Knowledge intensive growth:
European Strategies in the Global Economy

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Research and entrepreneurship: A new innovation strategy for Europe

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Foreword

Two years from the term of the Lisbon strategy, the EU remains quite far from its objective to become "the most competitive knowledge-based economy in the world". Despite increased financial efforts in recent years and structural reforms being implemented in a number of countries, Europe has not significantly improved its position in the global knowledge economy. The gap with the U.S. has not narrowed, while some emerging countries rapidly increase their capabilities in higher education and research. Companies have adapted to this new phase of globalization by developing global innovation networks spanning both developed and emerging countries. In this challenging global environment, Europe risks falling behind. EU political, economic and scientific leaders declare their conviction that stronger innovation capability is key to sustainable economic performance and high standards of living in Europe. Some European countries have already launched ambitious innovation strategies and made substantial progress

In this context, the French Presidency of the European Union organises a conference to stimulate the debate about a European innovation strategy. The conference draws on the European experience since 2000, on recent research on the knowledge economy and on inputs from companies on their R&D practices in order to identify the building blocks of a European strategy for innovation-based growth. The purpose is first to discuss evolutions of European innovation systems with an integrated approach, taking full account of the interactions between public and private research, between research and higher education or between research and economic mobility. The conference is also designed to discuss the contribution of the European Research Area to such a strategy.

This discussion paper is a contribution to this conference and to the debate over a European innovation strategy. It first emphasises neglected issues in the debate over the EU R&D deficit. Most of the paper is then devoted to proposals aiming at promoting innovation in Europe. The final objective is to increase the sustainable growth potential of Europe. A specific proposal relates to the creation of ERA global challenges programmes. The idea is that ERA can boost to innovation in Europe and enable Europe to contribute to solving global challenges.

An expert group was set up to discuss the analysis and the proposals put forward in the paper. Besides, the paper draws on recent studies, on contributions supported by the European Commission on the development of the ERA and on reflection conducted at the OECD as part of its "Innovation Strategy". This document reflects the personal views of its authors only and not necessarily the views of the organisations in which they work or the views of the experts consulted.

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Summary

R&D intensity remains below 2% of GDP in the EU - despite the 3% target included in the Lisbon strategy. This poor performance is not due to inaction, but rather to an incomplete policy mix to implement the Lisbon Strategy resulting in Europe's inability to promote the emergence and growth of innovative businesses in new sectors (new technologies and services). This inability is related to two major problems. First, academic research is insufficiently funded, but also often below world excellence, insufficiently flexible and open to social and economic demand. Second, new innovative businesses face difficulties in accessing capital and markets.

This discussion paper makes a number of recommandations in order to promote research and entrepreneurship in Europe. These propositions require joint efforts from the member states and the Union.

- Supplement the 3% R&D target with three objectives, which would draw political attention towards major determinants of R&D intensity. Two objectives relate to results to be achieved by 2020:

  * Europe will have 15 universities in the top 50 worldwide, ranked according to the quality of their research, including 5 in the top 20;

  * 30% of EU business R&D will be conducted by companies created after the year 2000.

  The third objective relate more directly to political decision: 30% of the EU budget will be allocated to research, innovation and higher education

- Allocate Framework Programme funds solely on the basis of the quality and relevance of the projects, and extend this principle to research and innovation projects financed by Structural Funds.

- Develop a thorough evaluation system to assess the impact of EU R&D funding.

- Establish a *European New Business Act* (NBA), which would ensure new businesses (as opposed to small businesses) access to a certain share of public procurement in R&D.

- Establish the Community Patent and promote the development of markets for technology in Europe.

- Set *global challenges ERA research programmes.* These programmes will support innovation to face global challenges (environment, health, energy, food security, etc.) and will be funded through the relevant sectoral budgets. They could be coordinated with their national counterpart, so as to strengthen the ERA.

Research and entrepreneurship: A new innovation strategy for Europe

Two years from the term of the Lisbon strategy, which aimed at making Europe "the most competitive knowledge-based economy in the world", the progress report is middling to say the least. Productivity gains remain slow and R&D investments have not intensified at the EU level. While the United States maintains its leadership in research and innovation, China, India and other emerging countries are engaged in fast-paced catching up. In this mobile and challenging world environment, Europe risks falling behind. It needs to improve its innovative performance to be able to maintain its high level of economic achievement and thus ensure its citizens attractive and sustainable living standards.

The analysis developed below is quite disquieting for Europe as a whole, which should not overshadow the better performance of some countries over the last decade. The most successful countries have managed to stimulate innovation through higher investment and structural reforms. The EU should draw insights from such experiences and recent studies on innovation and productivity growth to elaborate a more consistent innovation strategy.

Diagnosis

There is no "European paradox"

Why is Europe still so far from the goal set in Lisbon, and how can it do to close the gap? Various reports and recent work by the European Commission have already provided convincing answers to this question.[1] This report focuses on two problems, which constitute major structural explanations to Europe's disappointing innovation performance: the organisation of academic research (which needs to improve its quality, flexibility and openness to society), and the weakness of innovative entrepreneurship (which needs better access to funds and markets). The weakness of innovation in Europe is not the result of a "paradox", as was suggested based on the assumption that European academic research was generally world class while its economic performance was dismal. It is rather the logical result of the way Europe's economies operate in their current setup and of previous political choices.

Europe needs to establish an innovation policy that meets two complementary objectives: promoting the creation and growth of businesses in emerging sectors (technologies, knowledge-intensive services) and addressing major global issues (energy, agriculture, health, environment). An academic research system that promotes excellence, flexibility and openness is crucial for both objectives, as are a fluid financial system and a truly unified European market. The allocation of public resources must also promote research and truly encourage new businesses. Pursuing these two major goals will require a consistent policy framework, including, beyond innovation policy, education policy, competition policy, education policy, investment in infrastructures, etc.

The starting point of the analysis is European countries' disappointing productivity growth (Figure 1). National standards of living and the resources an economy can allocate to investment depend on the productivity level. Labour productivity (the ratio of GDP to hours of labour) increased annually by 1.3% in the EU1 between 2001 and 2006, i.e. 0.9% less than in the United States and 0.5% less than the OECD average[2]. Were this gap to persist over twenty years, it would result in a 20% increase in Americans' standard of living relative to that of Europeans. It would mean a weaker position of Europe in the global economy, while emerging countries will continue to catch up. It would also make retirement benefits more difficult to support as the ageing of the population will require ever-greater contributions from the employed workforce. Finally, it would make investment in sustainable development more difficult to support.

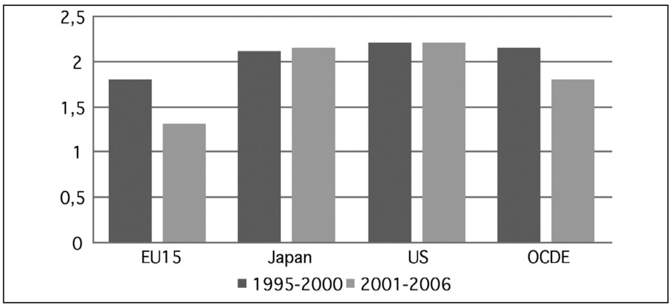

Figure 1. Labour Productivity - Average Annual Growth,%

Source: OECD

Europe's productivity lag has causes that are now well understood: low adaptability of institutions and markets in particular (goods, financial services, labour), fragmented European markets and inadequate investments in knowledge (quantitatively and qualitatively).[3] Innovation has not been high enough on the policy agenda in a number of European countries, where

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1 In particular, Sapir (2004), van Ark and Bartelsman (2004), Aho (2006), European Commission (2007).

2 OECD (2008).

3 Macroeconomic components, such as monetary policy, also contribute to explaining the difference in productivity growth between the United States and Europe.

incumbents and traditional activities have been favoured over new entrants and new business models. Europe's institutional framework, at the EU and national levels, does not promote the allocation of resources to the most productive and promising uses. In order to increase the rate of productivity growth in a sustainable way, Europe will have to create more knowledge – embodied into persons, equipment, businesses, services or technologies – and to implement it efficiently.

This was already the objective of the Lisbon agenda adopted by the EU in 2000, to which was added the quantitative "Barcelona target" of increasing R&D intensity to 3% of GDP by 2010.

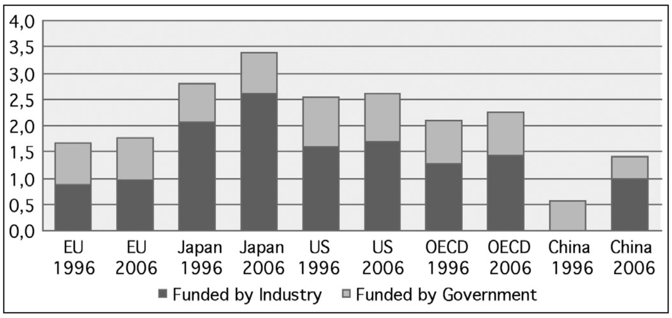

Figure 2. Global Expenditure on R&D as% of GDP by source of funding *Source:* OECD

In 2006, R&D intensity was 1.76% of GDP in the EU27, and 1.88% in the EU15. In other words, R&D intensity has not increased since 2000 (1.74% and 1.85% respectively) and Europe has made hardly any progress towards the Barcelona objective. In 2006, US R&D intensity was also below 3%, at 2.74%. R&D intensity was 3.39% in Japan. Business funded R&D in the EU, for which the Barcelona objective was 2% of GDP, has remained at below 1%. In 2006, business funded R&D share of GDP was higher in China than in Europe.

Europe is slow in entering new sectors

Why does European industry spend less on R&D than others? Various national and European[4] studies point to the importance of the sector distribution within each country. Europe has a low level of specialisation in R&D-intensive activities, such as information technologies or biotechnologies. Business R&D is driven by competitive constraints: in order to defend its market share or gain a larger one, a company has to keep up with its competitors' R&D spending. In this sense, the demand for R&D largely depends on sector characteristics, e.g. it is high in fields relating to information technology and low in the construction or restaurant industries. A country or area in which the economic activity has a higher demand for R&D will logically have a higher R&D intensity. The fields with the highest demand for R&D are emerging technologies, such as information and communication technologies (ICT, including computer services), biotechnologies and nanotechnologies.

Europe's weakness in emerging technologies may be illustrated by the structure of its patent portfolio, which indicates a "comparative disadvantage" in these fields (figure 2). On the contrary, the United-States exhibits a specialisation in all three emerging technologies, especially in the most recent ones, biotechnologies and nanotechnologies. Japan and Korea are specialised in ICT and nanotechnologies. Denmark is strongly specialised in biotechnologies and Finland in ICT, which suggests that success in emerging technologies is also possible within Europe.

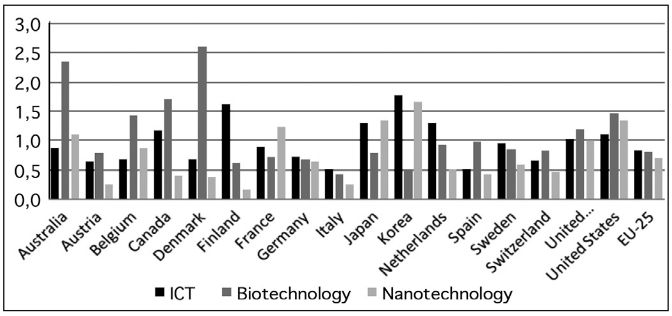

Figure 3. Specialisation in emerging technologies *Source:* OECD

Note: The comparative advantage is calculated as a country's share of OECD patents in a given industry divided by its share of all OECD patents. It takes a value higher (or lower) than 1 when the country takes a comparably higher (or lower) number of patents in the given industry than in other industries.

Europe appears to have missed the window of opportunity of ICT, and then again that of biotechnologies. Nowadays, despite interest and efforts, nanotechnologies develop less rapidly in Europe than in the United-States and some Asian countries. The technological gap in ICT largely explains Europe's R&D. It counts few leading companies in these industries – and not one that could be compared to the American leaders, except perhaps in mobile phone. Yet before translating this observation into policy recommendation, we must try to understand its underlying causes. These technologies were initially developed by new companies, which were born with them; emerging technologies are generally developed by emerging businesses. In 2005, half the business R&D in the United States was conducted by companies that were less than 25 years old[5]. This is a far cry from the situation in Europe: it has not generated a similar wave of high-tech start-ups, nor have new businesses grown into world leaders.

The ICT scenario was repeated with biotechnologies, and may repeat itself once again with nanotechnologies. European high- and mid-high tech companies tend to be long-established large companies or mid-sized leaders on niche markets, such as the German Mittelstand companies. Large incumbents have been able to adapt and transform themselves in response to new opportunities and international competition. The case of Nokia may be the most radical example of such an adaptation. It was a multi-product company until the 1980s, before redeploying all its resources to become a world leader in mobile telephony. The industrial restructuring process that was operated through markets in the United States occurred within compa-

4 In particular, see van Pottelsberghe (2008).

5 Hunt and Nakamura (2007).

nies in Europe. But whereas the United States added new businesses in new sectors to its already long list of world leaders, Europe was transforming its existing companies without generating new ones. The low rate of growth of new firms resulted in an ageing population of companies, whose R&D expenses are relatively constant as long as they do not change their specialisation or business model. The dearth of high growth companies in emerging sectors is thus a major explanation for the persistent R&D deficit in Europe. Moreover, service industries tend to experience an innovation deficit, even though they rely much less on R&D to innovate.

The contribution of entrepreneurship to innovation is unique and can only be partially offset by large companies.[6] New companies are created in order to exploit a specific technological or commercial opportunity, which oftentimes has been neglected by large companies, either because they do not recognise its market potential, or because the new development could threaten their existing activities. As a result, radical breakthroughs tend to be developed by new companies, while existing companies are better at incremental innovation, which strengthen their market positions and skills. They change radically only when faced with market decline, as when Nokia turned to mobile telephony. New technologies emerge thanks to emerging companies. The future giants in the industry appear during the initial stage, and it is not until later, when applications develop, that incumbents may enter the market. If companies do not get born created to develop a new opportunity, it will remain unexploited (especially if it may threaten existing companies), or will be exploited later. In the meantime, consumers will have to wait longer for the new product, or foreign companies may enter the market first.

Large European companies have repeatedly acquired high-tech start ups in the United States. These acquisitions have become a way for incumbents to access technologies they need but have not developed themselves. Having such new companies in emerging sectors in Europe would make the constant adaptation easier for European large companies. Finally, the existence of new entrants – or the mere possibility that new companies may emerge – represents competitive pressures on incumbents, forcing them to invest in innovation. Theoretical and empirical studies have confirmed the role of lively competition in stimulating high tech sectors.[7] As a result of these interactions, systems that hamper the creation and growth of start-ups may also hinder innovation in large companies.

Europe must therefore promote the creation and above all the growth of new businesses – fast-growing firms or *gazelles* – in order to enhance the portfolio of European activities. Moreover, spin-offs (companies created based on academic research) are a highly-effective means of ensuring the transfer of fundamental knowledge from its birthplace to a downstream development site. As fundamental knowledge is often at the origin of radical breakthroughs, the spin-off system offers a means of profitably exploiting investments in public research. The majority of large American companies in ICT or biotechnologies were born on university campuses.

Many empirical studies show that having enough *gazelles* is an essential factor in a country's growth and innovation performance. Between a third and a half of productivity growth in the US manufacturing industry is due to the redistribution of market shares from the least productive firms to the most productive, the creation of (more productive) new firms, and the destruction of the least productive ones.[8] *Gazelles* are more innovative (particularly in Europe's most advanced countries) and export more (particularly in Europe's least advanced countries) than other comparable businesses (same country, industry, initial size).[9] *Gazelles* are more numerous in more recent sectors (ICT services and industry) than in more mature sectors (chemistry, energy). They are a driving force in the development of emerging industries, and are boosted by the numerous opportunities generated by these industries (Hölzl 2008).

By international standards, Europe creates a reasonable number of new firms. According to a recent study by OECD, the rate of start-ups creation with at last one employee (excludes self-employment) in the United States is about 9%, i.e. below the rate of 5 of the 7 EU countries for which the data is available (including the United Kingdom and Italy). Europe's handicap in comparison to the United States is rather that of the low growth for new firms.[10] Another OECD study[11] found that in the United States, companies that survive seven years from their creation date are on average 60 times larger than when they started, whereas in different European countries, they are 5 to 30 times larger.

The relatively low rate of creation and growth of high tech start-ups in Europe can be traced to two main problems. First, academic research does not play the same role in Europe as in the United States; it is not a large reservoir for new ideas, some of which will turn into new businesses. In the United States, quite a number of leading companies in ICT or biotechnologies were born from university campuses. In Europe universities do not offer such a fertile environment, which requires i) academic excellence, ii) the ability to quickly and massively refocus research efforts on new opportunities, iii) openness to the outside world, and responsiveness to demand from society and the economy. Second, business environment for the creation and growth of new firms tends to be much less favourable in Europe. Funding opportunities for new businesses are scarcer (less development of venture capital), and

6 Philippon and Véron (2008).

7 See Aghion (2006).

8 Foster, Haltiwanger and Krizan (2000).

9 Hölzl (2008).

10 Young firms also exhibit relatively slow growth in Japan and Korea.

11 Bartelsman et al. (2003).

goods and service markets are fragmented by country, which increases the cost of entering into small, varied markets. This has a disproportionate impact on *gazelles*, which should be using precious capital to support their fast growth rather than to overcome artificial barriers (large companies already have subsidiaries in different countries and are benefit from distribution networks, etc.). The cost (administrative, legal, financial) of cross-border economic activities is too high in Europe – be it for investment, partnerships or distribution.

Recommendations

Beyond the 3% R&D target

Europe's persistent deficit in R&D is the result of its failure to generate a large population of *gazelles*. In other words, the 3% R&D target cannot be achieved through policies aiming at *directly* influencing business R&D spending, which has its own determinants. Increasing Europe's R&D intensity will require an evolution of its production structure. The Barcelona target was instrumental in heightening European policy-makers awareness of the importance of innovation and its promotion. It was a catalyst for debates and significant political decisions in favour of research and innovation. But alone, it is not enough, because it focuses attention on a symptom of the problem (the European R&D deficit) rather than on the problem itself (insufficient innovation) and its underlying structural causes (funding and organisation of academic research; firms' demography).

Besides, an R&D spending target overlooks the other determinants of innovation capability, e.g. the availability of human capital (generated by the system of higher education), or non-technological innovation, which is highly complementary to technological innovation but not reliant on R&D. In emerging industries, new business models are just as important as new technologies (Dell, Google), whereas traditional industries can be revitalised by new organisational modes (Starbucks, FedEx).

Finally, a narrow interpretation of the Barcelona objective may give rise to distortions in certain national policies, as countries attempt to reach the 3% target mechanically, by strongly increasing direct or indirect subsidies to corporate R&D. The high budgetary cost of such policies may imply lower expenses in favour of public research. Alternatively, their cost may call such policies into question after a few years. Such policies could also trigger a costly tax competition between countries to attract business R&D, while the latter is mainly attracted by market potential and support to local production or by world class scientific and technological capabilities. Competition in this field would therefore result in an increase in public support while businesses would not expand their R&D expenditure EU-wide. Results from recent studies thus suggest that European countries should stimulate the development of leading markets and the promotion of research excellence to increase their attractiveness for R&D.[12]

For all these reasons, it seems appropriate to officially adopt a set of four objectives, which would draw political attention towards major determinants of R&D intensity. The first three objectives relate to results to be achieved by 2020:

– Europe will have 15 universities in the top world 50 ranked according to the quality of their research, including 5 in the top 20;
– 30% of EU business R&D will be conducted by companies created after the year 2000;
– EU R&D intensity will reach 3%.

The fourth objective relates more directly to political decision: in order to demonstrate their determination to contribute to the advancement of knowledge and innovation, policy makers could make a defined budgetary commitment, e.g. 30% of th EU budget will be allocated to research, innovation and higher education.

These quantitative commitments should be supported by companion structural policies, which are outlined below:

– the funding, excellence, responsiveness and openness to society of academic research,
– the creation and growth of new innovative businesses;
– the promotion of innovation in the EU to address global challenges (environment, etc.).

Strengthening academic research

The development of the knowledge economy in Europe, the creation of innovative start-ups and innovative answers to global challenges require excellent academic research, which should also be responsive the needs of society. In order to increase its quality and its global influence, Europe academic research should more funded, better organised and attract more funds. Europe needs a more selective research system, in which the best teams receive more funding, and a more integrated system, in which teams can both work together and compete with each other, rather than remaining isolated behind their national and linguistic barriers. Research should be able to quickly adapt to new opportunities (new issues and emerging fields) rather than keeping resources for lines of research with decreasing returns. Finally, European research should be open in order to deploy resources in the areas in which society and the economy have the most pressing needs, and transfer knowledge to the organisations which can exploit it the most productively.

Building this type of research system requires considerable financial resources, as well as extensive institutional changes. These changes have to be introduced at the local, university, level, as well as at the national and EU levels through the mechanisms of resource allocation of funding for research.

Funding for higher education is too low (1.3% of GDP compared to 3.3% in the United States), which has a direct impact on Europe's ability to train a sufficient

12 See Thursby and Thursby (2006), Sachwald (2008).

number of skilled managers and researchers. Increasing spending for higher education 1 percentage point by 2020, as suggested by the European Commission and others[13] may seem ambitious, but it seems necessary to develop innovation-based growth.

More funding is complementary to reforms in university governance. The objective is to allow for greater autonomy and responsibility at the university level. Decentralised university systems will be better prepared to achieve excellence through cooperation and competition, have stronger incentives to redeploy their activities according to the resources available, and to be receptive to signals from society and the economy. A number of EU countries have undertaken such reforms of their university system. The movement merits support from the EU. The best possible form of encouragement will be to allocate European research funds on the basis of excellence and relevance, thereby promoting the most effective teams, who will be coming from reformed systems.

The framework programme should also evolve to promote excellence and focus research funding on fundamental knowledge and addressing global issues. This reorientation, away from the initial objective of promoting European network building and towards a more integrated innovation strategy at the ERA level, could be operated through several changes.

First, Framework Programme funds should be allocated on the basis of projects' scientific excellence and relevance, with much less weight to network building requirements. Cooperative networks represent over 60% of the budget of the 7th FPRD. Although the creation of networks in research is, in itself, a good thing, their configuration should depend on the appropriateness of the partners, for companies and academic researchers alike. Experience tends to show that the administrative stipulation requiring the creation of vast multinational networks is counter-productive. Their actual composition may be artificial and include too many participants given the research project (groups are included not for their excellence or specialisation, but to include more nationalities or more participants). Moreover, their size can have adverse effects (e.g. diluting the incentive of each individual team to contribute) and incur excessive management costs.

Second, ERA should promote thematic programmes supporting basic research (nanosciences and nanotechnologies, biotechnologies, information technologies, interdisciplinary programmes, etc.), within the framework of which projects would be selected according to their degree of excellence. These programmes should be connected to the ERA global challenges programmes (see infra), for which they could provide generic inputs.

Finally, the endowment of the European Research Council (ERC), which is an extremely effective means of advancing fundamental knowledge, should be increased. ERC is a new basic research funding scheme, which works according to a "bottom up" principle, and which selects candidates based on excellence. This type of model could be adapted to the basic research thematic programmes just mentioned and to ERA global challenges programmes. This principle allows researchers to propose their ideas directly, with no predefined filter, thus potentially opening the door for original research topics that might have been dismissed *ex ante* in a strictly "top down" procedure.

These measures at the ERA level should go hand in hand with similar efforts at the national level in a number of countries. Besides, they should be accompanied by greater integration of national research systems at the European level – the "Ljubjana Process". They could also be reinforced by other changes at the EU level.

As for other research programmes, Structural Funds earmarked for research should be allocated on the basis of projects' scientific excellence and relevance, and generally not according to the geographical location of the project team. If the research topics financed under the Structural Funds have to correspond to priorities for regions that cannot fund projects themselves, the teams that conduct the project should nevertheless be selected according to the quality of their offer and not their location. This way, regions that need more scientific and technological resources than they can generate will benefit from the results of high-quality research that may have been conducted elsewhere, rather than doing their own second-rate research. The territorial aspect of the Structural Funds must of course be maintained for technology transfer activities, so that the regions that have expressed need in this area fully benefit from the results of European research. The territorial aspect of the Structural Funds is also justified for expenses relating to higher education up to the Bachelor degree, when students' geographical mobility may not be necessary. Structural Funds can therefore help boost the European effort needed in higher education (by 1% of GDP by 2020). However, from the Master's degree on, it is certainly preferable to finance the student's mobility in order to concentrate specialised programs in centres of excellence, which are also research sites. This way, students from regions that are under-equipped in terms of universities will no longer be at a disadvantage compared to those from better-equipped regions – which is in line with the Structural Fund objective of ensuring equity between territories.

The mobility of students and researchers within Europe could be stimulated further. ERASMUS programme could be extended to 300,000 students (at an estimated of 3 billion Euros per year). This expansion could be financed under the Structural Funds insofar as the students from less advanced areas have a greater need to pursue education in other locations than students from areas with stronger higher education systems. The expansion of the Marie Curie actions could stimulate researchers' mobility. Mobility would also be stimu-

13 European Commission (2006); Aghion et al. (2008).

lated by establishing full transferability of social rights (including retirement) for researchers and teaching staff and by adjusting any aspects of researchers' status that hinder international mobility.

Finally, ERA would benefit from a European evaluation system of EU R&D policies within the Commission, supplemented by an external system (e.g. under the auspices of the European Parliament). At present, there is no independent and public evaluation of this type, as the European Court of Auditors recently noted (2007). It would increase transparency in fund allocation. It could be implemented both *ex ante* and *ex post* so as to ensure consistency between the objectives and policy instruments. This rigour and transparency are essential to improving the effectiveness of programmes and justifying budget increases.

Developing a population of European gazelles

The creation of new businesses and their growth are crucial factors for economic vitality and productivity. Europe's handicap in this respect is two-fold: slow growth of young firms and insufficient creation of start-ups in high-tech sectors. How can the barriers to the growth of young firms and to the creation of high-tech start-ups be overcome?

Young companies would first benefit from a fully integrated European market, particularly service industries; the objective being the completion of the Lisbon agenda with respect to the Single market. The size of companies is influenced by the size of the market they address. Diversity in national regulations (particularly in services) and national policies that often compete with each other, hinder firms' growth within the EU[14]. R&D is a fixed cost (independent of turnover) which the company will be more willing to incur when it serves a vast market. The size of the market a company can reach is thus particularly important in sectors in which R&D investment is high.

The opening-up of national markets – e.g. for energy or transport – will increase competition, which is also an incentive for innovation. Barriers to cross-border operations (e.g. investment or research) should be lifted within Europe. It should become administratively equivalent for a European company to create an establishment in its country of origin and in another EU country. Relevant areas include numerous regulations (employment, environment, and technical standards), taxation, contract law, etc. The creation of the "European Company" status, which would give the right to operate in all EU countries, should be finalised as quickly as possible.

The EU should implement a European *New Business Act* (NBA). Inspired by the Small Business Act (SBA) in the United States, the European NBA would offer special treatment for new businesses rather than small businesses as in the American model. In particular, the NBA would guarantee young companies a certain percentage of public procurement at the European level (as in the United States, the SBIR guarantees small businesses a share of government R&D contracts). The precise eligibility criteria remain to be defined, as does the exact content of the public support that would be granted (which quotas for which government contracts, etc.). National programmes currently underway could provide insights (in France or Denmark, etc.). The rationale is to promote innovation projects by firms that do not have the same financial means and access to contracts as established firms. A firm's age tends to be a more fundamental determinant than size when it comes to innovation. Many companies are structurally small because of their owner's ambition, their sector or the market they serve. As a consequence, they do not need any particular support system. On the contrary, radical breakthroughs are developed by young businesses that do not necessarily stay small for long if their innovation is successful. The European NBA would target these companies, which were identified above as *gazelles*.

A policy that would base eligibility on small size would risk encouraging companies that are unlikely to grow, which is precisely the opposite of the objective of the NBA. One reason for the lack of growth of young businesses in some countries is the existence of threshold effects: administrative, social and tax requirements that increase with the size of the company tend to increase the cost of growth. These effects are amplified when public support depends on size.

Contracts granted to young businesses under the NBA (as with the SBIR in the United States), could provide for phased payments. This would allow companies to invest in R&D sequentially: funding would increase at each phase, provided the previous phase passed the evaluation, on the venture capital model. The NBA would notably apply to ERA global challenges programmes discussed above. It could also tie in with national programmes aimed at similar types of firms, using instruments such as tax credit or social charges relief.

Strengthen the protection and the circulation of technology

Europe needs a Community patent, of high-quality, that can be obtained quickly at a reasonable price. The patent system is instrumental in the innovation process, as an incentive for investments in invention activities. An effective patent system offers protection for new entrants to the market, who do not have the distribution networks or reputation that can in some ways protect inventions. Their main strategic defence is intellectual property. Moreover, the patent is a pillar of technology markets, whose development can be a catalyst for innovation in Europe.

An effective patent system would have the following characteristics: it would be accessible at a low cost (to avoid discrimination among inventors based on their initial wealth); its decision-making procedures would

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14 Foray and van Ark 2007 demonstrate that the low level of integration of national research system reduces the overall effectiveness of the European research system.

work quickly (to promptly eliminate "bad" applications, which are detrimental to competition, and to quickly grant good ones so that they are properly protected); it would issue high-quality patents (to significant inventions). Despite the ratification of the London Protocol in 2007, the situation in Europe at present can be improved through measures on various levels[15]. First, by establishing a Community patent with minimum translation requirements and a common jurisdiction; this would allow inventors to obtain direct protection throughout all of Europe at a lower cost and with greater legal security than today. The "judicial protectionism" we see in some countries today is a damper on innovation in Europe. Secondly, this patent must be issued by the European Patent Office (EPO), which has to apply more stringent granting criteria than at present – in order not only to reject unfavourable applications, but also to deter them (which would cut down on the Office's workload, and therefore reduce the decision time needed for each patent). From this perspective, it would be advisable to re-examine the governance of the OEB. At present, the national patent offices play a predominant role, whereas primarily financial interests (increasing the fees collected) push some of them to support indulgent patent granting policies. Thirdly, patent fees could be reduced for businesses eligible for the NBA and for universities - entities that are more sensitive to the cost of the patent than large companies (in the United Sates and Japan, there are 50% reductions for small businesses and universities).

Europe could establish a technological sharing platform. An inventor can implement his invention himself, or transfer the property or exploitation rights to another company. This happens when an inventor does not have manufacturing and marketing capabilities (the case of universities or companies specialised in R&D, e.g. biotechnologies or software), or when the manufacture of a product or service will require the involvement of multiple inventions made by separate entities – inventions which must therefore be approved in order to be implemented together.

With the growing complexity of products and the appearance and growth of R&D-specialised companies (which do not market their inventions themselves), technology-related transactions have become increasingly important in recent years, triggering the emergence of a technology market[16]. Technology-related transactions are varied, and can include the purchase of patents, licences, cross licences, etc. Furthermore, financial transactions such as securitization or collateralisation are in a development trend, allowing young companies to obtain liquidity without giving up their essential asset – technology. These transactions are complex: the partners have to be found and contracts have to be established that satisfy all parties in terms of price and guaranties.

A recent study[17] reveals that 20% of patent-holding companies in Europe grant licences, and that this number could double if the barriers to development of the market were eliminated. The first barrier, according to the companies surveyed, is the difficulty in finding a partner – a potential user of the invention. Faced with this growing complexity, companies – even large ones – increasingly seek external support in negotiating these transactions. Marketplaces have been set up on the Internet; specialised intermediaries now offer their services (locating partners, evaluation, insurance); and intellectual property "aggregators" have emerged, funds which purchase patents to create portfolios covering specific technological sectors. The fact is, almost all the initiatives of consequence in this area originate in the United States: the marketplaces, auctions and aggregators are nearly all American, and Europe remains under-represented. This is not necessarily a problem for well-established European companies, who can use the American (global) circuits with which they are already familiar. For universities and European start-ups, however, therein lies a source of potential difficulty since, for them, the cost of accessing these tools is higher while their negotiating power is lower. The development of these instruments therefore represents an unexploited opportunity for universities and young companies in Europe.

Japan responded to a similar situation by creating, in 2001, INPIT (National Center for Industrial Property Information and Training), the mission of which is to advise companies (particularly small Japanese businesses) and serve as an intermediary in technology-related transactions. The OECD study also shows that small Japanese businesses have less difficulty negotiating technological transactions than small European businesses; the existence of the INPIT may well play into this difference.

Europe needs to consider what strategy to take in this area, and to involve all players (universities, companies, financiers, administrations in charge of intellectual property) in the thinking process. What are the barriers to development in Europe's technological markets? How can they be reduced? What type of platform is best? How should the authorities be involved? Finally, thought on the European technological sharing platform must cover not just patents, but all the intellectual assets that businesses may want to share.

Global challenges ERA programmes

The urgency of global issues – energy, the environment, food security, ageing, epidemics – indicates the inadequacy of efforts made in these areas in the recent past. Europe must play a part in addressing these issues, not only for societal reasons, but also because they present the major economic opportunities of the future. R&D will be a vital instrument in facing these issues, to go hand in hand with a broader base of essential tools, such as policies in regulation, taxation, government

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15 See Guellec and van Pottelsberghe (2007).

16 On open innovation, see Herstad *et al.* (2008) and OECD(2008c).

17 OECD (2008b).

investment, public procurement, etc. Technological innovations will help improve the global situation in terms of the environment, food and energy, in economically sustainable conditions. An appropriate format for organising the technical response to these issues is the *global challenges ERA programme*.[18] These programmes could be set up in areas such as new energies, agro-development/biotechnologies, green cars, etc. These programmes will be supplemented by regulatory policies for developing demand (standards such as "20% of electricity from renewable sources", lower CO2 emissions thresholds for automobiles, etc.) and public procurement policies based on the lead market principle (ordering goods that are yet to be developed), which the Commission and Member States are working on at present.

Major programmes aim to meet well-defined needs that the market alone will not cover, either because the need corresponds to an externality (e.g. the environment), or because the research done to meet the need generates too many externalities to make it profitable according to market principles alone. To a certain extent, a precedent to this initiative is the SET Plan (Strategic Energy Technology Plan). Yet, as opposed to this plan, the major programmes proposed here also have to provide leverage to boost university research and promote the creation/growth of new businesses, rather than simply strengthening existing large companies.

These are the characteristics the programmes should have in order to meet these goals:
Their governance must be structured to promote excellence, responsiveness (seizing new opportunities) and openness (as opposed to disconnectedness or absorption). As research is a means of achieving the goals defined, the agenda for research must take these goals into account. Public authorities at the highest level have to be involved, as well as players from civil society, the economic world, and of course researchers. The "Grenelle environment Forum" held in France in March 2008 is an example of this type of consensus-building process. A high level of political and social consensus is also necessary due to the level of public and private funding to be allocated over a long term. Once the general goals have been set, the programme must be managed as transparently as possible, in order to avoid capture by private party interests and to preserve the consensus. Rigorous reporting, technical and financial procedures must be applied. The governance must be handled by representatives of all the players involved, the "prime contractors", users and financiers on one hand (national governments, commission, civil society), and operators on the other hand (academics, established and new companies).

The projects undertaken within these programmes will be subject to systematic evaluation, with built-in project stoppage or shift-in-focus mechanisms should a patent problem arise (e.g. the project will be stopped after two years if it has not attained certain specific objectives). The strategy taken by these programmes does not consist in "picking winners", when the public authority decides *ex ante* which veins to follow and not to follow (and therefore which companies to pick). To ensure effectiveness, and in the face of highly-complex scientific and technical problems, it is important that all proposed veins of research be explored at least until reasonable chances of success at an acceptable cost are exhausted. Thus, preference should be given to a "bottom up" approach that is open and competitive in terms of technological choices, particularly in the higher-up, more exploratory phases (open calls for proposals, etc.).

The ERA programmes will leverage changes in academic research to ensure greater excellence, flexibility and openness to society. By allocating funding based on quality and relevance and through the body of monies involved, they will decisively influence academic research. These applied ERA programmes will be complementary to upstream research programmes (on generic technologies) since they will provide a direct outlet for the discoveries made. In order to address global issues, there needs to be ambitious, often fundamental, research relating to generic sciences and techniques (computer science, nanoscience and nanotechnology, biotechnology, etc.). Moreover, unexpected scientific discoveries or the appearance of global challenges require generic technical expertise, which lends research an ability to be responsive that it would not have if it were solely applied. Coordination between these two approaches – upstream and downstream, or "science push" and "demand pull" – is necessary and complex. Universities, as players in both generic and applied programmes, will fulfil a fundamental role in coordinating the two.

Experience shows that radically new technical solutions are often developed by new companies, and the global issues justify research in radically new solutions. One means of ensuring that these programmes are open to new businesses is to incorporate an NBA into their legal framework, according to the model described above: a certain proportion of public monies allocated to companies should obligatorily be given to companies under a certain age. For example, 10% of monies would go to companies under ten years of age. It is also important that large companies take part in these programmes, since many of the solutions adopted will be based on proven techniques, and large companies will have very high leverage in the areas of engineering, management and finance.

In order to truly carry weight, these programmes will have to be very large-scale. L. Georghiou (2008b) mentions a figure of 5-10 billion Euros per programme. This is necessary because of the scale of the challenges to be met. These programmes could be financed by reallocating the Commission's R&D budgets, e.g. first of all, that of the 8th FPRD, of which these programmes would be the main component. It would also be coherent to finance these programmes with funds other than those for research, but which share the end-goals of the programmes, e.g. a major programme in "food security"

18 Georghiou (2008a) develops a similar idea.

could be partly supported by CAP funds, and likewise, environmental programmes concerning the rural world could benefit from the redeployment of Structural Funds. Moreover, in many countries, research programmes already exist in these areas. Coordinating them with major Community programmes, within the framework of the European Research Area, would provide additional financial leverage.

Devoting public and private funds to innovation

Increasing Europe's ability for innovation is a question of structural reforms, but it is also a question of resources: more funding, both public and private, needs to be allocated to the activities that produce knowledge and innovation. Public funds are determined by political decisions, and private funds depend on the conditions offered in terms of return and risk, which are affected by the regulatory framework.

With regard to public funds, this contribution proposes, as one goal of the European innovation strategy, to increase the share of the Community budget allocated to the creation of knowledge and to innovation, in order to reach 30% by 2020. This would manifest the true height of the priority placed on this area.

The fact that innovation is partly linked to socio-economic objectives already covered in the Community budget would allow for new funding in continuity with current policies. For example, part of the sectoral funds could support research programmes in areas such as food security or the environment. Part of the Structural Funds budget is already allocated to research, and could be extended through the integration of research programmes of regional or interregional interest (e.g. those tied to the environment or renewable energy) and the integration of additional budgets for the mobility of students in regions that are under-equipped in terms of universities. Reallocating funds this way would allow the RTD framework programme to be focused on fundamental and strategic research (upstream), making these areas even stronger. Moreover, the increasing involvement of the European Investment Bank (EIB) in innovation-related operations is a good direction to pursue. European and Community funding will have to be supplemented by national public funding. If the member states were to cut their own spending in innovation to implicitly rely on the increase in European funding, this would considerably reduce some of the positive effects of these measures. On the contrary, strengthening the European Research Area and the Ljubljana process must allow European funding to be supplemented by coordinated national funding.

When it comes to private funds, the reluctance to finance innovative new businesses is well-known and understandable, given a high level of risk: failure of the business is a distinct possibility, and in the event of failure, the business has very little compensation to offer the providers of capital providers (little tangible collateral). To offset this difficulty, specific financial mechanisms have been invented and specialised financial intermediaries (notably, capital risk) have emerged. The low level of private funds allocated to young innovative companies in Europe, particularly with respect to the United States, indicates the need for reforms, especially in terms of financial regulations and taxation[19]. The reforms required include: i) greater integration of national financial systems at the European level, ii) removing certain barriers to the securitisation of assets (e.g. intellectual assets – see above) and the development of subordinated debts, particularly useful for innovative companies (national legislation on bankruptcy seems particularly implicated here), iii) removing barriers to the direct or indirect entry of institutional investors (pensions funds, insurance companies) into the capital of young innovative companies, and iv) eliminating barriers to the emergence of cross-border funds, especially venture capital (the Commission has begun working on this).

Conclusion

Following the Lisbon Strategy, Europe has undertaken structural reforms, which prepare a better environment for dynamic innovation-based growth. Yet much remains to be accomplished, and the current reform efforts need to be continued and expanded. The target date 2020, which is now relevant for such an agenda, is getting closer. Reforms must be initiated and tested during the 7th Framework Programme, so that they can be fully applied with the 8th Programme. As other reforms, such as that of the Structural Funds or the Agricultural policy, the evolution of the EU research system calls for considerable preparation.

Significant increase in research funding could generate inflationary pressures in the EU research system: an insufficient number of researchers in certain fields and a lack of specialised equipment could translate higher demand into higher cost rather than into more resources allocated to research. It is therefore essential to allow time for the research system to adapt in both quantitative terms (training more researchers) and structural terms (flexibility in the allocation of resources). Resources should be increased progressively and accompanied by governance changes; policy planning should start now.

19 Philippon and Véron (2008).

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