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The Europe of Knowledge: Innovation Policy and the Academic Research Enterprise

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Introduction

During many centuries, the European universities have contributed significantly to the social, economic, and cultural development of Europe. Since the creation of the European Union, the universities have gained a special position as objects of European-level policymaking. This chapter discusses and analyzes that special position. It presents both a historical overview and an analysis of EU policies with respect to the European academic research enterprise (ARE).

The European policy domains of research, higher education, and innovation are embedded in the broader European integration process. Analyzing these policy domains necessarily forces us to understand the main phases and dimensions of this integration process. As a short introduction to our further analyses, let us therefore first look at the broader European political context.

In the aftermath of World War II and during the onset of the Cold War, the wish to create peace and stability in Europe became a common target, and the idea of pooling European countries' interests seemed highly attractive. The 1950s in Europe were a time of reconstruction, reorientation, and reconciliation. In this context, European visionaries like Jean Monnet and Robert Schuman conceived of and took the first steps toward an integrated Europe.

However, these first steps were not taken easily. The dream of Sir Winston Churchill to launch a "United States of Europe," which he had outlined directly after World War II, was discussed at a European Congress under his chairmanship in May 1948 in The Hague. But a unified and integrated Europe appeared to be too difficult to realize. The individual interests and sovereignties of the national European states only allowed for intergovernmental cooperation.

The objective to create an integrated Europe, able to act in a supranational way, apparently had to be addressed in a pragmatic, step-by-step fashion. Rather than turning attention to building the dream of Europe, it turned to building a Europe that was actually possible. The results were the first three community treaties, creating the foundation of what is now called the European Union.

The treaties are effectively the basic constitutional texts of the EU. They set out the objectives of the Union and establish the various institutions intended to achieve them. The first three founding treaties of the European Union are: the Treaty of Paris, establishing the European Coal and Steel Community, signed in April 1951, entering into force on July 23, 1952, and expiring on July 23, 2002; the treaty establishing the European Atomic Energy Community (Euratom), signed in March 1957 and entering into force on January 1, 1958; and the treaty establishing the European Economic Community (EEC), signed--along with the Euratom Treaty--in Rome on March 25, 1957, entering into force on January 1, 1958. This third treaty is usually referred to as the "Treaty of Rome."

With the establishment of these communities, six continental governments agreed to work together and to create a common market.[1] In particular, the EEC Treaty has been an important source for European research policy. Before the 1980s, European activities in this policy domain were undertaken on the basis of article 235 of this treaty, which allowed European policy initiatives, when necessary, to realize a community objective.

The first treaties were essentially economic in scope and basically pragmatic. However, they created the first supranational policy context in Europe. In contrast with the pure intergovernmental approach, the new community method began to focus on a true European integration process in key policy domains, with a European Commission (EC), established in the EEC Treaty in 1957, as the major supranational institution.

History shows that further important milestones were the Single European Act (signed in 1986 and entering into force on July 1, 1987), leading to the single market strategy, and the Maastricht Treaty, which paved the way for the Economic and Monetary Union. The Maastricht Treaty (signed on February 7, 1992 and entering into force on November 1, 1993) changed the name of the European Economic Community to simply "the European Community." With the two other so-called pillars (the Common Foreign and Security Policy and the Police and Judicial Cooperation Policy), the European Community has become known as the European Union, with political and economic scope. It was also this treaty (called the Treaty on European Union) in which, after some debates on the interpretation of the competences of the community in the EEC Treaty's articles in the 1980s, the subsidiarity principle

was formulated. This principle ensures that decisions are taken as closely as possible to the citizens of Europe and that checks are made as to whether actions at community level are justified. The EU is assumed not to take action, except in the areas that fall within its exclusive competence, unless the member states cannot themselves sufficiently achieve the intended results.

A further milestone of European integration was the Treaty of Amsterdam, signed on October 2, 1997 and entering into force on May 1, 1999. This treaty includes a whole chapter on research and technological development. Research and technological development are assumed to be crucial for the competitiveness of European business and industry and the employment of its citizens as well as for consumer protection and environmental policy.

In general political terms, the European integration process has moved slowly since the Amsterdam Treaty. When the European Council (the heads of state or government and the president of the EC) met in Nice in December 2000, it agreed on a review of the existing treaties. In an annex to the Treaty of Nice (signed on February 26, 2001 and entering into force on February 1, 2003) the Council declared that it intended an open debate on the future of the Union. When the Council met again in Laeken (Belgium) in December 2001, it established the European Convention, a body of 105 members chaired by former French president Valéry Giscard d'Estaing, which was given the task of producing a draft European constitution.

This draft constitution was signed by the heads of state or government at a ceremony in Rome on October 29, 2004. However, before it could enter into force, it had to be unanimously ratified by each member state, a process that was expected to take around two years. Following the rejection of the constitution in the referenda in France and the Netherlands in 2005, the European Council extended the deadline for ratification. Finally, after a period of uncertainty and confusion, in June 2007 the European political leaders reached an agreement. Formally there will no longer be a constitution, only a review of the existing treaties to be established in the Treaty of Lisbon (2008). The decision-making processes of the Union and the composition of the Commission will be simplified; there will be more authority for the European Parliament and the national parliaments; and member states can withdraw from the Union if they wish to do so. However, after the negative outcome of the referendum in Ireland in June 2008, the ratification of the Lisbon Treaty has again become problematic, although the EC still expects the treaty to enter into force (EC 2008). Once again, Churchill's dream and the intentions of the early European visionaries appear to be far removed from political reality.

The most crucial recent phase in the European integration process, having a major impact on developments in the policy domains of research, higher education, and innovation, is the "Lisbon process." When the EU leaders met in Lisbon in the year 2000, they decided to boost the Union's competitiveness and growth. They wanted to create "a Europe of knowledge" and formulated the goal that by 2010 the EU should be "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth, with more and better jobs, and greater social cohesion" (European Council 2000, para. 5). The ambition formulated by the European political leaders created an additional context for European policymaking, not so much with classic policy instruments like directives and regulation, but rather under an "Open Method of Coordination" (OMC) by which the governments of the member states themselves agree to peer review and benchmarking on a number of relevant policy indicators (EC 2000a).

The OMC radically changed European policymaking. It provided a new platform to discuss national policies and their outcomes at the European level without further impinging on national competences. The objective was to benchmark the performances of the member states on a number of common concerns and priorities and to discuss and compare their progress on reaching the objectives of the Lisbon agenda.

Unfortunately, as the evaluation report of a special high-level group showed (European Communities 2004), at mid-term (2005) the ambitious political goals of the Lisbon summit appeared to be very difficult to reach. Of course, the weak economic growth in the larger member states has been a major factor. But the fact that the design and implementation of the policy actions to reach the

European goals rely strongly on the efforts of the member states and industry has also been identified as a major reason for the failure of the Lisbon process (Weber 2006).
The European Commission deliberately restarted the process. During the 2005 Spring European Council, the Commission launched the New Lisbon Partnership for Growth and Jobs (EC 2005e), which resulted in the singling out of "knowledge and innovation for growth" as one of the three main areas of action. In addition, it developed integrated guidelines for the preparation of the three-year so-called National Reform Programmes (NRPs) of the member states as well as the Community Lisbon Programme consisting of a set of Actions for Growth and Employment (EC 2005a), thus building a new, overarching community-member states partnership for the Lisbon agenda.

With this new partnership, the EC took a major step forward. The policy domains of research, higher education, and innovation had never been higher on the European policy agenda.

The European Academic Research Enterprise

The EU research system is a rather complex one, with research being carried out in industry, the universities, and other public and private research institutions. These three main types of institutional actors complement each other and all contribute to the processes of knowledge production, dissemination, and application. The research sponsors in the EU are predominantly industry and governments. Research sponsors appear to play increasingly important roles and to become more diversified, including public authorities, industry, financial institutions, foundations, etc. This increasing diversity of stakeholders clearly adds to the complexity of the EU research system.

The total gross domestic expenditure on R&D (research and development) by the EU (2005) is $226,827.5 million (PPP), larger than almost any OECD country. Only the United States has a higher expenditure level (more than one-third larger), but the EU investment in R&D is nearly two times that of Japan (OECD 2006). Of these investments, 53.4% comes from industry and 35.7% from government. The EU Academic Research Enterprise (ARE) represents only a limited portion of the overall EU research system. Industry performs 63% of the total research activities. Of this, nearly a quarter is performed by small and medium-sized enterprises (SMEs). The university sector performs 22.4% and government 13.6%. The proportion of EU R&D performed by the European ARE is well above the OECD average of 17.3%.

The EU ARE is the main producer of scientific knowledge in Europe, and the most important training ground for researchers. There are no clear and formal data about the size of the European ARE. The European University Association (EUA) assumes that the number of PhD-granting universities in the EU is about 1,000, a large number compared to the United States. The EU universities employ 36.6% of all European researchers (2004), which is also a relatively high number compared to the United States (14.7% in 2000) and Japan (25.5% in 2003) (EC 2007, 49). The EU enlargement of recent years has increased both the demand for R&D outcomes and the overall R&D capacity. The enlargement has also increased diversity in terms of scientific culture, specialization patterns, and investment levels. With the incorporation of the twelve new EU member states since 2000, the diversity of the EU academic research enterprise has clearly grown.

As was indicated, in addition to the university sector, research in the EU is performed by business and industry and by public and private research organizations. Business and industry carry out nearly two-thirds of all EU R&D. The various public and private research organizations provide R&D, technology, and innovation services to business, governments, and other clients. They have often been created by government and in many cases started their activities with a publicly ordained mission paid for with public funds. However, many of these organizations have evolved into contract institutes and consultancy firms. A limited number are involved in academic research and sometimes even research training.

The EU is the world's leading market in terms of purchasing power and demand for knowledge-intensive products and is likely to remain so in the near future. Demand for science- and technology-intensive products is a major driver for decisions regarding investments in and location of R&D activities worldwide. The problem that the EU faces is that a single EU market for knowledge-

intensive products does not yet exist. The EU's market is confronted with barriers like different national legislation and different technical standards and specifications in local markets (European Communities 2006a).

From the early 1950s to the beginning of the 1970s, the EU witnessed sharp labor productivity growth. The GDP per capita increased and appeared to be catching up with the United States. However, from the 1970s on, things changed. After the mid 1970s, the EU continued to catch up with the United States in terms of labor productivity. Yet, because of the EU's increasing employment and decrease in average working hours per capita, the gap in GDP per capita levels between the EU and the United States did not narrow. Even more crucial, the EU stopped catching up in terms of labor productivity in the mid 1990s, with the EU's labor productivity growth rate falling under that of the United States. The policy conclusion drawn from these trends was obvious: this development implies a serious threat to the international competitiveness of business activities in Europe. To address this threat, Europe will have to strengthen its ability to create and apply knowledge and increase its potential for innovation. Europe will have to become a knowledge society. Increased investments in R&D and education are crucial for Europe's future (European Communities 2005).

However, although the EU investments in R&D are substantial, they are also problematic. The R&D intensity of the EU (Gross Domestic Expenditure–GERD–as a percentage of GDP) showed slow but continued growth between 1996 and 2002 and a slight decrease between 2002 (1.89%) and 2005 (1.85%) (see figure 5.1). Figure 5.1 also shows that the R&D investment gap between the EU and the United States has been increasing since 2002. In addition, the data predict that, if the current trend persists, China will have caught up with the EU by 2009.

<Figure 5.1 about here>

As will be discussed later, the EU has set itself a policy target of a 3% of GDP R&D investment level, of which two-thirds should come from the private sector. As figure 5.1 shows, this 3% objective is still far from being reached.

Government funding of R&D has been stable since the 1990s at around 0.64% of GDP, which is too low to reach the 3% target. There also is little progress towards the two-thirds objective for investment by the private sector. Until 2000, business funding of R&D grew at a high rate, but after 2001 the economic slowdown translated into a sharp reduction in the growth of business-funded R&D. See table 5.1, in which growth of R&D expenditure by business is compared with GDP growth.

<Table 5.1 about here>

The enlargement of the EU has increased the diversity in R&D investment levels in the EU. The discrepancies among the EU member states in terms of R&D intensities range from 0.4% in Cyprus to 3.86% in Sweden (2005). The discrepancies among sub-national regions are even more dramatic, with R&D intensity ranging from 0.01% in Severozapadan in Bulgaria to 7.11% in Braunschweig, Germany (2002) (EC 2007b).

The number of researchers in full time equivalent (FTE) per thousand labor force participants amounted to 5.4 in the EU in 2003, compared to 10.1 in Japan and 9.0 in the United States. Nonetheless, this number grew at an annual average rate of 2.8% between 1997 and 2003. This deficit in the share of researchers in the labor force compared to Japan and the United States is mainly found in the business sector. Of the 1.18 million researchers (FTE) in the EU in 2003, 49% were employed by the business sector. This compared to 67.9% in Japan and 80.5% in the United States (European Communities 2005). In contrast, the EU ARE is relatively larger than those in the United States and Japan, with nearly 37 percent of the researchers employed in the EU university sector, compared to about 15 percent in the United States and 25.5% in Japan (EC 2007, 49).

Especially in the earliest member states, the aging of the research labor force is becoming a concern. In 2003, 34.7% of highly qualified science and technology employees were in the 45-64-year-old age group, compared to 30.8% in the 25-34-year-old age group. In addition to the need to

expand it, there also is a clear need to ensure a sufficient replacement rate for the research workforce. Fortunately, the EU produces a substantial number of science and technology graduates: In 2003, 24.2% of all degrees awarded in the EU were in the science and engineering fields of study, compared to 18.5% in the United States and 23.1% in Japan. Women are still under-represented among both science and engineering researchers and graduates. Their share in the total number of researchers in 2002 was below 50 percent in nearly all member states (EC 2005d).

The intra-European transnational mobility of researchers and doctoral candidates is poor. Only around 5 percent of doctoral candidates and at most 10 percent of researchers at the postdoctoral level are involved in mobility processes. In addition, intersectoral mobility (between the private and public sectors) is still underdeveloped, largely because of cultural differences, but also because of practical issues like pension build up (EC 2007b).

There is a considerable drain of EU graduates and researchers, particularly to the United States. The number of EU researchers working in the United States amounts to some 5 to 8 percent of the total EU researcher population of 80,000 to100,000 researchers. Most of these researchers are reluctant to return to Europe, primarily because of a lack of attractive research conditions and career prospects.

The overall situation in terms of quality of the ARE in the EU can be characterized as "generally good on average, but with a very limited basis of universities at world-level" (EC 2007b, 50). In terms of both total number and world share of scientific publications, the EU is the world leader. In 2004, the EU's world share was 38%, compared to 33% for the United States and 9% for Japan. China ranked fourth with 6%.[2] However, the picture changes when publications are compared to population. Then the United States leads with 809 publications per million population, followed by the EU with 639 and Japan with 569 (European Communities 2005).

Evidence clearly shows that the EU's scientific impact lags behind that of the United States in almost all disciplines. Using data on the field-normalized Citation Impact Score per scientific discipline, figure 5.2 shows that the EU's scientific impact is around or below world average in almost all disciplines. The EU demonstrates a score above world average in only 6 out of the 37 fields. Also, the EU shows lower scores than the United States in 35 of the 37 disciplines.

<Figure 5.2 about here>

An institutional citation impact analysis per discipline shows that only 26 percent of EU universities are world leaders in at least one discipline, compared to 81 percent of US universities. In addition, the number of disciplines in which an EU university is the world leader is on average substantially lower than that for US universities. A number of EU universities are considered among the top universities in the world, but their top is generally less broad than that of US universities (EC 2007b).

The EU's performance in the exploitation of scientific knowledge remains problematic. The EU's share of triadic patents (30%) is below that of the United States (36%) (see figure 5.3).

<Figure 5.3 about here>

A broader view of innovation performance is provided by the European Innovation Scoreboard. The 2006 and 2007 results of this instrument show that the EU is still not performing at the level of the United States and Japan but that the gaps in innovation performance, particularly between the EU and the United States, are decreasing (Innovation Scoreboard 2006, 2007).

The EU ARE is seen as a key system for the European innovation agenda. Given the fact that the EU's innovation performance is still considered to be internationally too limited, the European ARE is assumed to be an important object of EU policy. The prominent role of the EU universities for the further social and economic development of Europe has become an important reason why the EU has designed and implemented a number of crucial policies in the domains of research and higher

education.

The Policy Framework

History

The European research-policy domain has fully developed since the 1980s. However, as was indicated before, the European Community had been active in this domain since its very beginning. The Treaty of Rome (1957), the Single European Act (1987), and the Maastricht Treaty (1993) have created important foundations for European policy on research and technological development.

The first three European integration treaties provided specifically for coal and steel research, nuclear energy research, and agricultural research. In Article 235, the Treaty of Rome offered the community a formal base for action in the research policy domain. On this basis, an incremental diversification of research policy initiatives in other fields, such as environmental, materials, and biomedical research could develop (Caracostas and Muldur 2001).

In the early 1980s the European Commission initiated major collaborative technology projects in information technologies (ESPRIT) and communication technologies (RACE). The Single European Act introduced a special title with respect to research and technological development. The Maastricht Treaty provided an explicit basis for research activities in all fields in which the EU is competent.

A crucial step was the creation of the first multi-annual research and technological development framework program (FP). The first FP (1984-87) was designed to strengthen strategic areas of European competitiveness. It funded the research efforts of business and industry as well as higher education and research institutions, and it stimulated the creation of research networks spanning organizational and national boundaries. After this first FP, a series of other FPs followed. FP2 (1987-90) was deliberately designed as the basis and instrument of European research and technology policy. FP3 (1990-94) regrouped the research activities around three strategic areas and emphasized quality as a major criterion for selection. FP4 (1994-98) emphasized the importance of consistency between national and community policies. FP5 (1998-2002) focused on a problem-solving approach and user needs and involvement (Geuna 1999). FP6 (2002-06) and FP7 (2007-13) have added major new policy elements to the general instrument of the FP. These elements will be discussed in more detail.

Research Policy

The FPs have developed into the central EU instrument in the policy domain of research and technology. The FPs have become *the* strategic documents describing the broad strategic EU research priorities, each to be implemented through specific programs. In addition, they address the overall EU budget to be spent for the duration of the program, the breakdown of this budget into priority areas, and the ways and modalities according to which funding is made available to projects (Caracostas and Muldur 2001). The FPs are a medium-term planning instrument. They indicate the priority areas and the financial scope of European activities in research and technological development. As such, they have become a dominant factor in the European research policy.

It should be pointed out, however, that other European programs have an impact in this domain as well. Particularly the regional and social policy activities funded by the EU Structural Funds (the Regional, Social and Agricultural Guidance Funds) should be mentioned here. The Structural Funds have as their political objective to strengthen economic and social cohesion in the EU, in particular in less-favored and declining regions. In the overall European integration policy, economic and social cohesion is seen to be as crucial as the development of the monetary union and the single market, expressing the political commitment by the EU to bridge the gaps between the more advanced and less-favored regions of Europe. Throughout the 1980s and 1990s, the Structural Funds have increasingly been used for interventions by means of research and innovation-related activities, hence creating an extra funding base for research and technology policy. In a communication in 2004, the EC argued for a reform of this cohesion policy and for making the Lisbon agenda “one of the main

bases for Structural Fund intervention" (EC 2004b, 10). Complementary funding from the Structural Funds and the FP is assumed to strengthen the process of reaching the strategic Lisbon objectives.

In addition, it should not be forgotten that the research and technology policy domain in Europe is a comprehensive, multi-actor environment in which a multiplicity of intergovernmental associations and organizations exist. Examples are the EUREKA initiative, launched in 1985, that finances pre-competitive projects according to a bottom-up industrial cooperation process; ESA (the European Space Agency); CERN (the European research center for particle physics); EMBO (the European molecular biology laboratory); and the European Science Foundation, which brings together a substantial number of networks in many European countries around a large number of research programs.

Furthermore, although the financial and political strengths of the FPs are considerable, the proportion of their financial research investments on a Europe-wide scale is limited. In the sixth framework program, this proportion was only 5 percent. The other 95 percent invested in European research comes from the member states. Of course, because these national resources often cover infrastructure, salaries, and running costs of European projects, the impact of the FP funding reaches much further than the 5 percent invested. Nevertheless, the overall European research landscape suffers from fragmentation and unnecessary duplication of efforts and resources (Andersson 2006). The major challenge in the European research and policy domain is to create critical mass and joint investment schemes. This is the challenge that is being addressed in the proposals for the European Research Area (ERA).

The European Research Area. The heads of state or government of the EU decided at their Lisbon summit in 2000 that their common and national investments in research and technological development had to be increased. Aware of the fact that the European investments were considerably more limited than those of the United States and Japan, and keeping in mind that since their Amsterdam Treaty they were on the way to the "European Knowledge Society," they proposed to create the European Research Area. They proposed that the ERA should be able to better integrate national research policies, to encourage researchers to work together at the European level, to stimulate cooperation between universities and industry, and to lower the political and administrative barriers to that cooperation.

The creation of the ERA has its own history. Since the 1980s, the FPs had developed substantially. By the end of the 1990s, not only had the overall funding levels more than quadrupled, the priorities in terms of support for specific research fields had clearly evolved in the direction of a knowledge economy. In addition, the relationships with industrial and societal needs were substantially intensified.

Nevertheless, an overall assessment of the FPs in the mid-1990s (chaired by former European Commissioner Viscount E. Davignon), while praising the quality of research undertaken under the programs and the strength of the networks developed as a result, also identified a major weakness of the FP instrument. The detailed decision-making procedures (in particular, the co-decision mechanism by the European Parliament and the Council of Ministers as well as the member states unanimity rule) slowed down the further development of a common European research policy, often leading to unsatisfactory compromises. European research policy needed a streamlined and better managed research strategy, set in the broader context of innovation and the increase of Europe's global competitiveness (Davignon 1997).

During the 1990s, several initiatives were undertaken to speed up the consolidation of the European innovation agenda, eventually leading to the decision by the heads of state or government during the 2000 Lisbon summit mentioned previously. The Amsterdam Treaty (1999) clearly spoke of the importance of research and technological development for the economy and social future of Europe. Regarding the European research policy, the fifth FP reflected the results of the Davignon evaluation. FP5 was to focus on a limited number of strategic priorities in four thematic programs that would redirect the European research efforts toward addressing the major economic and societal issues of Europe. In addition, FP5 was to strengthen the structural consolidation of a truly European

system of research and innovation through three so-called horizontal programs aimed at confirming the international role of community research, promoting innovation of and encouraging the participation of SMEs, and improving human potential and the socioeconomic knowledge base. The horizontal programs were the new coordinating mechanisms in the program. They were designed to allow an integrated pursuit of better structural relationships between the European research policy and the overall innovation agenda.

The ERA was formally launched in 2000, when it was put on the agenda by means of a communication of the EC (EC 2000b). The subsequent conclusions of the Lisbon summit of that year endorsed the idea of the ERA, making it a key component of the Lisbon strategy.

However, it was only in 2002 that the ERA took further shape. In the communication *The European Research Area*, the EC noted that a specific European research policy still did not exist in the full sense of the term and called for a more ambitious approach and greater co-operation. The ERA should be a major vehicle to implement the EU's declared ambition to achieve a genuine common research policy. The objective was "to move into a new stage by introducing a coherent and centered approach at Union level from which joint strategies could be developed." The ERA intended to reflect the political will expressed by the political leaders at the 2000 Lisbon summit. "Without this political will, Europe is condemned to increasing marginalisation in a global world economy. With the ERA, on the other hand, Europe gives itself the resources with which to fully exploit its exceptional potential and to become--in the words of the Lisbon European Summit of March 2000--'the world's most competitive and dynamic economy'" (EC 2002a, 9).

The EC noted that European research represents a jigsaw of (then) fifteen often very different national scientific and technological policies. The FPs appeared to be no more than a "sort of 16th research policy, coming on top of national effects, but not dynamic enough to have a truly integrating effect." The result was compartmentalization, dispersion, and duplication as well as the failure to assemble the critical mass of human, technological, and financial resources that major scientific advances demand today. Europe also still largely lacks a proper market for knowledge capital and technological development. Creating such a market calls for a genuine European research policy (EC 2002a, 8).

The Commission pressed for a concerted effort and suggested that FP6 be designed to do exactly that. FP6 would promote integrated, cross-border projects that would benefit from shared resources and critical mass. In this sense, FP6 would create "European added value," a principle thought to be more or less synonymous with that of subsidiarity, implying that action undertaken by the Union is intended to complement that undertaken by the member states. In the research policy domain, this principle of European added value could apply in several areas: where the "critical mass" of a research project, in terms of financial and human resources, exceeds the means of a single country; where cooperation is economically meaningful (economies of scale) and offers positive effects in terms of stimulating private research; where complementary national skills can be combined, in particular in interdisciplinary situations; where joint research is of interest given the cross-border nature of the problem; and where the research links in with the Union's priorities and implementation of its policies. FP6, in this sense, was to have three main areas of action: integrating European research, structuring the ERA, and strengthening the foundations of the ERA.

FP6 had a substantial budget: over €19 billion, compared to nearly €15 billion for FP5. At a more operational level, FP6 contained various action lines, either existing ones that were strengthened in terms of support for researcher training and mobility, or new lines for development aid and for creating the scientific and technological infrastructures of the ERA. Substantial parts of the program were also devoted to identifying future European science and technology priorities and to the coordination and reciprocal opening up of national research programs. In addition, three major new instruments were introduced: support for cross-national networking of thematic centers of excellence in universities, research organizations, and business enterprises; support for integrated projects involving a critical mass of scientific and industrial partners and directed towards significant products, processes, or service applications; and participation in specific science and technology cooperation programs set up jointly by certain governments or national research organizations.

In its communication *More Research for Europe* (2002b), the EC stated that the only way to reach the ambitious targets was to increase the general investment in research to 3% of GDP and that a substantial part of this effort should come from business and industry. The Commission challenged the member states, showing that this target would imply an increase of the national expenditure levels for research of 6 to 10% on average per year. Nevertheless, during a political summit in Barcelona in March 2002, the 3% GDP target (of which two-thirds was expected to come from private funding) was accepted and was to be reached by 2010. The EU took its research area seriously.

Unfortunately, the 3% GDP target for 2010 appeared to be very hard to reach. The knowledge gap between Europe and the United States remained large. In particular, the European R&D expenditure by business and industry lagged behind (Van Vught 2004).

Therefore, it is not surprising that, at midterm between 2000 and 2010, the EU was far from its target. The special high-level group chaired by former Dutch Prime Minister Wim Kok that evaluated the progress towards the Lisbon and Barcelona objectives noted that the targets were still far away. It concluded that "halfway to 2010 the overall picture is very mixed and much needs to be done in order to prevent Lisbon from becoming a synonym for missed objectives and failed promises" (European Communities 2004, 10). Similarly, another high-level expert group, chaired by former Finnish Prime Minister Esko Aho, concluded in 2006 that there was a large gap between the political rhetoric about the knowledge society and the realities of budgetary and other priorities, and that action was urgently needed "before it is too late." The group suggested forming a pact for research and innovation made up of political, industrial, and social leaders to really build the Europe of innovation (European Communities 2006a).

A number of other pacts had meanwhile been established in the so-called technology platforms. These platforms have largely been set up at the initiative of industry and bring together companies, research institutions, the financial world, and the regulatory authorities at the European level. The objective is to develop a common strategic research agenda per platform that could mobilize a critical mass of public and private funding at the national and European levels (EC 2004b). The technology platforms are bottom-up processes uniting stakeholders around a joint vision and approach for a strategic technology. They define an overall strategy in a specific technological field to be translated into an operational program. In 2008 there were 34 European technology platforms spinning a wide range of technologies. The platforms' objective is to influence industrial and research policy at the EU, national, and regional level, while encouraging public and private investments in key technological fields. The EC sponsored some of the platforms through specific support actions in FP6. It encouraged the platforms to apply for funding in FP7, but it indicated that they should also look elsewhere for financial support. In FP7, the Commission introduced the Joint Technology Initiatives (JTIs), which are eligible for FP funding.

When the sixth FP came to its end, the ERA was still under construction. Of course, FP6 could not realize the full ERA by itself. The EU needed a policy framework that creates incentives for its member states to contribute beyond what the Union is able to offer. "Without active involvement of Member States, the Commission cannot succeed in enacting an effective global strategy for science and technology" (European Research Advisory Board 2006, 7).

In developing the seventh FP, the EC took this suggestion to heart. It noted that in FP6 successful efforts were made to improve the coordination of national research programs but that these efforts must be strengthened. The networking of national programs (through the so-called ERA-NET activities) should receive more resources, and more attention should be given to the mutual opening up of national research programs (EC 2004b).

During the summer of 2006, the leaders of the EU reached an agreement on FP7, with a budget of €53.2 billion. FP7, which started in January 2007, is a major program for realizing the "re-launched" Lisbon agenda. It is the chief instrument for funding European research and innovation and creates a new policy context for the ERA.

Subtitled "Building the European Research Area of Knowledge Growth," FP7 is designed to respond to the competitiveness and employment needs of the EU. It is based on the assumption that knowledge is Europe's greatest resource and that growth and competitiveness can be given a new

impetus by this resource. The program places greater emphasis than before on research that is relevant to the needs of European industry through the technology platforms and the new Joint Technology Initiatives (JTIs), which will develop research projects in fields identified through dialogue with industry. The program also, for the first time, provides support for the best European "frontier research," with the creation of a European Research Council (ERC). The ERC funds the best European research activities, as assessed by international academic peer review.

The Commission acknowledges that the technology platforms, led by industry, have been able to create more focus in the European research activities. In FP7, it introduces the JTIs as a new funding scheme, offering a framework for particularly ambitious research and technology agendas that require public and private investment at the European level. JTIs are dedicated legal structures that coordinate the mobilization of large-scale public and private investments and substantial research resources. JTIs are assumed to accelerate the generation of new knowledge, to enhance the uptake of research results into strategic technologies, and to foster the necessary specialization in high-tech sectors that may determine the EU's future industrial competitiveness. Initially, six JTIs have been identified.

FP7 is organized into four specific programs. In the Cooperation Program, the objective is to gain European leadership in key areas through cooperation of industry and research institutions (like the JTIs). Support is given to research activities carried out in transnational cooperation, from collaborative projects and networks to the coordination of national research programs.

In the Ideas Program, the objective is to strengthen the science base of Europe by funding European-wide competition. The autonomous ERC (with a budget of €7 billion) supports frontier research by individuals or partnerships in all scientific and technological fields.

The People Program has as its objective to reinforce the career prospects and mobility of European researchers. Support is available for training, mobility, and the development of European research careers.

In the Capacities Program, the objective is to develop research and innovation capacities throughout Europe, so that the European researchers have excellent facilities at their service. Support is available for research infrastructures, regional clusters, research for and by SMEs, "science in society" issues, and horizontal international cooperation.

FP7 is a continuation of FP6 and continues to develop the ERA. But FP7 intends to be less bureaucratic and simpler in its operation. In addition, FP7 has international cooperation as an integrated dimension in each of its four programs; it has a focus on the development of the "regions of knowledge" (strengthening the research potential of regions); and it comprises a Risk-Sharing Finance Facility aimed at fostering private investment in research by improving access to the European Investment Bank.

In the spring of 2007, the EC took an important next step in developing the ERA. It published a green paper, entitled *The European Research Area: New Perspectives* (2007c) and opened a discussion on how the current research system of Europe can be improved. The Commission intends to further develop the idea of the ERA. It argues that, since the ERA's introduction in 2000, the context of European research has evolved. Globalization has accelerated, various new socioeconomic challenges have grown (climate change, aging, the risks of infectious diseases), and the European research landscape has changed (notably with the launching of new measures such as the ERC and the European Institute of Innovation and Technology). Within this changing context, the ERA concept itself has been subject to gradual changes. Its scope has broadened from a focus on how to improve the effectiveness and efficiency of the fragmented European research landscape, to the awareness that more public and private investment in research is needed, and to the view that research policy should be related to other EU policies in order to achieve coherence and synergies in the context of the overall Lisbon strategy. According to the Commission, the expanded ERA must comprise six features: (1) an adequate flow of competent researchers with high levels of mobility among institutions, disciplines, sectors, and countries; (2) world-class research infrastructures, accessible to all; (3) excellent research institutions engaged in public-private cooperation, involved in clusters and virtual communities, and attracting human and financial resources; (4) effective knowledge-sharing between

the public and private sectors and with the public at large; (5) well-coordinated research programs and priorities; and (6) the opening of the ERA to the world, with special emphasis on neighboring countries.

Researcher mobility is clearly a priority throughout the green paper. It suggests that the movement of knowledge is crucial for the future of the EU. The movement of knowledge should become a "fifth freedom" within the EU, complementing the four freedoms of the Treaty on European Union, which protects the free movement of goods, services, capital, and labor (EC 2007c).

The 2007 green paper once more reflects the idea that knowledge is Europe's best resource. According to the EC, investing in knowledge is the most important way to foster economic growth and to create more and better jobs while at the same time ensuring social progress and environmental sustainability. The EU research policy plays an important role in delivering these goals. Research has come to be at the core of the EU's renewed ambition to stimulate growth and employment. It is the key component of a broader European innovation policy.

Higher Education Policy

Generally speaking, higher education has come only slowly onto the supranational European agenda. Although some educational activities were developed at the European level during the 1970s (in particular in the field of vocational training and the education of migrant workers' children), the education sector was for a long time "taboo" for European policy initiatives (Neave 1984, 6). The European Community had not been given competence in the field of education by the national governments.

Only in the period 1985-1993 did a first group of policy initiatives come about. Well-known European programs in the late 1980s and early 1990s are: the Community Programme for Education and Training in Technology (Comett), the European Community Action Scheme for the Mobility of Students (Erasmus), and the Trans-Mobility Programme for University Students (the inter-university cooperation program with nations of central and eastern Europe--Tempus) (European Communities 2006b). The Maastricht Treaty forms an important further milestone in this context. This treaty is a landmark in the history of the European policy domain of education and training, creating for the first time a clear and legal basis for European initiatives in this field.

In the Treaty of Nice (2001), it was decided that the EU would be able to contribute to the development of quality education by encouraging cooperation between member states through a wide range of actions, such as promoting the mobility of citizens, designing joint study programs, establishing networks, exchanging information, and teaching languages for all citizens of the EU. The basic idea was that, although the competence for education in general and higher education in particular remains at the level of the member states, the Union has a complementary role to play by adding a European dimension to education, by helping to develop quality education, and by encouraging life-long learning.

The main tool for putting this ambition into practice became the Socrates program. The first phase of this program ran over the period 1995-1999, the second phase during the years 2000-2006. The Socrates II program supports European cooperation in eight areas, from school to higher education, and from new technologies to adult learners. The higher education section of the program continues the older Action Scheme for the Mobility of the Students, called the Erasmus program, established in 1987. As the higher education Action of Socrates II, the Erasmus program intends to enhance the quality of and reinforce the European dimension of higher education by encouraging transnational cooperation between universities, by boosting mobility, and by improving the transparency and recognition of studies and qualifications.

The European Higher Education Area. However, the roots of the current European higher education policy lie, in a special way, in the history of the European universities. In May 1998, the French minister of education used the 800th anniversary of the Sorbonne as an occasion to design a joint declaration of the ministers of France, Germany, Italy, and the United Kingdom on the

"harmonization of the architecture of the European higher education system." The objective was to create a European higher education area by means of a common two-cycle degree structure, the mutual recognition of degrees, and increased student mobility. The ministers stressed that "the Europe we are building is not only that of the Euro, the banks, and the economy, it must be a Europe of knowledge as well" (Sorbonne Declaration 1998, 1).

The Sorbonne Declaration proved to be a "quantum leap" in the development of European higher education policy (Witte 2006, 124). The four ministers agreed to organize a follow-up meeting in Italy and called on other European countries to join their initiative. The result was astonishing. The eagerness of the other European education ministers to participate in this initiative becomes visible in the twenty-nine signatures of the European ministers under the Bologna Declaration, designed in a city with an even older European university. The Bologna Declaration formulates the wish to construct the European higher education area (EHEA), to promote mobility and employability, and to increase the compatibility and comparability of the European higher education systems. It also emphasizes the need to increase the "international competitiveness" of Europe's higher education and its "worldwide degree of attraction" (Bologna Declaration 1999).

Since the Bologna conference, the process accelerated. Follow-up conferences were held in Prague (2001), Berlin (2003), Bergen (2005), and London (2007). The "Bologna ministers" (an expanding group of forty-six nations in 2007) added new actions on lifelong learning, on a common framework of qualifications, on a coherent quality assurance and accreditation mechanism, and on an additional focus on the doctorate level (the third cycle) in the Bologna process. In addition, they increasingly focused on the alignment of the EHEA with the ERA.

The Bologna process rapidly became a central dimension in the emerging higher education policy of the EU. In particular, since the formulation of the Lisbon agenda in 2000, higher education rapidly moved up the ladder of the EU's policy concerns (Shaw 1999; Corbett 2005).

In 2003, the EC opened a debate on the "place and role of European universities in society and the knowledge economy" (EC 2003b, 4). The EC had not reflected on the European universities since the early 1990s, when it had published a memorandum on higher education in Europe (EC 1991). However, since the European universities at the beginning of the twenty-first century are at the heart of the Europe of Knowledge, being responsible for 80 percent of Europe's fundamental research, the EC intended to explore the conditions under which Europe's universities would be better able to effectively play their role in the knowledge society and economy (EC 2003b).

The analysis by the Commission is stern: "[t]he European university world is not trouble-free, and the European universities are not at present globally competitive." They should realize that the traditional model of Wilhelm van Humboldt no longer fits the current international context and that the high degree of fragmentation of the European university landscape prevents Europe from responding to new global challenges. These challenges go beyond national frontiers and have to be addressed at a European level. "More specifically, they require a joint and coordinated endeavour by the Member States…., backed up and supported by the European Union" (EC 2003b, 10).

In its contribution to the Bergen conference of the Bologna process (2005), the Commission stated clearly that "from the EU perspective, the Bologna process fits into the broader Lisbon Strategy" (EC 2005b, 2). But it again emphasized that Europe and its universities face stronger competition that ever before. The figures tell us "that the situation is alarming."

Only 21% of the EU working-age population in 2002 had achieved tertiary education, significantly lower than in the United States (38%), Canada (43%), Japan (36%), and South Korea (26%). In the EU, 52% of the relevant age group was enrolled in higher education; this was slightly more than Japan (49%) but less than Canada (59%) and certainly the United States (81%) and South Korea (82%). The number of researchers per 1,000 employees in the EU was 5.4, marginally less than Canada or South Korea, but far below the United States (9.0) or Japan (9.7) (EC 2005d, 3). Only a handful of European universities were found in the top fifty of the world. Indeed, the situation is alarming, and profound reforms are needed.

According to the EC, the European universities have so far failed to unleash their full potential to stimulate economic growth, social cohesion, and improvement in the quality and quantity of the

jobs. In a policy paper in 2005, the EC identifies the following bottlenecks: a tendency to uniformity and egalitarianism in many national higher education systems, too much emphasis on monodisciplinarity and traditional learning and learners, and too little world-class excellence (EC 2005d). European higher education remains fragmented into medium or small clusters with different regulations and languages; it is largely insulated from industry; graduates lack entrepreneurship; and there is a strong dependency on the state. European higher education also is over-regulated and therefore inefficient and inflexible. In addition, European universities are underfunded; EU countries spend only 1.9% of GDP on research while the United States, Japan, and South Korea are close to 3%; EU countries spend only 1.1% of GDP on higher education, far less than Canada (2.5%), the United States (2.7%), and South Korea (2.7%); underfunding leads to low enrollment rates, failures to prepare students for the labor market, and difficulties in attracting and retaining top talent.

In the view of the Commission, the quality and attractiveness of the European universities need to increase, human resources need to be strengthened, and the diversity of the European higher education system needs to be combined with increased compatibility (EC 2004a). The Commission launched in 2004 the Integrated Lifelong Learning Programme (2007-2013), with the general objective of contributing to the European knowledge society. The Lifelong Learning Programme consists of four sub-programs, one of which is the Erasmus program. A crucial aim of this program is to reinforce the contribution of higher education institutions to the process of innovation. For this aim, the autonomy of and investments in universities should be increased. The Commission urges the member states to establish a new partnership with their universities, moving from state control to accountability, and to acknowledge that addressing the severe funding deficit in higher education is a core condition for achieving the Lisbon ambitions (EC 2005d).

The political leaders of Europe lent a ready ear to the Commission's analysis and suggestions. During the Spring European Council of 2006, they decided that all member states should try to reach the overall EU target for 2010 for R&D spending of 3% of GDP and that the investments in higher education should rise to at least 2% of GDP by 2010. The Commission produced another communication in which it identified four priority actions for more growth and jobs, "requiring a strong impetus from the highest political level and which should be implemented no later than the end of 2007." One of these four actions is: "investing more in knowledge and innovation," including the urgent promotion of excellence in both research and education, "particularly world-class universities with adequate funding streams and closer links with business" (EC 2006e, 14-17).

It appears that by 2006 higher education had evolved as a crucial policy concern at the supranational, European level.

Innovation Policy

Innovation is a concept that has rapidly risen on the political agenda of Europe. Already FP1,which was intended to strengthen strategic areas of European competitiveness, has stimulated the creation of research networks in which both universities and industry participate.

However, it was not until 1995 that the EC published a green paper on innovation, launching a vast debate on innovation in all member states (EC 1995). Based on this, the Commission drew up an action plan for innovation in which three objectives were singled out: to develop a true culture of innovation; to adapt the administrative, legal, financial, and fiscal environment; and to strengthen the links between research and innovation.

The first objective intended to improve the generic societal perception of innovation and the mobility of researchers, teachers, and students. The second wanted to design the various administrative service systems that could stimulate research and innovation (intellectual property issues, venture capital, etc.). The third intended to create better links between research and innovation and was reflected in FP5 as well as in other Community instruments (in particular the Structural Funds).

The fifth and sixth framework programs made explicit reference to the importance of innovation. FP5 intended to consolidate a truly European system of innovation through the

strengthening of the horizontal programs for innovation, international distinction, and human capital formation. FP6 was assumed to help create a proper European market for knowledge capital and technological development in order to allow the Union to further develop its innovation agenda.

The seventh framework program is clearly designed to address the competitiveness and innovation needs of the EU. FP7 puts greater emphasis on the linkages between knowledge institutions and industry than ever before. It acknowledges that knowledge is Europe's main asset and that the production and application of knowledge are crucial processes in achieving the goals of increased economic growth and more and better jobs.

As indicated previously, in 2005 the EC launched the New Lisbon Partnership for Growth and Jobs (EC 2005e). The Spring European Council of that year singled out "knowledge and innovation for growth" as one of the three main areas of action for the Union. Innovation and research policies were assumed to be the central elements of the new strategy, as together they cover the full spectrum of issues regarding the production and exploitation of knowledge.

The new partnership specifies the actions for the member states (based on the partnership's integrated guidelines) regarding the preparation of the three-year National Reform Programmes as well as those for the Community (The Community Lisbon Programme). The overall objectives are to achieve sustainable global competitiveness and to create a vibrant European knowledge economy. A coherent and integrated set of policies is assumed to be crucial to reach these ambitious goals.

The European policy domain of research and technology is a priority area in this broader policy set. It has become part of the integrated research and innovation agenda that focuses on both knowledge creation and knowledge utilization. The Commission's action plan *More Research and Innovation* (European Innovation 2005) makes this very clear. It addresses the full research and innovation spectrum, including non-technological innovation. It makes explicit the commitments taken by the Community Lisbon Programme, by detailing the measures in support of research and innovation that will be undertaken. It outlines ambitious actions, reaching beyond the 3 percent target for 2010. It strengthens the links between research and innovation, with research policy focusing more on developing new knowledge and innovation policy focusing on transforming knowledge into economic value and commercial success (European Innovation 2005).

Research and innovation clearly have moved to the heart of EU policymaking. In this central focus of policy, the Commission promises better and more effective regulation (the "better regulation" initiative) with respect to research and innovation, but it also urges the member states to support research and innovation wherever possible. The Commission also encourages cross-border research cooperation, public-private partnerships, research dissemination strategies, and joint European research projects. It intends to further develop the European protection of intellectual property and to continue exploring a "European patent." It wants to create an open and competitive European labor market for researchers and to stimulate research career paths at the transnational level. It points at the benefits of public procurement for innovation (public authorities as launching customers for innovative products and services) and at the positive effects of R&D tax incentives. In its "industrial policy" the EC provides special innovation policy tools, like the Innovation Scoreboard for benchmarking national and regional innovations performance; the Network of Innovating Regions for the exchange of best practices; Europe INNOVA, a communication platform for professionals in various clusters and sectors: the Innovation Relay Centers for stimulating knowledge transfer in a wide range of markets; and the IPR Helpdesk, an on-line information tool on intellectual property rights for SMEs.

In short, the EC intends to create a truly European innovation agenda. It asks the member states to identify research and innovation as key challenges in their National Reform Programmes (NRPs) and to report annually on their targets and policy progress in these fields. In the context of its research policy, the Commission focuses on the new instruments in the seventh framework program, in particular the JTIs, the Risk-Sharing Finance Facility, the extra funding for the research and innovation capacity of SMEs, and the Regions of Knowledge initiative. In addition, the Commission promotes the use of the Structural Funds and the Rural Fund to improve the European knowledge and innovation base and the use of financial risk facilities for SMEs. The focus on SMEs is particularly

found in the EU's Competitiveness and Innovation Programme (CIP, 2007-2013), which is designed to support actions to help business and industry to innovate, particularly SMEs.

A special initiative by the EC concerns the European Institute of Innovation and Technology (EIT). The proposal to establish an EIT was put forward as part of the midterm review of the Lisbon strategy in 2005 and has since been further developed. The suggestion is that the EIT could be an "education, research, and innovation operator" and that it will be structured to integrate these three areas. The EIT should be a "knowledge flagship." It should set out "to attract and keep the best talents in students, researchers and staff in Europe, to work side by side with leading edge business in the development and exploitation of knowledge and research, and to enhance research and innovation skills generally" (EC 2006b, 2).

Realizing that the EU's funding to promote innovation and research activities represents only a small fraction of the overall public European effort (only about 5 percent), the Commission also presses for the mobilization of national funding in support of European research and innovation activities. It proposes to extend the Community's instruments to further stimulate transnational cooperation and coordination by providing direct Community support for joint research and innovation programs between member states. The new European innovation agenda indeed is designed as a new partnership between the EU and the member states.

The coordination of national and regional research programs in the EU context already was a focus of attention since early 2002, when the European research ministers acknowledged the importance of the progressive opening-up of national research programs as an important step towards the construction of the ERA. For the first time, in FP6, a specific action line was designed to address this issue: the ERA-NET scheme. ERA-NET is the network of national research councils, working together on a voluntary basis for more cooperation. ERA-NET is essentially a bottom-up process in which national research programs are coordinated and mutually opened up. The objective of the ERA-NET is to increase the cooperation and coordination of national and regional research programs in the member states through the networking of these programs. In FP7, the ERA-NET is reinforced by a new module (called ERA-NET Plus) that provides a financial incentive by topping-up joint transnational funding with Community funding.

As a result of the EU innovation policy, the positions of the European universities in research and innovation are clearly reinforced. The European research policy domain has become a cornerstone of a full European innovation policy, and the European universities and other public research institutions are being challenged to contribute to implementing that policy.

Doctoral Education Policy

A crucial dimension of the overall policy framework of the European academic research enterprise is the increasing attention to and importance of doctoral education. The topic of doctoral education was addressed at the European level during the Bologna summit in Berlin (2003) and later in Bergen (2005) and London (2007). In Berlin, the education ministers decided that it was "necessary to go beyond the present focus on two main cycles of higher education and to include the doctoral level as the third cycle in the Bologna process." They emphasized the importance of research and research training in enhancing the competitiveness of European higher education and called for increased mobility at the doctoral level and stronger inter-institutional cooperation (Berlin Communiqué 2003, 7). During the Bergen meeting, the ministers urged the European universities "to ensure that their doctoral programs promote interdisciplinary training and the development of transferable skills, thus meeting the needs of the wider employment market." Also, the number of doctoral candidates should be increased to contribute to the needs of the knowledge society (Bergen Communiqué 2005, 4). At their London meeting, the ministers invited the universities to reinforce their efforts to embed doctoral programs in their institutional strategies and to develop career paths for doctoral candidates and early-stage researchers (London Communiqué 2007).

In 2003, the EC also paid attention to doctoral education. In its communication *Researchers in the European Research Area: One Profession, Multiple Careers*, the Commission discussed the

recruitment, training, and career opportunities of researchers (EC 2003a). In particular, it argued that the competencies and skills of doctoral candidates should focus on a wider labor market perspective than only academic careers.

Doctoral education is beginning to feature higher on the European research and education agendas. The days of the Humboldtian doctorate as the entrance to an academic career appear to have passed. Doctoral education is assumed to be able to play a major role in creating the highly trained labor force for the knowledge society, which is understood to need knowledge professionals who have the competencies to work in highly complex, knowledge-intensive environments. Europe indeed seems to have discovered the full potential of the third cycle in higher education (Bartelse and Huisman 2008).

Doctoral education is considered to be the major link between the Bologna and the Lisbon agendas (Aghion et al. 2008), and more specifically between the European higher education and research areas. Not only has it become an official part of the European political agenda in the Bologna process, it also is a crucial point of attention in the EU innovation strategy. The EC presses for an open, single, and competitive labor market for researchers with attractive career prospects and incentives for mobility. In the near future, doctoral graduates may be assumed to not only find their careers in academia, government, and private sector R&D laboratories but also in general management positions.

As a consequence, doctoral education appears to be entering a phase of further innovation and diversification. The European University Association (EUA) has set up a special Council on Doctoral Education with the objective of contributing to the development, advancement, and improvement of doctoral education and research training. European universities also have recognized the need to offer doctoral candidates a broader experience than core research disciplinary skills based on individual training by doing research. They increasingly introduce courses and modules offering transferable skills-training and preparing candidates for career opportunities in sectors beyond academic institutions (EUA 2005b). European universities appear to be accepting the challenge to diversify their doctoral training programs. Relatively new concepts like professional doctorates, industrial doctorates, taught doctorates, and practice-based doctorates have made their entry into the European discussions. In the years to come the traditional Humboldtian doctorate may very well be supplemented with a variety of new European doctorates (Scott 2006).

Knowledge Transfer Policy

In the 2006 Spring European Council, the European member states indicated that they expected to increase their R&D spending. The Commission urged them to implement their NRPs (National Reform Programmes) and to set ambitious expenditure targets for R&D and higher education, but it also indicated that Europe needs to continue to improve its knowledge infrastructure and to reinforce its capacity for knowledge transfer. More investments in knowledge and innovation are needed, and "the quality of the European innovation systems requires particular attention" (EC 2006e, 16). Excellence in both research and higher education needs to be further promoted. But stronger links with business and industry are also needed, and the knowledge transfer processes need to be strengthened.

The 2006 Council called on the EC to present a "broad based innovation strategy for Europe that translates investments in knowledge into products and services" (European Council 2006, 6). In September 2006, the Commission published its communication *Putting Knowledge into Practice: A Broad-based Innovation Strategy for the EU* (EC 2006d).

The strategy is a comprehensive European innovation policy, with a clear emphasis on knowledge transfer. It is intended to frame policy discussions on innovation at national and European levels. It outlines the most important planned and ongoing initiatives, identifies new areas of action, and in particular introduces a more focused strategy to facilitate the creation and marketing of new innovative products and services in promising areas--"the lead markets" (EC 2006d, 3).

In April 2007 the Commission published its communication on knowledge transfer and a set of voluntary guidelines for research organizations to help them improve their links with industry. The document uses a broad definition of the knowledge transfer concept: "Knowledge transfer involves the process of capturing, collecting and sharing explicit and tacit knowledge, including skills and competence. It includes both commercial and non-commercial activities such as research collaborations, licensing, spin-off creation, researcher mobility, publication, etc." (EC 2007d, 2). The general objective of the communication is to serve as a starting point for increased cooperation among the member states and the EU in this field, leading to a common European approach to knowledge transfer.

According to the Commission, major barriers to greater knowledge transfer exist in the EU. They include cultural differences between the academic and the business communities, legal barriers, fragmented markets, and lack of incentives. Some member states have set up initiatives to promote knowledge transfer, but these largely ignore its international dimensions (EC 2007d).

The document highlights the importance of a number of measures, like creating a workforce of skilled knowledge transfer staff in universities (and a professional qualification and accreditation scheme), developing a more entrepreneurial mindset in universities, and allowing for exchanges of staff between research organizations and industry. It also emphasizes the importance of financial support for knowledge transfer. In addition to FP7, European funds mentioned include the Regional Development Fund and the Social Fund. The suggested voluntary guidelines to help improve knowledge transfer cover issues like intellectual property management, incentives for researchers to participate in knowledge transfer activities, and the development of knowledge transfer resources (EC 2007f).

During the 2007 Spring European Council of the heads of state or government, the current level of European competitiveness was discussed. The member states invited the Commission to push forward the implementation of the general innovation policy. The meeting concluded that the member states are determined to improve the conditions for innovation, such as competitive markets, and to mobilize additional resources for research, development, and innovation. They also underlined the importance of increased attention to knowledge transfer. In this context, the European ARE is seen as a crucial actor for the revitalization of the knowledge and innovation capacity of Europe. It is urged to use its qualities, not only to create, but also to "activate" knowledge (Soete 2005). It is invited to play a pivotal role in the further development of the European knowledge society.

Assessment

Integrated Subsystems

In the preceding paragraphs, it has become clear that during the last few decades a supranational European innovation policy has been developed that now includes a number of inter-related policy fields. Generally speaking, these policy fields can be divided into two large policy domains: research policy (including knowledge transfer policy) and higher education policy (including doctoral education policy). Although these two policy domains have their own origins and histories, they increasingly appear to have come together under the broader umbrella of the all-embracing Lisbon agenda.

In particular, since the re-launch of this agenda in the New Lisbon Partnership in 2005, the EC has tried to develop a general strategy that could form a solid base for the further development of the EU. The Union faces fierce economic competition on a global scale and sees it as a major task to develop a comprehensive innovation agenda. The higher education and research policy domains have become crucial elements of this broader agenda.

The Commission's communication to the Spring European Council in 2005 makes these points clearly: "Just think what Europe could be. Think of the innate strengths of our enlarged Union. Think of its untapped potential to create prosperity and offer opportunity and justice for all its citizens. Europe can be a beacon of economic, social and environmental progress to the rest of the world" (EC

2005e, 3). Referring to the midterm evaluation by the Kok high-level group, which stressed the widening growth gap with North America and Asia, the Commission rose to the challenge to present its proposals for the Union's strategic objectives:

> Europe's performance has diverged from that of our competitors in other parts of the world. Their productivity has grown faster and they have invested more in research and development. We have yet to put in place the structures needed to anticipate and manage better the changes in our economy and society. We need a dynamic economy to fuel our wider social and environmental ambitions. This is why the renewed Lisbon Strategy focuses on growth and jobs. In order to do this we must ensure that: Europe is a more attractive place to invest and work; knowledge and innovation are at the beating heart of European growth; we shape the policies allowing our business to create more and better jobs. (EC 2005e, 4)

The higher education and research policy domains are interpreted as subsystems of a larger overall European innovation policy. To allow Europe to focus on its two principal tasks--delivering stronger, lasting growth and creating more and better jobs--the Union needs a knowledge and innovation policy, consisting of a number of elements:

> public authorities at all levels in the Member States must work to support innovation, making a reality of our vision of a knowledge society; more investments by both the public and private sector spending on research and development are needed; a major reform of State Aid policy should be realized to allow Member States to support research and innovation; our universities should be able to compete with the best in the World through the completion of the EHEA; a 'European Institute of Innovation and Technology' should be created; Innovation Poles designed to help regional actors bring together the best scientific and business minds should be supported; the promotion of eco-innovation should be intensified; partnering with industry should be fostered by European Technology Initiatives…. (EC 2005e, 9)

The renewed Lisbon agenda is an ambitious innovation agenda to which the higher education and research policies are assumed to contribute. The Commission's 2005 action plan "More Research and Innovation" argues that the relationship between research and innovation is the key factor for economic growth (European Innovation 2005). Similarly, the Commission's communication to the 2006 Spring European Council stresses the importance of promoting excellence in both higher education and research as well as further strengthening the links between academia and industry (EC 2006a).

During that conference, the European heads of state or government asked the Commission to design a broad-based European innovation strategy. The Commission's answer was its 2006 communication *Putting Knowledge into Practice*, in which it argues that "the EU can only become comprehensively innovative if all actors become involved and in particular if there is a market demand for innovative products." For this, "education is a core policy" and a "two-way communication between researchers and business" is required. (EC 2006d, 4, 8-9). In its innovation strategy the Commission emphasizes the importance of the integration of the various policy domains. The innovation strategy "presents a framework to take innovation forward bringing together different policy areas that have a bearing on innovation" (EC 2006d, 3).

In the broader context of the Union's innovation strategy, the European research and higher education policies have not only been subsumed under a more comprehensive policy, they also have become more integrated than ever before. FP7, the *Modernizations Agenda for the European Universities* (EC 2006a), the communications on doctoral education and knowledge transfer, and the green paper on the ERA (EC 2007c) breathe the same spirit. As major documents in their policy domains, they convey the same message: the European universities have crucial roles to play in further developing the European knowledge society.

A Multi-Echelon System

The integrated European innovation policy system is a rather complex phenomenon. It encompasses a broad array of issues, addresses a variety of actors, and makes use of a diversified set of instruments.

It appears that the European innovation policy system can be described as a multi-echelon system. A multi-echelon system consists of a family of interacting subsystems, of which many have decision-making competences that allow them to influence one another. The concept of echelons refers to the mutual relationships between the decision-making levels comprising the overall system. The echelons have their own authorities and competences but are mutually interdependent. The very nature of multi-echelon systems is this interdependency of the various levels of a system. In a multi-echelon system the higher level units condition, but do not completely control, the goal-seeking activities of the lower-level units. The lower level units have the freedom to (at least partly) select their own courses of action. Their decisions might be, but are not necessarily, the ones that the higher level would select (Mesarović, Macko, and Takahara 1970).

In the European innovation policy system, at least four crucial echelons can be distinguished: the EU (with its various actors), the member states (with their political actors), the universities, and the groups of individual academics working in these universities. All of these four echelons have their own competences and decision-making authorities. But in the European innovation policy system, these echelons also are interrelated and interdependent.

In the increasingly integrated policy domains of research and higher education, the EU addresses both the member states and the public research organizations (including the individual academics in these organizations). In addition, in the broader context of its innovation policy, the Union reaches out to business and industry and to other societal actors (regional and local authorities, civil society organizations, trade unions, and consumers). The EU calls for "a wide partnership for innovation where supply of new ideas and demand for new solutions both push and pull innovations" (EC 2006d, 3-4).

As we have seen, the EU has strong competences in the research policy domain. Since the mid-1980s, the EU has used its FPs as a crucial, strategic, financial policy instrument to influence the overall research agenda of Europe. Arguing that the Union's policies in this field create "European added value," emphasis has been put on building focus and critical mass and on fostering cooperation and excellence.

The FPs address research organizations, research groups, and individual researchers directly. They are strong and attractive funding schemes that have a considerable influence on the dynamics of European research. Many European universities and researchers have acquired EU research funding from the successive programs.

Regarding the member states, the European research policy initiatives promote the coordination and reciprocal opening up of national research programs. Through the ERA-NET scheme (implemented in FP6 and expanded in FP7), the EU seeks to increase the cooperation and coordination of national research programs, using its financial capabilities to provide incentives for the organization of joint initiatives by member states. In addition, also in this domain, the "Open Method of Coordination" (OMC) is being used to create a Union-wide policy forum for comparing and discussing national efforts and results.

Another initiative by the EU that addresses the other echelons of the innovation policy system is the introduction of an integrated European human resources strategy. To enhance the public recognition of the role of researchers in the European knowledge society, the EU has published a recommendation on the European Charter for Researchers and on the Code of Conduct for the Recruitment of Researchers (EC 2005c). The intention of the Charter and the Code is to give individual researchers the same rights and obligations wherever they work in the EU. In the 2007 green paper on the ERA (EC 2007c), the Commission outlines a broad strategy for the free movement of knowledge, of which researcher mobility is a crucial element.

In the innovation policy system, several policy echelons coexist. The EU tries to influence and coordinate the decisions and activities of the other echelons by using the competences it has at its disposal. It does so by means of a diversified set of policy instruments.

European Policy Instruments

The EU has several categories of policy instruments at its disposal. In accordance with the literature on policy analysis, I distinguish three basic categories of European policy instruments (Mitnick 1980; Hood 1983; Van Vught 1994).

The first category consists of the legal policy instruments of the EU. Here it is important to keep in mind that the EU is formally neither a federal government nor an intergovernmental organization. The EU is based on the agreements among its member states.

Generally speaking, there are three types of European legal instruments. The first is the so-called primary legislation type. Primary European legislation basically consists of the various European treaties and their annexes and protocols. Treaties are legally binding and have to be ratified by the parliaments of the member states. The treaties form the "constitutional structure" of the EU and provide the formal contexts in which research and higher education policies can be developed.

In addition to the treaties (primary legislation), secondary European legislation regards the various legal instruments that the EU uses to develop and implement its policies. These instruments are:

- Regulations: legislative acts of the EU that have general scope, are obligatory in all of their elements, and are directly applicable in all member states.
- Directives: legislative acts of the EU that require the member states to achieve a particular result without dictating the means of achieving that result. Directives are only binding on the member states to whom they are addressed. In practice, they are addressed to all member states.
- Decisions: binding legislative acts of the EU that are not of general application and only apply to its particular addressee.
- Recommendations: non-binding EU acts aiming at the preparation of legislation by the member states.

The three binding policy instruments of secondary legislation (regulations, directives, and decisions) are strong and powerful forms of EU law. They are applied in the research policy domain but only minimally in the context of higher education. In the research policy domain in particular, the FPs are implemented through decisions and their more detailed elaboration (in the so-called Rules of Participation) through regulations.

The third type of European legal instrument includes the decisions by the European Court of Justice and the Court of First Instance. The European Court of Justice is the EU's Supreme Court, which adjudicates on matters of interpretation of EU law, most commonly claims by member states that the EC has exceeded its authority or by the Commission that a member state has not implemented a binding legislative act. The Court of First Instance (which is an independent Court attached to the European Court of Justice) hears and determines nearly all direct actions brought by individuals and member states, including actions against acts as well as inactions by the Community institutions.

In the research and higher education policy-domains, several examples of this type of legal instrument can be found. Well-known is the landmark decision by the European Court of Justice in 1985 (the Gravier case) that access to university is covered under European primary legislation and that any discrimination based on nationality would be against European law. As a result, EU students can only be charged the same (if any) study fees as national students. Another well-known case is the one in 2004 of a French student claiming financial support from the British government on the basis of the nondiscriminatory principle (the Bidar case). The Court judged in favor of the claim. In the research policy domain, many cases are found in which either one or more member states or the Commission ask for the Court's judgment. It appears that in the majority of cases the Court rules in favor of the Commission's position.

Nearly all policy issues in the European higher education policy domain are implemented by means of intergovernmental conventions and resolutions, without any legal authority at the level of the Union. In the context of the Bologna process, for example, the action lines (like the three-cycle structure, the Bologna process qualifications framework, and the coordination of the quality assurance processes) all are the result of interministerial agreements. The EU does not have the authority to

make use of its legal instruments in this policy domain. Given the subsidiarity principle, it necessarily limits itself largely to its instruments of information and communication.

The second category of European policy instruments are the financial instruments. Most prominent in this category is the subsidy instrument, which basically refers to the power of signing checks. Subsidies are payments made to individuals or organizations under the condition that the recipient supplies a particular product or service. In this sense, subsidies are contracts, under which payments are made when the recipient accepts the conditions set by the provider of the funds.

In the EU research policy domain, the FPs employ this policy instrument. Similarly, the CIP (Competitiveness and Innovation Programme) uses this instrument to stimulate actions and outcomes that support the objectives of the renewed Lisbon strategy. In the higher education policy domain, the Life Long Learning Programme and the Socrates/Erasmus mobility program provide examples of the application of the subsidy instrument.

In addition to the subsidy instrument, other financial instruments, particularly loans and warranties, appear to be increasingly considered in the European context. In the seventh framework program, the Risk-Sharing Finance Facility is a clear example. In the CIP, a financial risk facility instrument for SMEs has been suggested.

The third and final category of European policy instruments are those of information and communication. Two crucial instruments in this category are the Communication and the OMC.

The EC can publish communications in areas wherein it is not assigned authority to use legal instruments. In practice, the Commission uses this policy instrument for agenda setting and as a means to share its views on certain issues. Communications are usually preceded by consultations of the relevant stakeholders and/or expert groups.

Several examples of the use of the communication instrument have already been presented. Let me repeat a few. The re-launch of the Lisbon strategy started with a communication to the Spring European Council in 2005 (EC 2005e). The 2006 broad EU innovation strategy with its ten-point program was presented as a communication from the Commission to the European Council, the European Parliament, the European Economic and Social Committee, and the Committee of the Regions (EC 2006d). In the research and technology policy domain, the Commission used the communication instrument, among others, to develop the ERA and to set the 3% of GDP target for R&D investments (EC 2002a). In the area of knowledge transfer policy, the Commission used the communication instrument to suggest guidelines for effective knowledge transfer (EC 2006d, 2007f). In the higher education policy domain, the Commission used the communication instrument to suggest a modernization agenda for the European universities (EC 2006a), to launch the EIT, and to start a discussion on the labor market skills of doctoral graduates.

The OMC is a relatively new European policy instrument, which was created at the 2000 Lisbon Council as an instrument for intergovernmental policy analysis. The OMC works with information and communication mechanisms, such as indicators, benchmarking, and the sharing of best practices. Generally speaking, the OMC works in stages. First, a Council of Ministers agrees on a set of (often broad) policy goals. These are then translated by the member states into national and regional policies. Next, specific benchmarks and indicators to measure best practice are agreed upon. Finally, the results are monitored, compared, and evaluated.

The OMC is a “soft” policy instrument that has a decentralized approach. The agreed policies are implemented by the member states and supervised by the European Council. The Commission has primarily a monitoring role, but in practice it appears to have considerable scope for agenda-setting and persuading member states to increase their efforts to reach agreed policy objectives. The OMC indeed allows the Commission to use peer pressure and “naming and shaming” processes to create stronger member state involvement in European policy processes.

In the policy domains of research and higher education, several applications of the OMC are found. The European Innovation Scoreboard monitors the member states’ innovation performance. In the education policy domain, the progress reports analyze the progress towards the educational Lisbon objectives and provide a platform to discuss education policies at the European level.

All in all, the European policy instruments show a rather large variety in their contexts and conditions of application. The EU policy level is increasingly equipped with European policy instruments.

European Policy Trends

The overall European innovation policy has a number of major influences on the European academic research system. Because of the integration of the European research and higher education policies (including the doctoral education and knowledge transfer policies), the European ARE has clearly opened up and become more integrated. The level of fragmentation in the European ARE has decreased, although it certainly still exists.

In addition, the innovation policy appears to have created a growing awareness of the European policy echelon. Clearly different from the days before the Lisbon agenda, the EU has become a major research and higher education policy actor, and many universities and academics have experienced its conditions and effects.

Two crucial trends appear to be related to European-level policymaking. These trends relate particularly to the changing conditions for the European ARE. They are presented here as fairly general developments in European policymaking regarding research and higher education.

A first general trend is the growing importance of the supranational European policy echelon. The Bologna Ministers Conferences regarding the EHEA and the EU political summits regarding the (renewed) Lisbon agenda (and the ERA as part of that agenda) leave their traces in the various research systems of Europe. Not only national politicians but also academics and research managers keep an eye on the European policy processes. They are aware of the available budgets and of the contexts in which these can be obtained; they look for partnerships in order to be eligible for funding; and they design consortia and networks to implement their cooperation strategies.

Generally speaking, as the 2005 Glasgow Declaration of the EUA for instance shows, the European universities accept their role as contributors to the "Europe of Knowledge." They emphasize that inter-institutional cooperation is increasingly important in a globalized and competitive environment. They are willing to reinforce the European dimension in various ways, i.e., benchmarking curricula, developing joint degrees, and enhancing intercultural and multilingual skills. They also urge European politicians to view the Bologna and Lisbon policy agendas together for each to be successful in the long term. "Universities acknowledge that European integration must be accompanied by strengthened international co-operation based on a community of interests" (EUA 2005a, 2).

The successive studies of the implementation processes of the Bologna agenda also show that there is general acceptance among European universities of the need for these reforms and that many universities have made great efforts to internalize the European reform process. Of course, moving towards a comprehensive three-cycle system throughout Europe is a complex cultural and social transformation. But it appears that considerable progress is being made and that a major innovation process of European higher education is currently taking place (Reichert and Tauch 2005; EUA 2007).

In the context of the ERA, the impact of the European (in particular EU) policy instruments is considerable. With a budget of €19.2 billion, FP6 has been among the largest R&D programs in the world. In 2003, more than 16,000 proposals were submitted for funding, involving nearly 160,000 participants from more than 50 countries. Some 2,600 of these proposals--with 27,000 participants--were selected for funding (EC 2005e). The substantial budget increase of FP7 to €53.2 billion, which is 40 percent higher than that of FP6, will create an even larger impact in the European research field.

The European FPs provide a vital opportunity for universities in countries with limited research funding (Geuna 1999). But even in countries where substantial research funds are available, the FPs appear to be increasingly attractive. As was indicated before, the amounts of research funding that are directly awarded by the various national funding entities are still far larger that those allocated through the EU FPs. Yet, for many universities and other public research institutions, the EU funding for collaborative research projects--comprising teams that can be institutionally situated anywhere

within the EU--is a key element in their pursuit of international academic reputation. The European FPs have created a competitive research funding context at the European level, triggering and prompting European researchers to try to obtain these prestigious research funds.

The second trend regards the increasing emphasis on the alignment of the European policies and the various national policies in the domains of higher education and research. Although the EU competence in the higher education policy domain is still limited, the re-emphasis on the European innovation strategy appears to offer a way to try to strengthen the alignment in this field. The integrated guidelines of the re-launched Lisbon strategy (2005), the benchmarking of the NRPs, and the ten-point program of the broad-based innovation strategy (2006) appear to create extra pressure on the member states to relate their national policy efforts to the European agenda. In its 2006 communication on the innovation strategy, the Commission argued that the member states "should ensure that there is sufficient availability of key skills to support innovation. Education must move with the times. As already agreed within the Integrated Guidelines for Growth and Jobs, Member States are invited to set, as a matter of priority, ambitious targets in their National Reform Programmes that address weakness in these areas" (EC 2006d, 5). The Commission also made it clear that it would continue to use the OMC to facilitate the modernization and restructuring of the national education systems. It invited the member states to significantly increase the share of public expenditure for education, to tackle the obstacles in their education systems for innovation, and particularly to implement the Commission's recommendation regarding the Modernisation Agenda for Universities.

In the research policy domain, the alignment is addressed in, on the one hand, the benchmarking of the national targets set for research, and on the other hand, the reinforcement of the ERA-NET instrument in FP7. The national targets, first of all, consider the level of R&D investments that, if met, would raise the level of EU R&D expenditure from 1.9% GDP to 2.6% in 2010. In addition, the member states are invited to explicitly take the transfer of knowledge into account in their national innovation policies; to earmark a large proportion of the cohesion policy funds for investing in knowledge and innovation; to create an open, single, and attractive European labor market for researchers; and to target their state aid on market failures preventing research and innovation activities. In the renewed Lisbon strategy, the Commission presses for a kind of "multilateral surveillance." "The Commission will, when assessing the (national) progress reports on the implementation of the National Reform Programmes, assess carefully Member States' reforms and policies addressing the innovation system and report on this in its Annual Progress Report" (EC 2006d, 15).

Using the new ERA-NET Plus Module in FP7, the Commission hopes to provide an incentive for joint, transnational research funding. Combining funding from member states and the Community appears to be a necessity to be able to really create the ERA. Alignment of national and European funding policies therefore is a major target. Without such an increased alignment, the high European ambitions cannot be reached.

However, it should be noted that the intergovernmental European cooperation in R&D has so far hardly resulted in more coordination and integration of national research policies. In this sense, a common European research space is still far away. As Marimon and Graca Carvalho (2008) argue, there seem to be both a lack of willingness and a lack of coordination capacity at national and regional levels in the EU to really develop a joint European Research Area. The former because of the absence of incentives to collaborate, the latter because of the fact that national research agencies are not designed to organize funding on a larger scale (Marimon and Graca Carvalho 2008).

Nevertheless, growing importance of the supranational European policy echelon and the increasing pressure for alignment of the EU's and the member states' policies show that European research and higher education policies indeed have developed at the supranational European level. Although the EU is not a federal government, it does have its own policymaking capacity in these fields.

European Policy Results and Effects

What are the results of the EU innovation policy and its various subpolicies? Which effects are observable? Which were intended? Which unintended? A number of results and effects will be discussed. In addition, conceptual frameworks will be offered to interpret some of these effects.

Let us first look at the *results* of the EU policies. These are monitored by the various assessment and benchmarking instruments that the Commission has developed since the introduction of the Lisbon strategy and by now offer a rather comprehensive statistical overview of the performances of both the member states and the EU.

The European Innovation Scoreboard is the main statistical tool for monitoring innovation performance. The Scoreboard was developed after the Lisbon European Council in 2000 and has been published since 2001. It shows the progress of the individual EU member states regarding the Lisbon ambitions and compares and ranks them on a number of indicators.

In the sixth and seventh edition of the Scoreboard (2006, 2007), innovation performance is measured by combining a set of twenty-five indicators organized in five broad categories: innovation drivers (input), including population with tertiary education per 100 population aged 25-64 and broad-band penetration rate; knowledge creation (input), including public and private R&D expenditure; innovation and entrepreneurship (input), including innovation expenditures and early-stage venture capital; application (output), including employment in high-tech services and export of high-tech products as share of total products; and intellectual property (output), including European Patent Office (EPO) patents per million population and triadic patent families per million population.

A summary innovation index and an average growth rate of this index allow an assessment of the relative strengths and weaknesses of the innovation performance of the member states and a comparison of the EU performance with the United States and Japan. The comparisons show four groups of countries: innovation leaders, innovation followers, moderate innovators, and catching-up countries.

The 2006 and 2007 Scoreboard editions show that some Scandinavian countries (Finland and Denmark), Germany, the UK, and non-EU-member Switzerland are the European innovation leaders. Most of the other "old" member states appear to be followers. The "new" members and the southern European countries are either moderate innovators or catching-up. At the same time, there appears to be a process of convergence in innovation performance in Europe. The countries showing below-average EU innovation performance are closing the gap with the innovation leaders and followers.

The United States and Japan are still performing better in innovation than the EU, but the gaps, particularly with the United States, are decreasing. The United States leads in 11 of the 15 indicators for which comparable data are available. Japan leads the EU in 12 out of 14 such indicators. Compared to the United States, the EU has improved its performance in, among other indicators, number of science and engineering graduates (13% of population aged 20-29; US 10.6%) and employment in medium/high and high-tech goods industries (7% of total workforce, compared to 4% in the US). On the other hand, the EU is lagging behind the United States and Japan in other areas, including business expenditure for R&D (1.2% GDP in EU, 1.9% in US, and 2.4% in Japan), ICT expenditure (6.4% in EU, 6.7% in the US, and 7.6% in Japan), and tertiary education attainment level (23% of the population in EU, 39% in the US, and 40% in Japan) (Innovation Scoreboard 2007).

The results regarding the EU innovation policy are getting better but are still too limited. The performances of the member states vary widely. On average, the European innovation results are still disappointing. There appears to be good reason to quickly implement the new broad-based EU innovation strategy.

With respect to education and training, the Commission publishes its so-called Progress Reports. The first report was adopted by the Commission in 2004 and analyzed the progress towards the Lisbon objectives in the field of education and training of thirty European countries (including the then fifteen EU countries). The second report (EC 2006c), adopted by the Commission in 2005, delivered a number of strong political messages to the European Spring Council of 2006 (when this Council reviewed the revised Lisbon strategy for the first time). The report stated that reforms are

moving forward but more substantial efforts are required and that education and training must be viewed as a priority for investments.

The 2006 Progress Report (EC 2006c) offered (among many other things) a mixed picture of the results in the policy domain of higher education. On the one hand, it appears that the EU is on and even ahead of schedule regarding the objective to have one million students graduating in mathematics, science, and technology every year by 2010 (compared to 755,000 in 2003). On the other hand, the EU still suffers from underinvestment in higher education. In 2002 public spending on tertiary education in the EU amounted to 1.14% GDP, compared to 1.40% in the United States. A considerably larger gap existed in private spending on higher education: 0.2% in the EU and 1.42% in the United States. To match the US level of public-plus-private expenditure, the EU would have to spend an additional €140 billion per year (EC 2006c).

Furthermore, in the EU higher education context, access to higher education is not improving sufficiently. Although there have been increases, further progress regarding the participation in tertiary education is still needed. Also, most EU students are still not taught two languages (an objective formulated during the 2002 European Council), and the mobility of students within the Erasmus program would have to more than double to reach the target of affecting 10 percent of the student population (EC 2006c).

The results thus far in the--geographically broader--Bologna process show that the European universities are going through a remarkable process of change. In less than a decade, the universities have become engaged in processes to adapt their curricula and degree systems, to implement quality assurance systems, to develop their governance models, and to professionalize their management. The European universities have taken responsibility for the emerging EHEA and support the underlying ideas of student-centered and problem-based learning (EUA 2007). Nevertheless, whether these changes will create the EHEA still remains to be seen. Much will depend on the ways in which the highly cherished diversity of the European higher education systems can be combined with increased cooperation, harmonization, and transparency on the European scale (Floud 2006).

The results in the policy domain of research and technological development are included in the independent five-year assessments of the research FPs. The third assessment reviews the implementation and achievements of the FPs over the period 1999-2003 (FP5 and--partly–FP6).

The review shows that, on the one hand, the FPs have played an important role in developing the European knowledge base. “The strength of emphasis on information and communication technologies and on life sciences has, for example, been instrumental in strengthening European capabilities. There has been strong interest from industry, universities, and other research institutes. The FPs have played an important part in the generation and diffusion of new knowledge and the formation and reinforcement of inter-organisational networks.” But on the other hand, the achievements of the programs, in terms of direct contribution to innovations with the potential to dominate global markets, are still limited (Assessment FPs 2004, II).

Regarding FP6, the assessment refers to the review by the Marimon Panel (a panel of high-level experts, chaired by R. Marimon), which praised the new instruments of FP6 (the Networks of Excellence and the Integrated Projects) for their ambition and their emphasis on transnational collaborative research, but which also pointed out the relatively high costs and risks of participation in these instruments for industry partners, notably SMEs, and the need for more flexibility and simplification (Marimon 2004).

The working document (EC 2007b) accompanying the 2007 green paper on the ERA provides an evaluation of the progress regarding the ERA so far. It mentions the following issues:

- The ERA-NET instrument has made a start at addressing the inefficiency and the fragmentation of the European research system. However, the volume involved is still marginal and the national and regional program owners are still reluctant to further develop genuine joint research programs.
- Regarding research infrastructure, good progress has been made. A first milestone was the adoption of the European Strategy Forum for Research Infrastructures (ESFRI) Roadmap.

However, new legal, institutional, and financial tools need to be developed for implementation of the Roadmap.

- In the area of international research cooperation, the EU has demonstrated that it is able to show leadership to address global challenges. The International Thermonuclear Experimental Reactor (ITER) is a showcase. However, these initiatives are far from systematic and often poorly coordinated with those of the member states.
- Although there is some success in better exploiting human resources, Europe still lacks an open, competitive, and attractive market for researchers. Some researchers are still leaving the EU. Others cannot enter research careers in Europe.
- Private investment in research is still far too limited. Europe's business-funded research intensity has not increased since 2000, and the gap between the EU and the United States has not been reduced.
- The research policies of the member states have certainly evolved, but the question is whether the pace of national policy reform is sufficient.
- Some convergence in national policymaking is materializing, largely through the communicative instruments of the Commission.
- Although transnational cooperation is an element of member state research policy, there is little evidence that national policy makers have taken ownership of the ERA concept. (EC 2007b, 8-9)

The conclusion regarding the results of the EU policies with respect to research and technological development is that while some results are visible, the innovation policy objectives certainly have not been reached. The policy instruments (in particular the FPs) can be further developed (as has been done in FP7), and the relationships between research policy and innovation policy can be further intensified. The progress on the ERA is limited, and there is still much to do. This is particularly true with respect to addressing the "governance void" in the ERA, which implies a lack of sufficient incentives for the implementation of strong and joint intergovernmental research funding (Marimon and Graca Carvalho 2008, 14)

But there also is reason for optimism. In its annual policy strategy for 2008, the Commission argued that the Lisbon strategy "is beginning to yield results and has contributed to the economic performance of the EU. The challenge now is to capitalise on the current upturn in order to press ahead with further reforms" (EC 2007a, 5). A 2007 review of progress in the Lisbon Strategy also showed that finally, in the seventh year of the Lisbon agenda, some of the objectives seem within reach. In an analysis of the original E15 countries, Europe is reported to be doing better economically than in any year since 2000. Economic growth in the E15 reached a level of 2.8% in 2006, and this growth appears to be more stable than before (Lisbon Council 2007). Realizing the Lisbon ambitions of the expanded EU of twenty-seven member states remains a major challenge.

The 2007 European Competitiveness Report also reveals that in 2006 the EU's GDP increase was the highest since 2000. The revised Lisbon strategy is judged to be beginning to bear fruit. The report identifies the key drivers contributing to this growth and argues that "increased investment in R&D can significantly increase productivity growth, especially if the elements of the knowledge triangle, R&D, innovation and education and training, are well integrated, including as concerns the provision of scientific personnel" (EC 2007e,4).

Another recent economic analysis criticizes the weak European progress in R&D, particularly the cost of patenting (still five times higher in Europe than in the United States) and the failure to reverse the "brain drain" from the EU to the United States (London School of Economics 2006). In this context, the recent EU initiative to introduce a European "blue card for talented knowledge workers," comparable to the US "green card" (which establishes legal permanent residency), can be mentioned. It may be expected that this initiative will have a positive influence on the reported brain drain.

A third study (Begg 2007), based on an analysis of the implementation reports of the NRPs, concludes that the re-launched Lisbon strategy is more successful than Lisbon I. Although the

economic improvement of the EU cannot be completely assigned to the Lisbon achievements up to now, real advances appear to have been made and a coherent and effective strategy is developing.

However, the global financial turmoil also has its impacts on the EU and it requires it to increase its innovation efforts. In its 2009 policy strategy paper the EC indicates that it will continue to pursue its broad-based innovation strategy and to "deepen the European Research Area" (EC 2008, 4).

In addition to the results of the EU policies a set of basically *intended effects* of European policymaking in the domains of research and higher education can be distinguished. Four intended effects can be indicated.

A first and clearly intended effect concerns the reinforcement of the relationships between the European ARE and European society. The very heart of the European innovation strategy is to create stronger linkages between academia and European society to further develop Europe as an innovation-friendly society.

According to the EC, "Europe has to become a truly knowledge-based and innovation-friendly society where innovation is not feared by the public but welcomed, is not hindered but encouraged, and where it is part of the core societal values and understood to work for the benefit of all its citizens" (EC 2006, 3-9). For education, this implies that talent and creativity should be promoted from an early stage and that key skills that support innovation need to be nurtured. The European universities can contribute to these processes, and they can do so more efficiently than they have done so far. For research, the innovation strategy emphasizes the importance of knowledge transfer:

> The knowledge economy relies of the transfer of knowledge from those who generate it to those who use it and can build on it. The transfer of knowledge between public research organisations and third parties (including industry and civil society organisations) needs to improve… Doing so will help to build new market opportunities on research. Public research organisations… have a particularly important role to play in this. All of the many forms of knowledge transfer--contract research, collaborative and co-operative research, licensing, publications and exchanges of skilled researchers between the public and private sectors--need to be further developed and better managed. (EC 2006d, 3-9)

The EU innovation strategy implies a shift in the orientation of the activities of the European universities. In their educational programs, they are urged to focus more intensely on entrepreneurial skills and to develop joint training activities with business and industry. In their research programs, they are prompted not only to address knowledge creation but also knowledge diffusion processes.

As a result, the basic functions of the European universities appear to be changing. The general goal of the ERA is to bring researchers together to facilitate both knowledge creation and distribution. The centers of excellence and networks create critical mass and synergies that improve the productivity of knowledge creation. Networking also intends to facilitate both the geographic diffusion of new knowledge and its industrial application.

It may be argued that EU research funding entails a few related strategic purposes. One certainly is to improve European industry's international competitiveness by inventing and developing new products and processes and by forging links between academic and industrial research groups. Another is that of fostering the "cohesion of Europe" by reducing disparities in its regions' R&D capabilities (David and Keely 2003, 261). Yet another purpose is to use the investment in R&D to further develop the extensible knowledge infrastructure, thus enabling it to continue to produce new knowledge (Geuna, Salter, and Steinmueller 2003).

These strategic European funding purposes have their impact on the ways the European universities address their research functions. Because of the financial and in particular the prestige-related aspects of EU funding, they appear to adapt to the European emphasis on the application of knowledge as a criterion for funding. The policy goal to increase the application of scientific knowledge in industry and other parts of society has pushed universities to develop, at least partly, a closer and more instrumental role in advancing Europe's economic competitiveness. The European universities are increasingly held responsible for generating not only intellectual but also economic and social capital. As Martin (2003, 25) argues, the social contract between (European) society and

the universities has changed: "there are now much more explicit and direct expectations that, in return for public funding, universities and researchers should endeavor to deliver greater and more direct benefits to society."

A second observable and clearly intended effect is the reinforcement of the knowledge transfer capacity of the EU. In the research and technology policy domain, the networking efforts in the FPs have increased Europe's knowledge diffusion capacity. The formation and strengthening of collaborative networks have had a major influence on the European R&D landscape. The Networks of Excellence and the Integrated Projects of FP6 have brought together groups of researchers and specialists from academia and industry. In particular, the technology platforms (although not an instrument of the FPs) have developed important strategic technology agendas with a strong knowledge-sharing and diffusion capacity. These platforms unite all relevant stakeholders, with industry taking the lead role. They have built bridges between industry, the academic community, the financial world, regulators, and consumers. FP7 intends to capitalize on these platforms, assisting them to translate their strategic research agendas into concrete actions. The Cooperation program of FP7 provides the means, via the JTI scheme, to implement the agendas that have a European dimension as well as a strong industrial relevance. The Structural Funds, the European Investment Bank, and the new Risk-Sharing Finance Facility in FP7 provide further financing options. It may be expected that, with the reinforcement of the research networking instruments and the increased emphasis on knowledge transfer, the European knowledge diffusion capacity will continue to grow.

For the process of knowledge transfer, a recent (rough) comparison between the EU and the United States shows that the European universities lag behind their US counterparts regarding invention disclosures as well as patent applications and grants but do better in regard to licenses granted and start-ups established (EC 2007b). Apparently, despite less effort, the EU is relatively successful in the actual use of public R&D results by the business sector, which again shows that the European knowledge diffusion capacity has been reinforced.

A special aspect of the reinforcement of the knowledge diffusion capacity of the EU is the increasing mobility of students. In the higher education policy domain, the 2004 decision of the European Parliament and of the Council on a single framework for the transparency of qualifications and competences (Europass) can be mentioned here, as well as the development of the credit transfer systems for academic and vocational education and training. And although the Erasmus mobility program has not yet reached its target of affecting 10 percent of the European student population, between 1987-88 and 2004-05 more than 1.3 million students studied abroad under the aegis of this program and 87 percent of all European universities participated (EC 2006c). Generally speaking, the harmonization activities in the Bologna process are creating a comprehensive system of easily readable and comparable degrees, with the potential to further integrate the various national higher education systems. As an effect, the knowledge-sharing and diffusion capacity of the EU is increasing.

A third effect could be described as "the rise of European social networking" in the European ARE. In the European research system, collaborative networks have become the major "instruments for collective action" (Foray 2003, 372). In the FPs, networks (of various kinds) have proven to be the main mechanisms of exchange among researchers and between research and industry.

However, it should be observed that in EU research and innovation policies there appears to be a strong emphasis on *establishing* academic-industry linkages. Geuna, Salter, and Steinmueller (2003, 399) argue that this European approach to social networking for research and innovation differs from the US approach. "In the case of the US, it was the combination of high industrial demand for research and the relative high quality of the US science system's output that helped to generate the new networks bridging science and innovation. It was demand that created the new networks, rather than the networks that created the demand. In the case of Europe, policy has often created networks that are in search of demand." The EU research policy intends to create and formalize social networks that promise to develop and implement research and innovation agendas but that have, at the time of their application for funding, often hardly begun to do so. The social networking processes in the European research policy domain are triggered and stimulated by the instruments that are being applied in, in particular, the FPs. The basic assumption is that the relationships between academia and industry are

limited and thus have to be increased. For this reason, the European social networking strategy focuses on the generation of new rather than on the recognition of existing research networks. In this sense, the EU social networking strategy also is a top-down rather than a bottom-up process. The exceptions are the technology platforms. These are largely initiated and led by industry and are clearly demand-driven. The recent recognition of these platforms as crucial instruments for strategic knowledge creation and application agenda setting indicates that the EU social networking approach is slowly changing.

It may be concluded that the social networking approach has become an increasingly dominant mechanism in European research. Over the years, the FPs have grown substantially. The financial support for the various research networks has become a major and increasingly prestigious factor in the European research efforts (Geuna 1999).

The fourth effect regards the changing governance model in the European ARE. Generally speaking, for decades now the trend in European higher education and research systems has been from state control to self-regulation and accountability (Van Vught 1989). The autonomy of universities has increased in Europe over the last twenty-five years, and detailed governmental planning strategies have lost ground to supervision and accountability strategies. The move to accountability has brought along the recognition of stakeholders' needs and interests, and hence the acceptance by universities of their social embeddedness and their relationships with and dependencies on various political and economic organizations.

On the European scene, this trend towards a new diversified governance model is recognizable in the increasingly instrumental role that universities are assumed to play in the European knowledge society (Geuna, Salter, and Steinmueller 2003). Instead of on their traditional academic role, they are increasingly being challenged to focus on their new roles of advancing the competitiveness of Europe and contributing to a European culture of innovation.

The EU universities modernization agenda provides a clear example of this changing role. It suggests that the member states should move from a control to an accountability strategy and that public research organizations should be stimulated to contribute to the overall innovation strategy of Europe.

In the research domain, universities are being incited to intensify their relationships with industry. Based on the belief that Europe is afflicted by an interaction deficit in its innovation system, they are encouraged to develop and participate in collaborative networks with industry in order to jointly create better conditions for the overall European innovation strategy.

The result is the emergence of a new, multi-stakeholder governance model in the European ARE with multiple funding sources, a stronger focus on autonomy combined with accountability, and a pressure to deliver innovation-relevant outcomes (Enders et al. 2006; Van der Ploeg and Veugelers 2008). The governance systems of the European higher education and research systems appear to have changed during the last decades, mainly as a result of the social and economic expectations regarding their processes and outputs.

Finally, in addition to the results and intended effects mentioned, there appears to be some empirical evidence for a few general *unintended effects*.

The first unintended effect occurs as the combined result of two processes and can be described as a stratification effect in the overall European ARE. The two processes that appear to create this stratification effect are the changing participation processes of the European universities in the FP programs and the occurrence of a counterproductive consequence of the reinforcement policy regarding the interaction between universities and industry.

Regarding the first process, it has been pointed out that in particular larger and older universities have a higher participation rate in the networks of the FPs than other universities. In addition, there appears to be (in the FPs) an increased homogenization of research institutions. The variety of participating institutions is decreasing over time. In addition, past success appears to be an important indicator for future participation (Geuna 1999; David and Keeley 2003). What appears to be happening is the occurrence of the well-known Matthew Effect: "research groups that are successful in finding external funding for their research have a higher priority of producing publishable research,

which improves their probability of getting funds in the future" (Geuna 1999, 117). Universities with successful research groups, in terms of receiving EU funding, appear to have a higher probability of also receiving future funding, because their earlier successes are seen as an indication of their high quality.

The effect is a slowly increasing stratification between universities that are more and those that are less successful in receiving FP funding. Given the fact that the variety of applying institutions appears to be decreasing and that larger and older universities are on average more successful in getting EU funding, the EU research funding policy appears to be contributing to the creation of a European category of research universities that are distinguishable from other higher education institutions.

The other process contributing to this stratification effect is the occurrence of a counterproductive force as a result of the push in EU innovation policy towards closer links between universities and industry. Geuna (1999) argues that this counterproductive effect particularly occurs in universities with a relatively weak financial situation. "Constrained to accept industrial funds for developing routine contract research, and faced with the impossibility of charging the real cost of the research, their collaboration with industry results not in a contribution to the wealth of society, but in an exploitation for private profit of a public investment" (Geuna 1999, 173).

Again, the effect of the further weakening of already financially vulnerable universities appears to be increased stratification in the overall European higher education system. While universities that are successful in getting EU funds appear to increase their potential for success in acquiring future funds (and thus in principle reinforce their financial situation), financially weaker universities that increase their links with industry run the risk of further weakening their financial situation. The outcome of this increasing differentiation between financially stronger and weaker universities is a growing diversity in terms of reputation. Like in any other higher education system around the world, the European universities are engaged in a "reputation race" (Van Vught 2006). Universities are first and foremost driven by their wish to maximize their academic prestige and to uphold their reputations. In this race, universities are constantly trying to create the highest possible reputation for themselves and for this they need all the financial resources they can find. A weakening of its financial position has a negative effect on the reputation-building capacity of a university, which will have stratification consequences at the overall systems level.

A second, unintended effect is a growing regional diversification in the European ARE. This effect appears to result from policy tensions between the Lisbon strategy, on the one hand, and the European cohesion policy, on the other. The general Lisbon innovation agenda focuses on an internationally competitive Europe and on the strengthening of its collective capacities for innovation and research. In contrast, the cohesion programs aim to reduce income disparities between the EU's poorest regions and the rest of Europe. The main instrument of the cohesion policy is the Structural Funds, specifically devoted to regions with per capita incomes that are less than 75 percent of the EU average.

The objectives of two policies appear to be incompatible. The Lisbon strategy appears to generate disproportionate benefits for the richer regions relative to the poorer regions, simply because they have larger concentrations of researchers and are better able to attract academic talent and quality. The result is an increasing "innovation gap" between Europe's most and least advanced regions, a process that the cohesion policy exactly tries to minimalize. In other words, there appear to be trade-off effects between the EU's innovation and cohesion policies (Sharp 1998; Clarysse and Muldur 2001).

The EC sees this differently. The Commission argues that the Structural Funds enable weaker regions to strengthen their knowledge bases, allowing them to participate more frequently and successfully in the programs of the ERA, and hence to decrease their innovation gaps. According to the Commission the cohesion policy is compatible with the Lisbon innovation strategy.

However, three inter-related processes have been identified that appear to create the unintended effect of a growing regional diversification as a result of the EU's general innovation policy (Frenken et al. 2008). The first one is the preference of researchers in "excellent regions" to

collaborate with each other, rather than with colleagues in lagging regions. Particularly the EU research policy appears to stimulate concentration of talent in the richer and academically better equipped regions. Lagging regions find it difficult to participate in successful European research networks and appear to have to pass a threshold of quality and size before they can do so.

Secondly, the ERA policy objective of the free movement of people appears to not only lead to an increased mobility of researchers but also to the concentration of talent in a selected number of excellent regions. The most talented researchers compete for the positions at the most prestigious universities, thus rendering it difficult for the lagging regions to retain talent within their borders.

Thirdly, the sectoral structure of the poorer European regions is usually characterized by a dominance of low-tech and medium-tech activities that hardly fit the thematic priorities of the ERA. The FPs almost exclusively concern high-tech sectors, thus creating a situation in which the research subsidies are becoming concentrated in the richer regions.

The result is the unintended but nevertheless real effect of regional diversification. The geography of the European ARE is changing from one based on the priority of national borders into one based on the clustering of talent. Wealthier regions are increasingly able to profit from the general European innovation policy, while poorer regions are left with the resources of the cohesion policy.

Conclusion

During the first years of the twenty-first century, the research and higher education policy domains have moved to the heart of EU policymaking. Since the March 2000 Lisbon European Council meeting, and in particular since the re-launch of Lisbon strategy in 2005, the two policy domains have become integrated in an overall and comprehensive European innovation strategy. In this innovation strategy, knowledge is singled out as Europe's most important resource. Knowledge is to be the driving force of the European lifelong learning society; it is the basis for Europe's future economic, social, and environmental development; it is the fundamental resource for the innovation of products and services. Universities are Europe's most crucial knowledge institutions. The European ARE has become the cornerstone of the European innovation policy.

The history of European research and higher education policies shows that the European universities have become one of the most important categories of policy addressees for the EU institutions. They are increasingly being addressed as crucial actors for the provision and exploitation of knowledge and hence for the realization of the European innovation strategy.

In the policy domain of research and technology, the EU policy intentions are to encourage researchers to work together at the European level and to stimulate cooperation between universities and business and industry. The EU seeks to increase the investments in R&D (to 3% GDP) and to create stronger coordination of national research policies. Research is seen as the core factor in the EU's ambition to create growth and employment. Particularly the seventh FP is offered as a major instrument to fully develop the ERA and, by doing so, to respond to the competitiveness and employment challenges of the EU. In this policy domain, the European universities are seen as major knowledge institutions, the positions and roles of which need to be reinforced to better enable them to contribute to the renewed Lisbon agenda.

In the policy domain of higher education, the recent EU Lifelong Learning Programme (2007-2013) is intended to contribute to the European knowledge society by fostering cooperation between the various national education systems. In its higher education subprogram (Erasmus) it is designed to reinforce the contribution of higher education to the overall European innovation strategy by supporting the realization of the EHEA. In the context of the Bologna process, the EU intends to create a "consistent, compatible and competitive" European higher education system fitting into the broader Lisbon strategy (EC 2003b, 11). The program emphasizes the importance of the three-cycle structure, a European qualification framework, and doctoral education. In addition, it emphasizes that the universities have a crucial place and role in the European knowledge society and should modernize themselves to become globally competitive institutions.

Analysis of the historical development of the two policy domains of research and higher education leads to the conclusion that, since the turn of the century, the EU indeed has developed an innovation policy. In this policy, the European higher education and research areas have become integrated, and a coherent set of policy objectives and instruments involving various policy actors has been designed and implemented. The EU innovation policy is being developed and implemented in a multi-echelon policy system in which several decision-making levels, each with its own authorities and competences, exist and are interrelated. The European universities are addressed both directly and indirectly by European policy initiatives. They are addressed indirectly by the coordination of the policy actions of their own nation-states that are increasingly aligned with the overall European ambitions and strategies. They are addressed directly by EU initiatives in both the research and the higher education policy fields (for example FP7, European Research Council, Erasmus Mundus, and the European qualifications framework).

In this multi-echelon policy system, the EU policy actors make use of a whole array of policy instruments: legal instruments, financial instruments, and information and communication instruments. In particular this last category of policy instruments has increased policy capacity at the EU level. The EC is increasingly using the soft OMC instrument (benchmarking and naming and shaming) to create stronger member state involvement in EU policy processes.

The European policymaking processes appear to have contributed to two crucial trends that may be expected to continue to be relevant for the future dynamics of the European higher education and research systems. Generally speaking, these trends can be described as the growing importance of the supranational European policy echelon and the increasing alignment of European and national policies. These general trends once more underscore the emergence of an EU policy context in the domains of research and higher education. And, although the EU is not a federal government, they show that a European-level EU innovation policy has developed and is creating its effects. In this sense, a supranational policy echelon has indeed come about "gradually and smoothly" (Huisman and Van der Wende 2004, 355; de Wit 2003). In the increasingly integrated policy domains of research and higher education, the EU member states have accepted this supranational policy echelon and have even started to develop, coordinate, and implement national policies that fit the European innovation policy agenda.

Given the fact that this policy is still rather young, the results of the EU innovation policy are currently hard to assess. On average they still appear to be disappointing. The policy results in both the research and the higher education policy domains are so far still limited. But there also is some reason for optimism, given the fact that some of the Lisbon objectives seem within reach.

At a general level, a set of basically intended effects of European policymaking in the research and higher education domains can be distinguished: the reinforcement of the relationships between the European ARE and European society, the reinforcement of the knowledge diffusion capacity of the EU, the rise of European social networking in research and higher education, and the changing higher education and research governance model. These effects mark the considerable changes that are taking place in the European ARE. The European universities are clearly influenced by the EU policies, and they are adapting to the new conditions that are being created by these policies.

Two unintended effects can also be identified. The first is an increasing stratification process in European higher education. As a combined result of the European universities' participation in the FPs and of the reinforcement policy regarding the interaction between universities and industry, a reputation differentiation appears to be emerging, which will have its impact on the dynamics of the overall European higher education and research system and which may in the future very well lead to a growing diversification of this system.

The second unintended effect is a growing regional diversification in the European ARE, with the richer regions profiting more from the general EU innovation policy than the poorer regions. The result is a concentration of talent and quality in the wealthier regions of Europe and a growing "innovation gap" between Europe's most and least advanced regions.

Finally the general conclusion must be that the overall European innovation policy and its various sub-policies increasingly have their effects on the dynamics of the European ARE. The

European policy echelon is having its impacts on the public research organization of Europe. In the future, the European ARE will certainly also be challenged to continue to contribute to the further development of the "Europe of Knowledge."

Figures and Tables

Figure 5-1

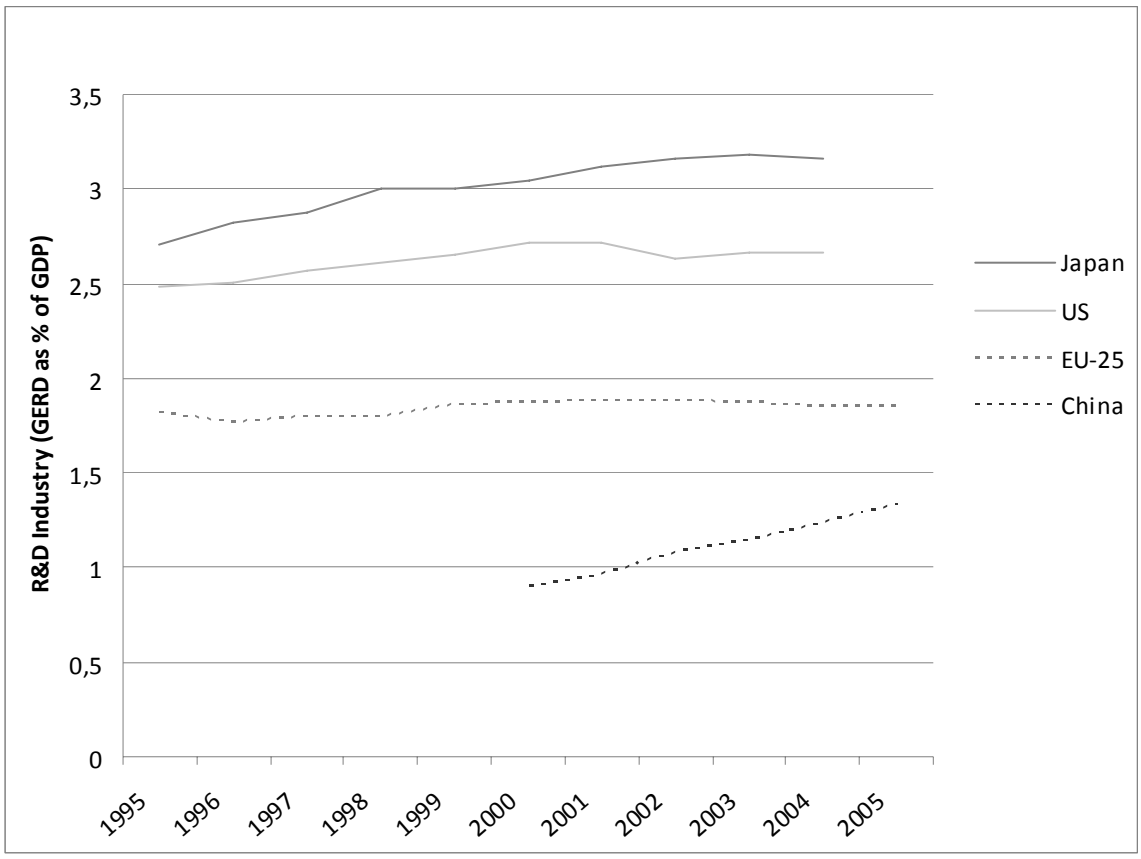


Table 5-1

GERD Financed by Business and GDP in the EU-25: Real Growth per Annum, 1998-2005

	1998	1999	2000	2001	2002	2003	2004	2005
GERD	5.0	8.5	5.8	2.9	-0.5	-0.3	2.9	1.8
GDP	3.0	3.1	3.9	2.0	1.2	1.4	2.5	1.8

Source: Eurostat, OECD

Figure 5-2

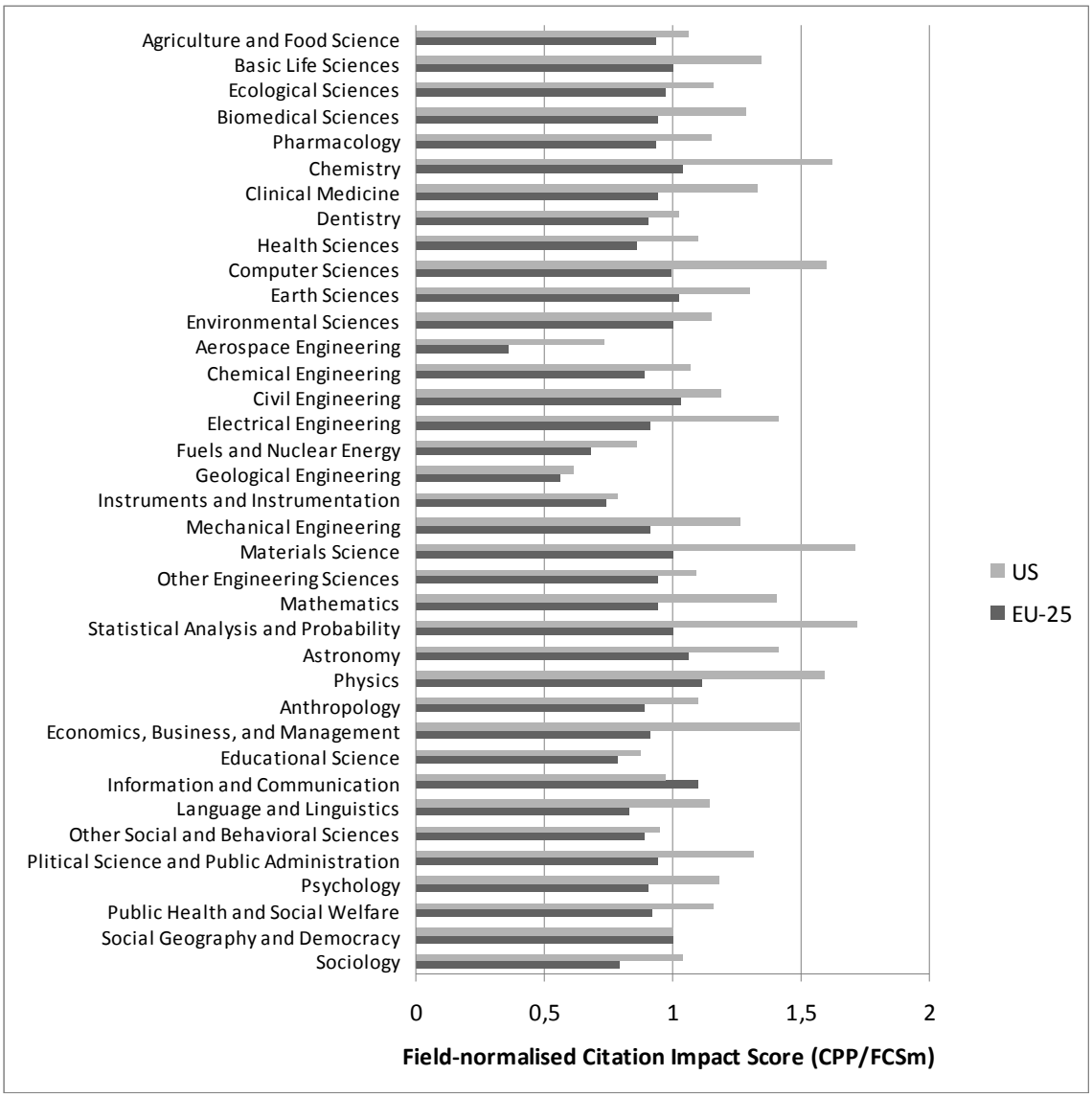
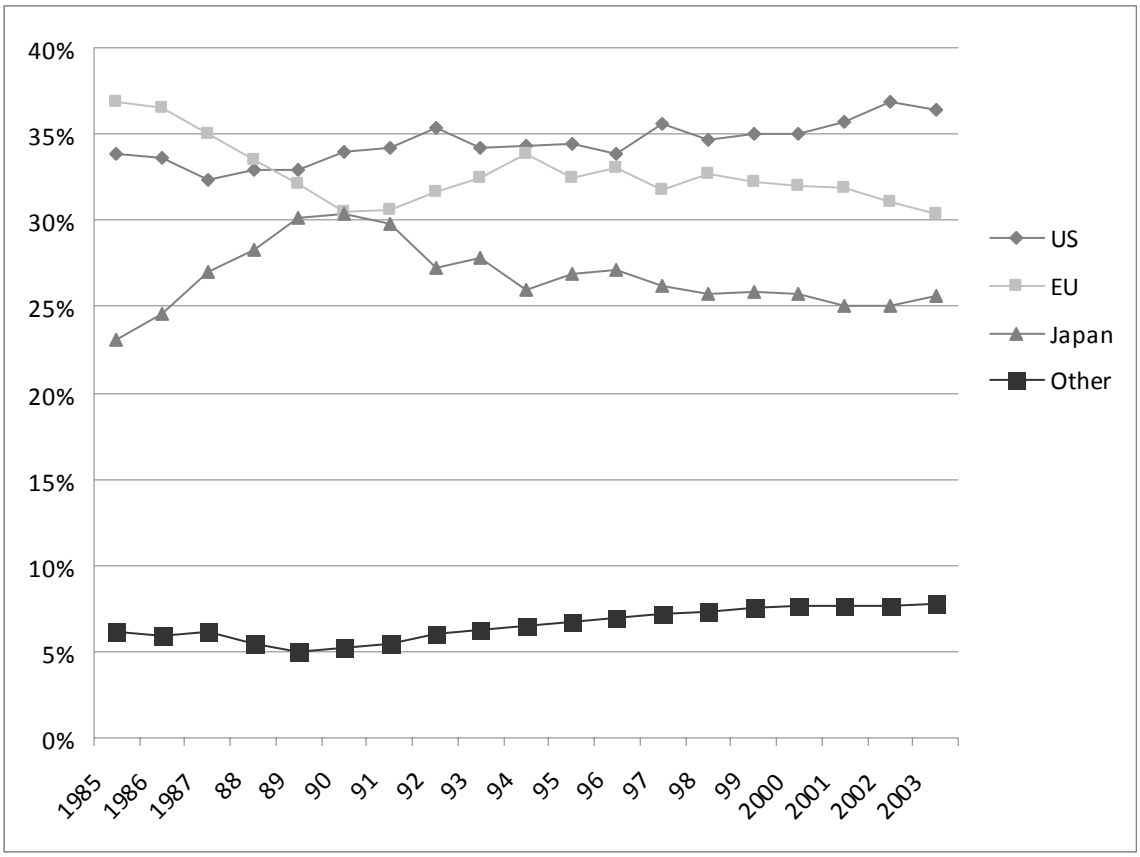

Agriculture and Food Science
Basic Life Sciences
Ecological Sciences
Biomedical Sciences
Pharmacology
Chemistry
Clinical Medicine
Dentistry
Health Sciences
Computer Sciences
Earth Sciences
Environmental Sciences
Aerospace Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Fuels and Nuclear Energy
Geological Engineering
Instruments and Instrumentation
Mechanical Engineering
Materials Science
Other Engineering Sciences
Mathematics
Statistical Analysis and Probability
Astronomy
Physics
Anthropology
Economics, Business, and Management
Educational Science
Information and Communication
Language and Linguistics
Other Social and Behavioral Sciences
Plitical Science and Public Administration
Psychology
Public Health and Social Welfare
Social Geography and Democracy
Sociology
US
EU-25
0
0,5
1
1,5
2
Field-normalised Citation Impact Score (CPP/FCSm)

Figure 5-3


40%
35%
30%
25%
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15%
10%
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0%
1985
1986
1987
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2000
2001
2002
2003
US
EU
Japan
Other

Notes

1. The six countries that created the first three European treaties were: Belgium, France, Germany, Italy, Luxemburg, and the Netherlands. In 2008 the EU consists of twenty-seven member states and, with around 490 million people, is the world's third largest population after China and India.
2. It is sometimes argued that a so-called "European Paradox" appears to exist, i.e., the conjecture that the EU is the global leader in terms of scientific output but lags behind in the ability to convert this strength into relevant innovations. However, as Dosi, Llerena, and Labini (2005) clearly show, this paradox has no empirical foundation. The EU lags behind the United States both in the total number of scientific publications and in their impacts.

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