find the cost of R&D inputs too high). From the perspective of policy, one needs to measure the marginal returns to R&D to decide which problem deserves the most attention. That is, if the rate of return to R&D among European firms is found to be high, that suggests that the cost of capital they face is high and requires that attention be paid to the functioning of financial markets. If the rate of return to R&D is found to be low, then our attention is directed to a number of other areas that influence the opportunities for R&D investment - the size of the market, entrepreneurship, regulation, the role of standards, the cost and availability of R&D labor, the presence of lead markets, and so forth.

There does exist considerable evidence on the rates of return to R&D for firms in individual countries. We have collected these estimates on a single chart shown in Figure 3. This figure shows cross-sectional estimates for the private gross rate of return to R&D capital from a number of European countries (France, Germany, Italy, Denmark, and the UK) along with the US for comparison. The samples of firms used are generally the largest R&D-

⁸ OECD (2008). *OECD Science, Technology and Industry Scoreboard 2007*. Paris, France. Relative to GDP, these figures are roughly 0.2%, 0.23%, and 0.2% for the EU, US, and Japan respectively.

doers. Although there is considerable dispersion in the estimates, the majority cluster around 0.15 to 0.35.⁹ The figure shows that the return to R&D in large EU firms have been generally below those for US firms in the period since the mid-1990s, ruling out the high cost of capital explanation for firms that already do R&D.¹⁰ Also note that the data points for 2006 are estimates using data from the EU and US top 1000 firms, and it is striking that the estimates for these samples, which are based on similar methodologies, are so close.

The conclusion of this analysis is that for the large firms that do R&D, rates of return are not obviously different between the EU and US. Any underperformance must lie elsewhere. Evidence from Cohen and Lorenzi (2000) suggests that one difference between the EU and the US is the number of young firms among the large R&D-doers in the latter region.¹¹ That is, among the top 200 R&D-doing firms in the US, accounting for 80% of business R&D, almost half are 20 years old or younger and started quite small.



5. The debate

When taken together with the previous work on these questions by O'Sullivan, the preceding analysis reaches the following conclusions:

1) There are fewer ICT firms in Europe, and ICT is very R&D-intensive, which explains a large share of the differences in business-funded R&D shares.

⁹ One reason for the high variability is that the methodologies used to obtain the estimates are not always identical; a second reason is that *ex post* rates of return to R&D are estimated imprecisely and may vary greatly over time, reflecting the uncertainty inherent in innovative activity.

¹⁰ ICT firms generally exhibit higher (gross) rates of return due to the rapid depreciation of R&D investment in that sector. Therefore we would expect the average rate of return to be somewhat lower in the EU than in the US, reflecting the lower ICT share of the R&D-performing sector.

¹¹ Cohen, E., and J.-H. Lorenzi (2000), *Politiques industrielles pour l'Europe*, rapport du CAE, no. 26, La Documentation française.

2) Even among non-ICT firms, there are fewer innovators applying new ICT technologies to other sectors, and those there are do not grow large.

3) Related to point (2), there are fewer young European firms among the large R&D-doers.

4) It is possible that the R&D deficit is not solely due to business-funded R&D.

Nevertheless, the following appear to be true and rule out simple explanations:

1) According to sources from corporate statistics average returns to R&D are not obviously higher (or lower) than in the US for those firms that do R&D.

2) Roughly the same amount of R&D is conducted by SMEs in Europe as in the US or Japan.

Therefore, it is natural to ask whether the problem is with R&D *per se*. Or should one look elsewhere for the explanation of what appears to be weaker innovative performance, perhaps at differences in labor or entry regulation, or at the failure to create a Venture Capital sector that is capable of financing fast-growing firms, or at some other cause?

R&D spending as investment

R&D spending is both similar to and different from ordinary investment. The similarity is that it is expenditure undertaken today to secure (uncertain) returns in the future, which is why it is referred to as “R&D investment” and why analysis of the R&D decision frequently uses the tools of investment analysis. The differences lie in the level of uncertainty, which is much larger, the public good nature of much research (it is useful to other firms as well as to the firm that performs it, and the fact that once done, the information produced can be used at almost any scale).

A second difference between R&D and ordinary investment creates some difficulties for analysis and interpretation: in the case of R&D, there is no well-developed secondhand market that would allow us to infer the price of R&D separately from its quantity, and to establish an independent measure of depreciation. Therefore R&D spending is usually deflated by the overall GDP deflator, and no account is taken of increases or decreases in its productivity in creating a stock of firm-based knowledge. This is why the analysis of the supply and demand for R&D is in terms of nominal rather than real quantities.

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Policy Briefs are delivered by the "Knowledge for Growth" Expert Group advising the Commissioner for Science and Research, Janez Potočnik. For more information on the Expert Group, see http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm.

How to better diffuse Technologies in Europe

Georg Licht¹

The Lisbon Strategy puts emphasis on R&D policies with its 3% target in order to become the most knowledge intensive economy. These goals of the Member States within the European Research Area could be supported by increased technology diffusion policies such as:

- *Setting up knowledge transfer institutions,*
- *Development of Higher education and lifelong learning,*
- *Awareness arising about technology diffusion management,*
- *FDI encouragement for knowledge transfer and best management practices.*

Diffusion policies would be of benefit in particular to the catching-up countries that lack resources to reach the 3% target and need to develop absorptive capacities to adopt advanced technologies faster.

The member countries of the European Research Area (ERA) and the EU Commission have put innovation at the top of the policy agenda. The Lisbon Strategy includes the ambitious 3% target for national R&D intensity and national governments have turned this into their own national goals. Governments have begun new initiatives and new policies to increase spending on R&D by both public and private sector. Supporting R&D and, thus, invention and innovation, is just a first step. To achieve additional employment and income growth, R&D must be transformed into new products, processes and technologies which are adopted by firms, households and governments. The factors which enhance the implementation of new knowledge can be quite different from the factors which stimulate invention and innovation. The question at stake for catching-up countries may be in view of economic growth and employment

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the priority for investments in technology creation by R&D or investments in institutions that favour the diffusion of technology.

Invention, innovation and diffusion are not necessarily intertwined. The history of technology is full of examples demonstrating that countries, firms and individuals which were leading in invention are not necessarily also leading in innovation or in the widespread diffusion of new technologies. One well known example is the fax machine, which was first developed in Germany but was turned into a worldwide successful product by Japanese companies. Similarly, the anti-lock brake system (ABS) was invented by US car makers but became prominent primarily due to German automotive suppliers.

The worldwide diffusion of Information and Communication Technologies (ICT) has significantly reduced the barriers to access information and has speeded up the diffusion of knowledge on recently developed technologies. This might make one think that the location of invention is no longer important to the successful transformation of invention into employment and income growth.

First of all, the fashionable idea that we live in a completely networked, dematerialised information society is not the best starting point and not a satisfactory basis for policy making. The adoption of a new technology often takes longer than the diffusion of knowledge. Diffusion of innovation is still a gradual process involving significant time and adjustment costs. Often, old and new technologies exist in parallel for a long period during which both are incrementally improved and adjusted.

Empirical evidence suggests that technology diffusion still has a locational component. Innovations are usually generated in high-income countries which are also the starting point for diffusion. Neighbour countries, trade partners (especially in the field of advanced capital goods) or countries with strong social ties to each other more rapidly adopt new technologies from the leading countries.

However, the speed of convergence of international technology adoption has significantly increased in the last decades. And so, the time advantage from which countries can profit from faster technology adoption has now become notably smaller. Despite a considerable heterogeneity across technologies, the overall pattern of international technology diffusion suggests that countries which are leaders in the adoption of a forerunner technology will also become leaders in the adoption of the next generation technology. In view of ERA this trend may receive policy attention to offering development potential for catching-up regions and countries.

To improve technology diffusion, the absorptive capacities for new technologies have to be increased. In this context, knowledge transfer institutions play a crucial role like for example the Fraunhofer institutes in Germany, TNO in the Netherlands or Innova in Sweden. In addition to

supporting knowledge transfer institutions which also may have a role in R&D, governments should also target three policy areas, namely education, the improvement of management practices, and FDI as a mechanism for technology diffusion.

- **Support technology diffusion by investments in education**

Several studies have frequently examined the role of human capital in technology diffusion. Economies with highly educated workers may be more capable of quickly and efficiently adopting new technologies. Therefore, the most obvious candidate to explain the successful adoption of technologies is the level of education of the workforce.

Looking at more recent technologies, *tertiary education* plays an important role in fostering technology diffusion. For example, empirical studies suggest that the diffusion of ICT is strongly enhanced by a sufficient supply of workers with at least a college degree. Hence, investment in education represents one major building block not only for future innovation but also for technology diffusion.

In order to exploit the full potential of new technologies, no longer the specific skills with respect to a specific technology but the ability to learn and to reconfigure skills is essential. Generally speaking, diffusion and adoption of successive generations of technologies is enhanced if the initial investment in education takes the form of *general human capital* rather than (technology-) specific human capital. A significant stock of human capital which is only related to a specific generation of technology might give rise to technological lock-ins which prevent or retard the adoption of new technologies.

Moreover, *lifelong learning* is also crucial for technology diffusion. Governments should provide incentives for employers and employees to invest in education and re-training to prevent lock-ins and to keep the existing stock of human capital in line with the diffusion of new technologies.

- **Improve management practices for technology diffusion**

The overall performance of most countries is determined not by the performance of its best managed companies, but by the size of its "tail" of poor performers. This means that management practices are essential for the efficient use of the labour force's competences and the opportunities generated by the adoption of new technologies. Empirical evidence shows that the diffusion of organisational innovations (e.g. management practices) is slower than the diffusion of new technologies. A recent international survey of management practices conducted by the London School of Economics and Political Science (LSE) indicated that, in comparison to EU firms, a larger share of US firms implements management practices which help to *adopt ICT effectively*. This advantage is especially prominent in

human resource management practices – an area which is important for knowledge economies.

- **Regard FDI as a mechanism for technology diffusion**

With respect to the improvement of management practices, *Foreign Direct Investment (FDI)* plays an important role in knowledge transfer. Foreign-run companies can be a driving force for the regional adoption of international best management practices.

Moreover, competition significantly stimulates the adoption of such practices. By developing environments that promote best management practices across all firms and by paying as much attention to the laggards as to the leaders in the business sector, governments can drive the competitiveness of their entire economies.

How can technology laggards in the European Research Area be advanced?

The welfare generated by new products, processes and technologies results mainly from their widespread adoption throughout the economy. A significant share of the associated costs refers to development and early adoption stages. This raises the question as to whether strong R&D performance is necessary for the broad diffusion of new technologies. The vast majority of firms will never undertake R&D but adopt new technologies by investing in capital goods, learning from others, etc. This free-riding seems to be a useful strategy for technology laggards at first sight. However, a free-rider policy that only emphasises the adoption of technologies developed in other countries will not be effective without significant national R&D. This is because countries need an absorptive capacity to adopt new technologies. In the case of General Purpose Technologies this is especially true, i.e. new technologies that affect the entire economy such as ICT, where co-inventions and modifications are needed to realise the full potential of the technology. Hence, innovation policies and diffusion policies are rather complements than substitutes. Both policies can be justified on the basis that they address market failures such as imperfect information, market structures, and externalities. Despite this, diffusion policies are far less common than R&D policies.

Diffusion policies stress the importance of creating an infrastructure which supports the rapid spread of awareness and knowledge of innovations. Such policies primarily address small and medium-sized enterprises (SMEs). Typical programmes in this field should include the following:

- To provide consultancy services to SMEs in order to facilitate the adoption of specific technologies
- To encourage the formation of clusters of regional firms in order to facilitate the interchange of knowledge and ideas and to promote networking

The importance of R&D policies has already been underlined by the 3% target of the Lisbon strategy. However, for diffusion policies remains a further need for action for policy makers. Technology diffusion has particular relevance for technology laggards. As a first step, mutual learning may emerge from the evaluation of technology diffusion policies in the regions and the exchange of results.

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http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

Technology and Specialisation: Strategies, Options and Risks

Tassos Giannitsis¹

Technical change and innovation have been powerful engines for enhancing 'dynamic' specialisation advantages of firms and industries and constructing 'differences' vis-à-vis competitors, achieving cumulative growth, rents and power. In a period of crisis, specialisation strategies can be conducted in ways that also enhance innovative specialisations and competitive advantages in the post-crisis period, facilitate repositioning strategies and underpin answers to severe global risks (e.g. energy shortage, climate change).

Specialisation strategies are based on technical change and innovation and they contain options and policy risks. Therefore, strategies have to consider the heterogeneity of research and technology specialisation patterns in the EU as well as divergent policy goals. Also, a distinct and adapted strategy is required responding to the related risks and opportunities. Eventually, the policy action should consider a risk management approach and draw on the concept of "portfolio management" adjusted to RTD policies.

1. The heterogeneity of research and technology specialisation patterns in the EU, and policy goals

The lagging position of the EU in frontier technologies coupled to its internal diversity resulting from the different research and technological capabilities of its member countries are at the origin of many policy concerns at both the E.U. and the national level.

¹ Professor at the University of Athens, Department of Economics. This Policy Debate Brief is mostly based on the report of T. Giannitsis and M. Kager, "Research and Technology Specialisation: What policies?", and T. Giannitsis, "Towards an Appropriate Policy Mix for Specialisation", in: D. Pontikakis, D. Kyriakou and R. Van Bavel, "The Question of R&D Specialisation: Perspectives and Policy Implications" (to be published, 2009). The views expressed here are those of the author and do not necessarily reflect those of the European Commission.

In fact, the EU's position in emerging technologies is likely to replicate the experience with ICT and bring Europe once again in the position of a laggard. It appears that there is a structural barrier preventing Europe to become leader in emerging frontier technologies. In many areas European technology advancement appears to be comparatively either "too little" or "too late". What is the policy lesson? Is it possible to reverse this trend and how? Can either a positive or a negative answer be given at zero social cost or risk? If not, what are the policy implications?

External and internal divergences justify different mixes of approaches to specialisation rather than one-size-fits-all strategies. The EU's strategies are focusing on three major challenges:

- to make the EU "the most dynamic and competitive knowledge-based economy in the world",
- to narrow internal discrepancies and enhance convergence, and
- to deal with global risks and prevent large systemic risks in areas of major public concern such as energy and climate change.

However, issues to be dealt with are not only technological. They are more complex, linking effective governance, coordination of research and technology policy, knowledge building and the shaping of productive processes. In addition, knowledge and technology factors are not related to specialisation in a linear way, making the game of who can create competitive positions complicated. In fact, technology factors are integrated into the different parts of the complete value chain of firms in very different ways. The success depends on how technology inputs interact with very diverse locally available labour forces, capital or other inputs and, in particular, the prices of these. The reality shows that firms can achieve diverse combinations between technology and the various elements of their value chain and construct very different and unpredicted specific or niche competitive advantages.

2. Three different strategies

Different goals call for different technology- and innovation-related specialisation strategies. Three main strategies can be identified:

- a) Strategies for technological leadership (strategies aiming at the frontier),
- b) Catching-up strategies for (fast or slow) followers,
- c) Preventive strategies to address global risks.

The implementation of all three types of strategy can take a more targeted (pro-active) or a more neutral (re-active) form. In particular, strategies to enhance specialisation in emerging technological fields (type a and b) raise a dilemma between selection and non-selection in the policy-making process. It can be argued that the goal to aim at the frontier and to address global

challenges seems to favour a policy mix with more pronounced targeted approaches, while catching-up strategies call for rather more horizontal policy mixes. However, it would be misleading to consider specialisation policies in absolute and/or dichotomic terms. In fact, even neutral policies include selections. What determines the success is the pragmatic mix between active and neutral approaches and the interactions between policy and its environment. Additionally, the more technologically advanced the environment is, the more these strategies coexist within the same national space, as they serve the parallel goals of the same actor.

In addition to the production of technology, specialisation policies should also give emphasis to diffusion aspects, which are often underrated. In the presence of weak trickle-down mechanisms, new technologies and knowledge will have a limited success in leveraging new specialisation, competitiveness and growth. Diffusion of technologies, for different reasons, is crucial for both, convergence strategies and strategies aiming at the frontier.

(a) Strategies aiming at the frontier

The rationale:

- Early specialisation in emerging technological and the related productive areas leads to significant benefits of both economic and non-economic nature,
- Frontier technologies develop over many decades and historical experience shows that rarely, if ever, such technologies can develop without strong public support mechanisms,
- Risk-aversion policies leading to latecomer positions in core technologies often have adverse implications for growth, employment and competitiveness, which last for a long time, are difficult to reverse and affect economic and social performance.

The dilemma: Specialisation strategies aiming at the frontier unavoidably raise a selection dilemma: which areas to enhance? The Lisbon strategy implicitly calls for policies to develop capabilities on those scientific and technological trajectories, the dynamics of which drive forward economic growth and welfare. Hence, the various high-tech areas (and, selectively, for medium to high-tech) implicitly occupy a central place in the implementation of the Lisbon and ERA strategies. In fact, various thematic areas and other initiatives constitute significant priorities of the Framework Programme or of the EU's broader research and technology policy.

The risks: Technology and innovation policies along these directions imply different risks. Policies aiming at frontier technologies face increased risks because of weak path-dependencies. The high uncertainties for private

actors in such situations can make intervention appropriate, but not necessarily any less risky.

The options: To deal with such risks, policy could be structured along three broad axes:

- a) To target ‘winning situations’, by leveraging the success of clusters of market players in particular technological, knowledge and specialisation areas, based on market-led pre-selection, the evolving market evidence and in cooperation to market agents. What matters is to spark and to underpin a self-sustained cumulative development of new specialisations.
- b) To broaden the policy spectrum by “evolutionary targeting”², in the sense e.g. to assure a critical mass of capable market agents, to target the emergence or to leverage the success of new multiagent structures (or clusters) in particular areas, and
- c) to combine a) and b) with smart policy initiatives and specialisations.

The concept of smart specialisation³:

- indicates a successful fine-tuning of policies envisaging the creation of innovative competitive units, clusters and/or regions,
- implies interventions and, hence, some explicit or implicit targets coupled to an intended concentration of resources in some form,
- makes necessary financial support mechanisms, which can generate extensive positive social externalities in the future,
- assumes that there are criteria to judge which specialisations and, consequently, which policy targets are smart.

The weak point is that, in particular regarding new technological areas, smart policies can be acknowledged as such only after their success becomes visible, while ex ante it is very difficult to define success criteria and to assess the combined outcome of market and policy processes.

b) Preventive strategies to face global risks:

In this phase, societies are faced with the need to develop technological solutions for dealing with qualitatively new global risks (climate change, energy, environmental issues), which enter more and more in the world

² Avlamelech, D., and M. Teubal (2008), "Evolutionary targeting", Journal of. Evolutionary Economics, 151-166.

³ D. Foray, ‘Les nouveaux centres mondiaux dans le domaine de la recherche et de l’innovation: vers une économie de la spécialisation intelligente (FutuRIS, 2008)’ and ‘Understanding “smart specialization” (July 2008)’.

agenda⁴. The crisis accelerated this process. In fact, what is at stake today for leading actors differs from the race to create new knowledge as an engine for growth? The difference is that there is an urgent social demand to find solutions within predetermined time limits, if social costs have to be kept within an acceptable range.

One difficulty is that in the case of expected global risks it is inherently difficult to have an ex ante measure of what is success or failure. How to measure future costs and benefits e.g. from the development or not of alternative energy technologies? Nevertheless, policies of selection and risk taking are necessary - 'non-selection' will also have risks and costs. The risk of inaction or of delay in the support of advancing critical technologies could be larger than the cost of action. It could be significant in terms of growth, income, employment, competitiveness, market positions and environmental degradation. It could have adverse economic and social effects nationwide and EU-wide.

In such a blurred landscape, a significant difference between more targeted and neutral specialisation strategies might be that for the latter, broader systemic failures to meet timely major risks, can become a certainty rather than being only a probability. The issue is that additional criteria for decision making are necessary, but of which kind?

c) The catching-up and the convergence issue:

In contrast to advanced technology systems, the absence of co-evolutionary processes between technologies, institutions, business activities and public policies in technologically weaker players increases the policy risks and uncertainties, in particular in the case of more targeted interventions. Equally, in weak technology systems the cause-effect relationship between specialisation and technological mastery is reciprocal. For technology specialisation to be transformed into competitive advantages there is also need of a sufficient level of expertise over the broader scope of the related technological base. Hence, while the weak market signals increase the unpredictability of where it might be good to specialise, policies regarding followers should be flexible, gradual and avoid the risk to prevent or to deter efforts to build capabilities and specialisations in promising fields.

Notwithstanding successful examples, horizontal policies appear to be a less risky approach for technologically weaker systems. They generate decentralised selection mechanisms, learning processes and a diversification of specialisation patterns, while they also facilitate innovative forms of combinations between technological knowledge and local factor capabilities.

⁴ "European research policy ... besides the pursuit of scientific excellence, should support knowledge advancement and dissemination and underpin policies ... in fields of major public concern such as health, energy and climate change" (ERA Green Paper).

From a different perspective, however, EU's strategic choices regarding frontier technologies or technologies targeting global risks should avoid restraining followers from developing new capabilities for these countries' technology areas. Technological evolution and application are non-deterministic and even what appears as duplication often creates diversity and distinctive capabilities and/or new opportunities. In other words, although targeted policies can be appropriate in a positive sense (e.g. to support the acceleration of technological advancements), they can have adverse effects if their consequence is to raise barriers, to concentrate resources in leading areas, to exclude certain actors, to limit windows of opportunity, the building up of new capabilities or the development of specialisations of followers in promising technology areas.

3. What are the choices and how to deal with the risks?

Frontier research is not a question of the spending as a percentage of GDP but of having smart goals and policies as well as appropriate, absolute amounts of financial and human resources. Evidence shows that voluntary top-down approaches have often failed, but also that neutral policies often have a failure cost, but that this is less transparent. The success of both, target-related and neutral strategies depends largely on the articulation of the policy mix and the definition of the objectives.

Faced with these different asymmetries of information, risks and opportunities, policy making can be addressed as a risk management issue drawing on the idea of *'portfolio management'*, adjusted to RTD policies. Portfolio management approaches favour variety and selection mechanisms. It can reduce risks and assess the multiple research and technology objectives on the basis of such criteria as financial cost, probabilities of success, externalities and/or social costs and benefits. The question is how to shape targets and choices, to better reflect a politically decided balance of policies, social risks and benefits. In view of the three major EU challenges the question are: if and what new policy concepts have to enrich or to enhance the existing policy-making process, and how policy could better succeed in organising a flexible and diversified framework and implementing specialisation targets.⁵ Success is determined by the co-evolution of a range of elements, such as:

- An appropriate coordination at European level of public organisations, business firms and research communities,

⁵ Pro-active policies at the EU (and national) level can aim at a 'research friendly ecology' (Georgiou, 2007), combined selectively with a 'cluster-specific environment'.

- The design of priorities on selected areas and a package of policies to support the research activities of firms and organisations and to cooperate closely with the business sector and the scientific community in detecting needs, capabilities, technological trends, key discoveries, possible advancements,
- For the evaluation of success, the selection of priorities as well as other policy strategies has to consider externalities - positive as well as negative ones - like climate change, energy supply and environment issues. Within the concept of portfolio management, the effects of these externalities have to be explicitly taken into account,
- The broadening of criteria on the basis of which the success of research and technology specialisation policies can be assessed,
- The enhancement of variety creation and the selection and support of differentiation elements vis-à-vis competitors.

The ERA can facilitate the development of a range of high-tech milieus with internal and external interactions, linkages with business partners, public research organisations and communities of joint research and technology targets. Such poles of excellence could support the promotion of emerging new technologies with crucial economic and/or social implications. The development of such high-tech milieus is justified from the critical mass of resources (financial and human, physical and soft infrastructures) which are needed but cannot be provided in the framework of existing policies at lower levels of governance. In such a way, the ERA can enhance research and technological change, enabling both the leveraging of continuous change, adaptation, and competitive strengthening of industrial structures as well as the unfolding of emerging new technology fields.

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http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm.

Smart Specialisation – The Concept

Dominique Foray¹, Paul A. David² and Bronwyn H. Hall³

This brief introduces the basic concept of "Smart Specialisation" (SS) which has been a leading idea of the Knowledge for Growth expert group (K4G). The concept is spelled out in more detail in Policy Brief N° 1 in relation to globalisation. Other K4G Policy Briefs that refer to the concept are those on Catching-up Member States (N° 5) and on technology and specialisation (N°8).

Rationale for invigorating the R&D specialisation policy discussion

Addressing the issue of specialisation in the R&D and innovation is particularly crucial for regions/countries that are not leaders in any of the major science or technology domains. Many would argue that these regions/countries need to increase the intensity of knowledge investments in the form of high education and vocational training, public and private R&D, and other innovation-related activities. The question is whether there is a better alternative to a policy that spreads that investment thinly across several frontier technology research fields, some in biotechnology, some in information technology, some in the several branches of nanotechnology, and, as a consequence, not making much of an impact in any one area. A more promising strategy appears to be to encourage investment in programmes that will complement the country's other productive assets to create future domestic capability and interregional comparative advantage.

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One simple idea

It should be understood at the outset that the idea of smart specialisation does not call for imposing specialisation through some form of top-down industrial policy that is directed in accord with a pre-conceived “grand plan”. Nor should the search for smart specialisation involve a foresight exercise, ordered from a consulting firm. We are suggesting an **entrepreneurial process of discovery** that can reveal what a country or region does best in terms of science and technology. That is, we are suggesting a learning process to discover the research and innovation domains in which a region can hope to excel. In this learning process, entrepreneurial actors are likely to play leading roles in discovering promising areas of future specialisation, not least because the needed adaptations to local skills, materials, environmental conditions, and market access conditions are unlikely to be able to draw on codified, publicly shared knowledge, and instead will entail gathering localized information and the formation of social capital assets.

This activity poses a public policy problem. The discovery of pertinent specialisation domains has high social value because it helps to guide the development of the region’s economy. But the entrepreneur who makes this initial discovery will only be able to capture a very limited part of his investment’s social value because other entrepreneurs will swiftly move into the identified domain. Furthermore, entrepreneurial individuals that are well-placed to explore and identify new activities often will not have sufficient external connections to marketing and financing sources and are likely to find themselves in a weak position when negotiating with these external parties for the resources need to expand their young enterprise, reducing their incentives to enter in the first place. Thus there is a potentially serious incentive problem that is not susceptible to resolution by resorting to protection via intellectual property rights. The resulting tendency toward under-investment in this particular type of “discovery process” warrants considering what corrective role can be filled by public policy measures to support greater engagement on the part of locally situated entrepreneurs.

Beyond trying to address this incentive problem, policy makers should accept that their role in “selecting the right areas for specialisation” may be a more modest one than is usually envisaged when support for infant industries and support for technology start-ups are under discussion. Public entities can play an important infrastructural role by providing and collating appropriate information about emerging technological and commercial opportunities and constraints, product and process safety standards for domestic and export markets, and external sources of finance and distribution agencies. Assisting local entrepreneurs to coordinate in forming mutually reinforcing connections and pool generic knowledge that will accelerate this discovery process may also be helpful activities.

One simple tool

The specific properties of *General Purpose Technologies* (GPTs) define a framework that helps to clarify the logic of Smart Specialisation (SS). While major innovations often result from the commercialization of a core GPT invention, and its successive technological elaborations – such as the double-condensing steam engine, the electric dynamo, the internal combustion engine, or the micro-processor, there are myriads of economically important innovations that result from the « co-invention » of applications (steam-ships and locomotives, arc-lamps and AC motors, etc.) In fact, the characteristics of a GPT are horizontal propagation throughout the economy and complementarity between invention and application development. Expressed in the words of an economist, invention of a GPT extends the frontier of invention possibilities for the whole economy, while application development changes the production function of a particular sector. Application co-invention increases the size of the general technology market and improves the economic return on invention activities relating to it. There are therefore dynamic feedback loops in accordance with which inventions give rise to the co-invention of applications, which in their turn increase the return on subsequent inventions. When things evolve favourably, a long-term dynamic develops, consisting of large-scale investments in research and innovation whose social and private marginal rates of return attain high levels. *This dynamic may be spatially distributed between regions specialised in the basic inventions and regions investing in specific application domains.*

This framework suggests strategies that can be pursued with advantage both by regions that are at the scientific and technological frontier, and by those that are less advanced. While the *leader regions*⁴ invest in the invention of a General Purpose Technology (GPT) or the combination of different GPTs (bioinformatics), *follower regions* often are better advised to invest in the « co-invention of applications » – that is – the development of the applications of a GPT in one or several important domains of the regional economy. Some examples would be biotechnology applied to the exploitation of maritime resources; nanotechnology applied to the wine quality control, fishing, cheese and olive oil industries; information technology applied to the management of knowledge about and the maintenance of archaeological and historical patrimonies. By so doing, the follower regions and the firms within them become part of a realistic and practicable competitive environment – defining an arena of competition in which the players are more symmetrically endowed, and a viable market niche can be created that will not be quickly exposed to the entry of larger external competitors. The human capacities and resources formed by the region, thanks in particular to its higher education, professional training and research programmes, will constitute « co-specialised assets » – in other words the regions and their

⁴ We distinguish between "leader regions" that master the technological frontier, follower regions that are able to catch up to a leader region and laggards who struggle to build up absorptive capacities to apply advanced technologies (see Policy Brief N° 5 on catching-up countries).

assets have mutual needs and attraction for one other – which accordingly reduces the risk of seeing these resources go elsewhere.

Implementation and policy

Finally, **there is a role for governmental S&T policies**, but it is not that of bureaucratically selecting areas of specialisation and fostering the development of “national champions” in inter-EU competition. Instead, governments have three main responsibilities:

- Supplying incentives to encourage entrepreneurs and other organisations (higher education, research laboratories) to become involved in the discovery of the regions’ respective specialisations. The incentive framework is essential since the social value of the knowledge produced is very high and entrepreneurs who make this kind of discovery are likely to capture only a negligible share of this social value.
- Evaluating and assessing effectiveness so that the support of a particular line of capability formation will not be discontinued too soon, nor continued so long that subsidies are wasted on otherwise non-viable enterprises. The challenge is to prevent the evaluation process from being captured by the interests that are benefiting from the programme or by rivals who would like to see it discontinued. So the national agency in charge of this policy should confine themselves to ascertaining whether two criteria are satisfied before initiating the usual policy tools to support R&D and innovation: i) what is the potential of the GPT to regenerate the targeted economic domain (production or services) through the co-invention of applications? ii) Is the size of this domain large enough (the size refers here not to GDP but to the size of the **relevant** sectors in the economy, that is, those sectors that could potentially benefit from the knowledge spillovers from the initial development of applications)?
- Identifying complementary investments associated with the emerging specialisations (educational and training institutions, for example) in the case of a region investing in the co-invention of applications of a General Purpose Technology (GPT). Supporting the provision of adequate supply-responses (in human capital formation) to the new “knowledge needs” of traditional industries that are starting to adapt and apply the GPT, by subsidizing the follower region’s access to problem-solving expertise from researchers in the leader region, and by attending to the development of a local personnel that can sustain the incremental improvement, as well as the maintenance of specialised application technologies in the region.

It will help to provide an example that illustrates the ways in which national public policy has an important role in supporting and accompanying emerging trends in smart specialisation. The Finnish Pulp and Paper (P&P)

industry views nanotechnology as promising source of valuable applications innovations, and its firms are taking steps to assess this potentiality. Some of the P&P companies are responding to these opportunities by increasing their overall internal R&D investments, which are aimed not only at implementing available technologies but also would explore recent advances in areas of nanotechnology and biotechnology. Analysing this development along the two criteria mentioned earlier (the potential of the GPT to renew the knowledge base of the industry and the size of the sector that could benefit from the spillovers generated by the initial discovery), there is an obvious role for national policy in enhancing the whole process and mitigating some of the problems (such as lack of human capital) that could impede the full realisation of the potential for disruptive technological change in this “old industry”.⁵

Many incentive and coordination problems can arise in such a situation, because working with “an old industry” in a remote region is not likely to hold great attractions as a career move for the scientists, engineers and business managers that are in the “leader regions,” yet access to their knowledge may be vital in the early stages of the “application enterprise.” How does one help solve this problem in a “generic” fashion that does not turn into a government subsidy for the development of a particular industry in a specific region? This is one instance of a class of difficult issues that frequently occupy the attentions of economists and experts from international organisations like the World Bank that work in developing regions. Possibly the resolution in this case lies in the idea that there are phases in smart specialisation where temporary “industrial policy” measures, such as infant industry policies, are warranted.

⁵ Nikulaien (2008) shows how patent data can be used to a certain extent to assess the progress of the industry toward smart specialisation by looking at the increase in patent applications by P&P firms related to nanotechnology. See T. Nikulainen, "Open innovation and nanotechnology - an opportunity for traditional industries", Working Paper, The Research Institute of the Finnish Economy, Helsinki, 11 April 2008.

Expert Group “Knowledge for Growth” (Knowledge economists – K4G)

In 2005, Commissioner Potočník established a group of prominent economists in the field of ‘Knowledge for Growth’, called the ‘knowledge economists’, in order to provide him with high-level advice on the contribution that knowledge can make to sustainable growth and prosperity and related policy aspects in order to support the Lisbon Strategy goals. The K4G Expert Group meets three times a year, under the chairmanship of the Commissioner. The Commissioner appointed Prof. Dominique Foray as Vice-Chairman to lead the work of the Group.

As a matter of fact, the Group decided not to undertake original research, given that all members have their own research agenda and are also heavily involved in other types of professional activities. The mode of operation of the Group was, therefore, more that of a forum where members of the group present written contributions based on existing knowledge and data, which are then critically discussed at various stages. The final outcome is a *report* developing a policy structured discussion. Each report is complemented with a *policy brief* that summarises the key messages.

The Reports and Policy Briefs may be downloaded from:

http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

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