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The EU Innovation Agenda: Challenges for European Higher Education and Research

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This article analyses the innovation agenda of the European Union (EU), places it in the context of globalisation and explores its foundation in the theoretical innovation systems perspective. It analyses a number of the central policy domains of this agenda: higher education, doctoral education, research and knowledge transfer.

In the second part of the article, some major challenges of the EU innovation agenda for European higher education and research are discussed. These challenges concern: future shortages of higher education graduates, the issue of access and equity, limited world-class research excellence, the need to further increase knowledge transfer efforts, the lack of private funding in higher education and research, and the processes of academic stratification and regional differentiation.

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Programme-cadre de l'UE en matière d'innovation : les défis de l'enseignement supérieur et de la recherche en Europe

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Cet article propose une analyse du programme-cadre de l'UE (Union européenne) pour l'innovation, qu'il place dans le contexte de la mondialisation et dont il explore les fondements à la lumière des systèmes d'innovation théoriques. Il examine différents domaines politiques fondamentaux constituant ce programme-cadre : l'enseignement supérieur, les thèses de doctorat, la recherche et le transfert des connaissances.

Dans une seconde partie, l'article propose une réflexion sur plusieurs défis importants qui attendent ce programme-cadre sur l'innovation pour l'enseignement supérieur et la recherche en Europe : la pénurie future de diplômés de l'enseignement supérieur, la question de l'accès et de l'équité, le niveau d'excellence limité de la recherche à l'échelle mondiale, la nécessité d'accroître les efforts liés au transfert des connaissances, le manque de financement privé dans l'enseignement supérieur et la recherche, et les processus de stratification académique et de différentiation régionale.

Introduction

We live in a globalised world, with increasingly interconnected markets. In this article I will focus on the innovation agenda of the European Union (EU), which is being developed and implemented in response to the ongoing process of globalisation. Innovation is seen as a crucial response to the global economic crisis, and higher education and research institutions are assumed to be major actors in finding effective answers to the crisis.

In the EU innovation agenda, knowledge is increasingly seen as the new strategic production factor. The creation, transfer and application of knowledge are assumed to be of prime importance for a process of economic reorientation and further social and economic development. As a consequence the European Union has become more active and assertive in its efforts to influence the behaviour of higher education and research organisations. In Europe, higher education and research are increasingly being challenged by the rapidly developing EU innovation strategy.

The innovation systems perspective

Since the early 1980s, the literature on the economics of innovation has reflected the emergence of a perspective on innovation policy being promoted by international organisations like the OECD and the World Bank. This perspective takes an explicit policy position emphasising the interactive character of the generation of ideas, scientific research, and the development and introduction of new products and processes.

Innovation perspectives have been discussed under various rubrics – the evolutionary approach (Nelson and Winter, 1977), the technological paradigm (Dosi, 1982), the technological innovation systems approach (Carlsson, 2002) and the concept of sectoral systems of innovation (Malerba, 2002). In this article I will use the term "innovation systems approach", inspired by authors such as Freeman (1982) and Dosi (1984), and further developed by Lundvall (1992), Nelson (1993) and Edquist (1997).

In the innovation systems approach, the basic assumption is that the key to international competitiveness is national "factors that influence the development, diffusion and use of innovation" (Edquist, 1997, p. 14). This perspective argues that industrial innovation is decidedly non-linear. Instead, innovation is an interactive, reciprocal process involving different actors and

organisations (Nelson, 1993). From the outset, academic institutions were identified as playing a critical role in the innovation systems approach, and the evidence suggests that, if anything, their influence has grown over time (Mowery and Sampat, 2004). However, while the tangible outputs of academic research – publications and patents – remain important, equally significant to successful innovation is the production of highly skilled human capital (Cohen, Nelson and Walsh, 2002). Most importantly, and in sharp contrast to the linear assumptions of the traditional "science-push model", the innovation systems perspective stresses the role of linkages between the various actors and organisations in the overall innovation process (Edquist, 1997; Nelson, 1993). These linkages include not only formal knowledge transfer arrangements between universities and industry, such as science parks and joint university-industry research ventures, but also soft linkages – the many channels of communication by which knowledge is exchanged.

During the last decades, the innovation systems approach, has clearly influenced policies and reforms in higher education and research in many countries (Laredo and Muster, 2001; Lundvall and Borrás, 2004; Rammer, 2006). Many are now implementing policies that intend to improve the effectiveness of higher education and research in the context of innovation. The EU innovation agenda clearly fits into this general picture. As suggested by the innovation systems approach, the EU innovation strategy addresses higher education and research organisations both as the creators of new knowledge and as the producers of skilled human capital.

The EU political context

The European policy domains of higher education and research are embedded in the broader European integration process. Analysing these policy domains necessarily requires us to look first 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 aim, and the idea of pooling European countries' interests seemed highly attractive. The results were the gradual creation of a supranational policy context, with the European Council (the heads of state and government and the European Commission president) and the European Commission as the major supranational entities with political scope. The European Union operates on the principle that decisions are taken as closely as possible to the citizens of Europe. The Union is assumed not to take action, except in areas that fall within its exclusive competence, unless the member states cannot themselves achieve the intended results – the principle of subsidiarity. Because education was not one of the areas over which power was ceded to

the European Union by its member states, the Union's involvement in higher education has been limited until more recent times.

The most crucial recent phase in the European integration process to have had a major impact on developments in higher education and research policy was the "Lisbon Process" which began in 2000. At their Lisbon meeting, EU leaders decided on a process to boost the Union's competitiveness and growth. Inspired by the ideas and concepts of the innovation systems approach, they wanted to create "a Europe of knowledge" and formulated the goal that by 2010 the European Union 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).

Unfortunately, as the evaluation report of a special high-level group showed (European Communities, 2004), by 2005 the ambitious political goals of the Lisbon summit appeared to be very difficult to reach. While weak economic growth in the larger member states had been a major factor, the design and implementation of policy to reach the targets, relying strongly on the efforts of member states and industry, was also identified as a major reason for the failure of the Lisbon Process (Weber, 2006).

The European Commission restarted the process in 2005 by launching the New Lisbon Partnership for Growth and Jobs (European Commission, 2005a), identifying "knowledge and innovation for growth" as one of the main areas for action. In addition, it developed integrated guidelines for the preparation of three-year National Reform Programmes (NRPs) by member states, as well as the Community Lisbon Programme consisting of a set of Actions for Growth and Employment (European Commission, 2005b), building a new, overarching community-member states partnership. With this new partnership, the European Commission created the foundations of the EU innovation agenda, known as the Lisbon Agenda.

The EU innovation strategy

The supranational EU innovation strategy that has emerged includes a number of inter-related policy fields. Two major policy domains are higher education policy (including doctoral education policy) and research policy (including knowledge transfer).

Since the re-launch of this agenda in the 2005 New Lisbon Partnership, the European Commission has tried to develop a general strategy that provides a solid base for the further development of the European Union. The Union faces fierce global economic competition and sees it as a major task to develop a comprehensive innovation agenda, and higher education and research policy has become a crucial element of this broader agenda.

According to the European Commission, "Knowledge and innovation are the … heart of European growth […] 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 investment by both the public and the private sector spending on research and development [is needed]. […] the Union must ensure that our universities can compete with the best in the world …" (European Commission, 2005a, pp. 4-9).

Higher education and research are interpreted as sub-systems of a larger overall European innovation policy. To allow Europe to create stronger, lasting growth and more and better jobs, the European Union has set an innovation agenda to which the higher education and research policies are assumed to contribute. In the following subsections I will explore these specific policies.

EU higher education policy

Generally speaking, higher education has come to the supranational European agenda only slowly. 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, p. 6).

However since 2001 the political view has developed that the European Union can contribute to the development of quality education by encouraging co-operation between member states through a wide range of actions, such as promoting the mobility of citizens, designing joint study programmes, establishing networks, exchanging information and teaching languages for all EU citizens. The basic idea is that although legislative power 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.

The main tool for putting this ambition into practice has been the Socrates programme. The first phase of this programme ran from 1995 to 1999 and the second phase from 2000 to 2006. The Socrates II programme supported European co-operation in eight areas, from school to higher education, and from new technologies to adult learners. The higher education section of the programme continued the older Erasmus programme, established in 1987. As the higher education Action of Socrates II, the Erasmus programme aimed to enhance the quality and reinforce the European dimension of higher education by encouraging transnational co-operation between universities, by boosting mobility, and by improving the transparency and recognition of studies and qualifications.

However, the roots of the current European higher education policy lie in a broader, intergovernmental European political context: the Bologna Process.

In 1999, 29 European ministers of education signed the Bologna Declaration, to create the European Higher Education Area (EHEA), to promote mobility and employability, and to increase the compatibility and comparability of European higher education systems. It also emphasises 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 has accelerated. Follow-up conferences were held in Prague (2001), Berlin (2003), Bergen (2005) and London (2007). The "Bologna ministers" (an expanding group of 46 nations in 2008) 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 (third cycle) of the Bologna Process. In 2009, the "Bologna ministers" meet in Leuven to discuss the next ten years of the Bologna Process.

In 2003, the European Commission initiated a debate on the "place and role of European universities in society and the knowledge economy" (European Commission, 2003, p. 4). Since the European universities are at the heart of the European knowledge society, being responsible for 80% of Europe's fundamental research, the European Commission intended to explore the conditions under which Europe's universities would be better able to play their role in the knowledge society and economy.

The Commission's analysis is stern: "the European university world is not trouble-free, and the European universities are not at present globally competitive." They should realise 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" (European Commission, 2003, p. 10).

According to the European Commission, 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 jobs. In a policy paper in 2005, the Commission identified several bottlenecks: a tendency to uniformity and egalitarianism in many national higher education systems, too much emphasis on mono-disciplinarity and traditional learning and learners, and too little world-class excellence (European Commission, 2005c). 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 is also over-regulated and therefore

inefficient and inflexible. In addition, European universities are underfunded; underfunding leads to low enrolment rates, failure to prepare students for the labour market, and difficulties in attracting and retaining top talent.

In the view of the Commission, the quality and attractiveness of European universities need to increase, human resources need to be strengthened both in numbers and in quality, and the diversity of the European higher education system needs to be combined with increased compatibility. In 2004, the Commission launched 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-programmes, one of which is the Erasmus programme. A crucial aim of this programme is to reinforce the contribution of higher education institutions to the European innovation agenda (European Commission, 2004).

EU doctoral training policy

A crucial dimension of overall European higher education policy is the increasing attention paid to the importance of doctoral training, including at several Bologna ministerial summits. The ministers emphasised 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 co-operation (Berlin Communiqué, 2003, p. 7). They urged European universities "to ensure that their doctoral programmes 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, p. 4). The ministers invited universities to reinforce their efforts to embed doctoral programmes in their institutional strategies and to develop career paths for doctoral candidates and early-stage researchers (London Communiqué, 2007).

Doctoral training is beginning to feature higher on the European research and education agendas. It is assumed to be able to play a major role in creating a highly trained labour force for the knowledge society, which is understood to need knowledge professionals who have the competencies to work in extremely 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 training is considered to be the major link between the Bologna Process and Lisbon Agenda (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 is also a crucial point of attention in the EU innovation strategy. The European Commission strives for an open, single and competitive labour market for researchers with attractive career prospects

and incentives for mobility. In the near future it is assumed that doctoral graduates will find their careers not only in academia and government, but also in private sector research and development (R&D) laboratories and general management positions.

EU research policy

Although the European Union has been active in research policy since the beginning, EU research policy has only developed fully since the 1980s. A vital step in the development of EU research policy was the creation of the multi-annual research and technological development framework programmes (FPs). The FPs have developed into the central EU instrument in research and technology policy. They have become *the* strategic documents describing broad strategic EU research priorities, each to be implemented through specific programmes. In addition, they address the overall EU budget to be spent for the duration of the programme, the breakdown of this budget into priority areas, and how funding will be made available to projects (Caracostas and Muldur, 2001).

However, while the financial and political strengths of the FPs are considerable, the proportion of their research investments on a Europe-wide scale is limited. In the sixth framework programme, this proportion was only 5%. The other 95% invested in European research came from the member states. 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 ERA was formally launched in 2000 (European Commission, 2000). The Lisbon summit of that year endorsed the creation of the ERA as a key component of the Lisbon Agenda. However, it was only in 2002 that the ERA took further shape. The European Commission noted that European research represented a jigsaw of 15 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" (European Commission, 2002, p. 8). The result was compartmentalisation, dispersion and duplication as well as a failure to assemble the critical mass of human, technological and financial resources that major scientific advances now demand.

The European Commission also stated that the only way to reach the ambitious targets was to increase general investment in research to 3% of gross domestic policy (GDP) and that a substantial part of this effort should come from business and industry. In March 2002, the 3% figure (of which two-

thirds was expected to come from private funding) was accepted as the target to be reached by 2010. But this appeared to be a difficult task, with European R&D expenditure by business and industry lagging well behind the United States, and at midterm the European Union was far from its target. It was concluded that "halfway to 2010 the overall picture is very mixed and much needs to be done to prevent Lisbon from becoming a synonym for missed objectives and failed promises" (European Communities, 2004, p. 10). There was a large gap between the political rhetoric about the knowledge society and the realities of budgetary and other priorities, and action was urgently needed.

The most recent framework programmes (FP6: 2002-06; FP7: 2007-13) address this issue by improving the co-ordination of national research funding programmes. They underline the need for an EU research policy framework that creates incentives for the member states to contribute to the joint EU innovation strategy. Without the active involvement of member states, the European Union cannot succeed in building the European knowledge society.

The current FP7, with a budget of EUR 53.2 billion, is a major programme for realising the "re-launched" Lisbon agenda. It is the current chief instrument for funding research and innovation and is creating a dialogue and co-operation with industry (in the Technology Platforms and Joint Technology Initiatives) and with the academic world through the creation of the European Research Council which is designed to provide support for the best European "frontier research".

With FP7 the ERA's scope has broadened from a focus on how to improve the effectiveness and efficiency of the fragmented European research landscape, to an awareness that more public and private investment in research is needed, and that research policy should be related to other EU policies 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 infrastructure, accessible to all; (3) excellent research institutions engaged in public-private co-operation, 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 programmes and priorities; and (6) the opening of the ERA to the world, with special emphasis on neighbouring countries.

EU knowledge transfer policy

The basic philosophy of the EU research policy is that excellence in research can be promoted by increasing co-operation and further

investments. But stronger links with business and industry are also needed, and knowledge transfer processes need to be strengthened.

In 2006, the European Commission published a strategy to stimulate "putting knowledge into practice" (European Commission, 2006), 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" (European Commission, 2006, p. 3).

According to the Commission, there are major barriers to greater knowledge transfer in the European Union, including 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 (European Commission, 2007a).

In this context a number of measures are suggested, including 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 providing for exchanges of staff between research organisations and industry. In addition, voluntary guidelines to help improve knowledge transfer cover issues such as intellectual property management, incentives for researchers to participate in knowledge transfer activities, and the development of knowledge transfer resources (European Commission, 2007b).

Challenges for European higher education and research

European higher education and research have shown themselves to be no strangers to change: for the better part of three decades higher education and research have been included in broader Western, Central and Eastern European reforms. Since the late 1990s though, the rate of change has accelerated to unprecedented levels, largely on the aforementioned foundations of the Lisbon Agenda (2000) and the Bologna Declaration (1999). While developing the European Higher Education and Research Areas (EHEA and ERA) several issues remain as major objects of concern. It is clear that Europe cannot compete internationally on the basis of labour costs so it must compete on productivity and innovation. According to the theoretical bases of the innovation systems approach, innovation processes are assumed to be founded on both new knowledge and larger numbers of employable knowledge workers. The creation of new knowledge should lead to new products and services as well as to higher levels of productivity. The increase in trained knowledge workers should allow the European Union to address the

new skill needs of the knowledge economy. The EU innovation strategy can therefore have a direct impact on the ways knowledge creation processes are organised and on the educational provision structures in higher education. New knowledge is driven by the search for innovation; education is first and foremost seen as a process of producing relevant professional qualifications for the labour market.

Enrolments and labour market needs

The overall EU innovation agenda has changed the European higher education landscape. Higher education and research organisations are confronted with new challenges in their educational and research roles. I will focus first on the educational role of higher education institutions, particularly on the challenge to produce sufficient numbers of qualified professionals for the labour market.

The projected demographic situation in Europe creates special problems for its innovation capacity. According to UN projections, the EU share of world population will decline by almost one third between 2008 and 2050 (from 7.5% to 5.2%). The world population will increase from 6.5 billion to 9.6 billion while the EU population will decrease from nearly 500 million to 470 million. This will lead to decreasing cohorts of the traditional age groups seeking higher education, with an average reduction of 23.3% in the 20-24 year age group by 2050, and decreases of more than 50% for countries such as Bulgaria and Poland (Ritzen, forthcoming).

Between 1960 and 1980, enrolments in European higher education increased by a factor of ten. Rising social demand and the absorption capacity of the labour market created a massification of higher education, leading to a substantial expansion of the EU higher education systems and a changing position of these systems in society from elite training to manpower production. However, the educational attainment level of the EU adult population (25-64 years old) is still limited (23%) and is outperformed by both the United States (39%) and Japan (40%).

The combination of a future decline in the traditional age cohorts enrolling in higher education and the relatively low educational attainment level of the adult population confronts the European Union with a major challenge for its innovation agenda. The labour market in industrialised countries shows that the "race between higher education and technology" (Tinbergen, 1977) is still being lost by education: the demand for higher education graduates keeps increasing beyond the increase in supply. Like many other nations in the world, the EU member states will have to reduce the gap between the demand and supply of graduates. Raising higher education enrolment rates, particularly in undergraduate higher education, is not only a

matter of social cohesion and stability, but also a necessity in a knowledge-based economy. The European Union needs more graduates and it needs these graduates to be directly employable. So the massification of European higher education will need to continue and enrolments will need to continue to grow. Recent skills forecasts for the European Union indicate that the demand for skills and qualifications is growing in most occupations. The total employment increase in Europe between 2006 and 2015 will be around 13.5 million new jobs, comprising over 12.5 million additional jobs at higher education level and almost 9.5 million jobs at medium education level, while the demand for jobs requiring low qualifications will fall by 8.5 million (CEDEFOP, 2008). In 2015, around 30% of jobs in the European Union will need higher education qualifications. To address this demand, the undergraduate education systems of the European Union member states will have to grow and larger numbers of first degree students will have to enrol. However, given the decreasing future traditional age cohort enrolments, the European Union also urgently needs to address new recruitment areas such as international students and adult learners.

In addition to increasing higher education enrolments, "access and equity" will also need attention. Despite the rapid expansion of European higher education, students from lower socio-economic groups continue to be underrepresented. An important dimension of the "European model" is the political wish to ensure that talent rather than socio-economic background counts in admission to higher education. While this objective has been kept in mind during the massification of European higher education, lower socio-economic under-representation remains a problem. In particular the children of immigrants with low or no educational attainment have difficulty in reaching higher education. While these participation rates have been increasing, they are still below those of the original population. Increasing them is important for social cohesion as well as to address the problem of future shortages of higher education graduates (Ritzen, forthcoming).

The challenges for EU higher education institutions are clear: they will have to find ways to expand their student bodies, particularly by enrolling non-traditional students. Consequently, they will have to diversify their educational programmes and adapt these to new categories of students and to strengthen the employability of their graduates in the context of the knowledge economy.

In doctoral training, universities will have to recognise the need to offer candidates a broader experience than core disciplinary research skills. Universities will have to introduce courses and modules offering transferable skills training and preparing candidates for career opportunities in labour market sectors beyond academic institutions. The traditional Humboldtian

doctorate may have to be supplemented by a variety of new professional doctorates.

Research excellence and knowledge transfer

In research, European higher education and research organisations are confronted with the challenges of world-class excellence and better knowledge transfer.

The European Commission has characterised the quality of the EU research output as "generally good on average, but with a very limited basis of universities at world-level" (European Commission, 2007c, p. 50). In terms of total number and world share of scientific publications, the European Union is the world leader. In 2004, the Union's world share was 38%, compared to 33% for the United States and 9% for Japan. China ranked fourth with 6%. However, the picture changes when publications are compared to population. Then the United States leads with 809 publications per million population, followed by the European Union with 639 and Japan with 569 (European Communities, 2005).

There is clear evidence that the European Union's scientific impact lags behind that of the United States in almost all disciplines. The data on the field-normalised Citation Impact Score per scientific discipline show that the European Union's scientific impact is around or below world average in almost all disciplines. The Union scores above world average in only 6 out of the 37 fields and has lower scores than the United States in 35 of the 37 disciplines.

An institutional citation impact analysis per discipline shows that of the universities that are world leaders in at least one discipline only 26% are EU universities while 81% are 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 (European Commission, 2007b).

To increase their performance in terms of world-class research excellence, the European universities and research organisations will need to strengthen their research base. The brain drain of EU graduates and researchers, particularly to the United States, will need to be curtailed. Currently some 5% to 8% of the total EU researcher population is working in the United States. Many of these researchers are reluctant to return to Europe, primarily because of a lack of attractive research conditions and career prospects. Universities will need to focus on their relative research strengths and create attractive conditions for top-level researchers. They will need to profile their research portfolios using investment and co-operation strategies. They will need to develop joint research networks with attractive research

infrastructure and academic career paths. The current EU research policy (particularly FP7) offers important opportunities to address these challenges.

The European Union also needs to increase its performance in the process of knowledge transfer. The number of full-time equivalent (FTE) researchers per thousand labour force participants amounted to 5.4 in the European Union in 2003, compared to 10.1 in Japan and 9.0 in the United States. The EU deficit in the proportion of researchers in the labour force is mainly found in the business sector. In the European Union in 2003, 49% of all researchers were employed by the business sector, compared to nearly 69% in Japan and over 80% in the United States (European Commission, 2007c).

In 2005, EU patent applications accounted for nearly 31% of the total number of patent applications in the world. The United States has more than 33% of all patent applications and Japan over 16%. Between 2000 and 2005, the patent applications from Asian countries increased dramatically (India 241%; China 137%), as a result of which the world share of both the European Union and the United States has declined. In the enabling technologies (biotechnology, ICT, nanotechnology), the EU share of patent applications is lower than that of the United States, indicating a concentration of US inventions in these areas compared to the European Union (European Commission, 2008a, p. 69).

During the last years, the European higher education and research institutions have clearly increased their knowledge transfer activities. More and more institutions have established technology management and technology transfer offices. The number of patents applied for by higher education institutions in the European Union has increased by more than 28% during the last decade (European Commission, 2008a, p. 132). Nevertheless, the EU higher education and research institutions will have to further increase their efforts in this field. The links with business and industry will have to be intensified. Regional knowledge application clusters need to be further developed. And also "soft knowledge transfer" processes (applied research, internships, guest lectures, projects) will have to expand.

Public and private funding

The ideal of public financing of higher education and research is still widely shared in Europe. But the EU innovation agenda implies a major challenge to this ideal. Government finance simply is unable to provide sufficient funds for the new challenges that European higher education institutions are confronted with. If European higher education is to contribute to the innovative capacity of the European Union, provide professional and academic training for growing numbers of students, and perform world-class research, it cannot be funded solely from the public purse. The increasing

demands on higher education institutions in terms of numbers and quality on the one hand and the limitations of public finance on the other will not allow the European Union to close the present funding gaps between itself and the United States.

EU research and development intensity (gross domestic expenditure on R&D as a percentage of GDP) lags behind Japan and the United States. In 2006, EU R&D intensity was 1.84%, significantly lower than that of Japan (3.39%) and the United States (2.61%). Government expenditure on R&D as a percentage of GDP was 0.63% in 2005, which is 15% higher than in Japan (0.55%) but 21% lower than in the United States (0.76%). Business expenditure on R&D in the European Union as a percentage of GDP stands at 1%, compared to 2.62% for Japan and 1.69% for the United States (European Commission, 2008a). In terms of R&D expenditure, the European Union is still a long way from its ambitious target – 3% of GDP.

EU investments in higher education show a similar gap with the United States and Japan. Total investments (public and private expenditure) in higher education institutions in the European Union (2004) is 1.30% of GDP, while in the United States and Japan this is 2.45% and 1.85% respectively. The difference between the European Union on the one hand and the United States and Japan on the other is largely the effect of a much higher private investment level in both the United States (1.91%) and Japan (0.80%) compared to the European Union (0.35%) (European Commission, 2008b).

Given these funding gaps in research and higher education, the differences in performance and attractiveness between the United States and the EU systems are likely to remain. If the European Union wants to be a world-class higher education and research performer, it needs to boost its expenditure in these domains. And for this there appears to be only one solution: to increase private finance for higher education and research.

These funding differences have become a major concern of EU policy. The European Commission has pointed out that the funding gaps are a serious obstacle to meeting the Lisbon goals, and has particularly emphasised the importance of fiscal rules enabling the increase of private investments in both higher education and research. The Commission also points to the need for cost-sharing and suggests that member states critically examine their current mixes of student fees and support schemes in the light of their actual efficiency and equity outcomes.

EU higher education and research institutions are therefore confronted with the challenge of increasing their private income in education and research. In education, the major option is the introduction of tuition fees, coupled with the adoption of student financial support systems. In OECD countries, private contributions to higher education (household expenditure

as a percentage of total higher education expenditure) has on average increased by 5% between 1995 and 2005 (with large increases in Australia and Japan). However, most EU countries remain hesitant in this respect, and there is considerable ambiguity over whether tuition fees should be charged.

An increase in private income for research can result from closer co-operation with business and industry, including in knowledge transfer processes. While further developing their research portfolios, universities and research institutions can diversify their funding base by responding to the knowledge needs of business and industry and by prioritising their research programmes in accordance with major clients in sectoral or regional clusters.

Multi-level governance, academic stratification and regional differentiation

Clearly different from the days before the Lisbon Agenda, the European Union has become a major higher education and research policy actor, and many universities and academics have experienced its conditions and effects. The supranational EU policy level has become part of the multi-level governance system that European higher education and research organisations are dealing with. There appears to be an increasing alignment of EU higher education and research policies with the various national policies. The "re-launched" Lisbon strategy creates extra pressure on member states to align their national policy efforts to the EU innovation agenda. As a result, higher education and research institutions are working in a multi-level policy context in which the focus is increasingly on the roles institutions can play in enhancing innovation.

There appear to be two effects of the dynamics of this multi-level governance system that create important challenges for EU higher education and research institutions. The first of these can be described as the academic stratification of the European higher education system, with increasing vertical diversity. This is the combined result of the changing participation processes of European higher education institutions in the research framework programmes and the counterproductive consequence of the reinforcement policy on the interaction between higher education and industry. With regard to the former, it has been noted that past success in the framework programmes appears to be an indicator of successful future participation in these programmes (David and Keeley, 2003). What appears to be emerging is the well-known Matthew Effect where research groups that have been successful in obtaining funding appear to increase their chances of winning future funds. The other process is the counterproductive effect of the European Union's push towards closer links between higher education and industry. It appears that those institutions in a relatively weak financial position are increasingly forced to accept industrial funding for often routine

contract research. Faced with the impossibility of charging real research costs, these institutions are often confronted with a further weakening of their financial situation and a decrease in their capacity to undertake academic research (Geuna, 1999). The combined outcome of these processes is an increasing differentiation between academically and financially stronger and weaker institutions, and hence a growing vertical diversity in the overall European higher education system.

The second unintended effect is a growing regional differentiation in European higher education and research. This appears to be the outcome of three interrelated processes emerging from EU research and innovation policies (Frenken *et al.*, 2008). The first is the preference of researchers in "excellent regions" to collaborate with each other, rather than with colleagues in lagging regions. EU research policy appears to stimulate the concentration of talent in the richer and academically better-equipped regions of Europe. Lagging regions find it difficult to participate in successful EU research networks and appear to have to cross a threshold of quality and size before they can do so. Secondly, the EU 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 positions at the most prestigious universities, rendering it difficult for lagging regions to retain talent. Thirdly, the sectoral structure of the poorer European regions is usually characterised by a dominance of low-tech and medium-tech activities that do not fit the thematic priorities of EU research policy. The framework programmes 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 an unintended but nevertheless real effect of regional differentiation. The geography of European higher education and research 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. This process also appears to contribute to the growing academic stratification in the EU higher education and research system.

Academic stratification and regional differentiation confront European higher education and research institutions with the challenge to increase their strategic behaviour at the European level. The innovation agenda appears to have increased competition for funding and reputation. Higher education and research institutions cannot ignore the effects of the multi-level processes they are governed by. They need to design and implement institutional strategies that allow them to play their own roles in the new system dynamics of EU higher education and research.

For European higher education and research institutions, the development of effective institutional strategies may well be the major challenge of the current EU higher education and research policies. These strategies should include the educational, research and knowledge transfer profiles the institutions want to pursue, as well as the financial arrangements that should be related to those profiles. In coming years, European higher education and research institutions will have to find strategic institutional answers to the challenges of the EU innovation agenda.

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References

Aghion, P.M. *et al.* (2008), *Higher Aspirations: An Agenda for Reforming European Universities*, Vol. 5, Breugel Blueprint Series, Brussels.

Andersson, B. (2006), "European Research Policy: Towards Knowledge and Innovation or Trivial Pursuit", in L.E. Weber and J.J. Duderstadt (eds), *Universities and Business: Partnering for the Knowledge Society*, Economica, London, pp. 79-86.

Bartelse, J.A. and J. Huisman (2008), "The Bologna Process", in M. Nerad and M. Heggelund (eds), *Towardsa Global PhD? Forces and Forms in Doctoral Education Worldwide*, CIRGE/University of Washington Press, Seattle, pp. 101-113.

Bergen Communiqué (2005), *The European Higher Education Area Achieving the Goals*, Communiqué of the Conference of Ministers Responsible for Higher Education, 19-20 May, Bergen.

Berlin Communiqué (2003), *Realising the European Higher Education Area,* Communiqué of the Conference of European Ministers Responsible for Higher Education, 19 September, Berlin.

Bologna Declaration (1999), *The European Higher Education Area*, Joint Declaration of the European Ministers of Education, 19 June, Bologna.

Caracostas, P. and U. Muldur (2001), "The Emergence of a New European Union Research and Innovation Policy", in P. Larédo and P. Mustar (eds), *Research and Innovation Policies in the New Global Economy: An International Comparative Analysis*, Edward Elgar Publishing, Cheltenham, United Kingdom, pp. 157-204.

Carlsson, B. (ed.) (2002), *Technological Systems in the Bio Industries: An International Study*, Kluwer Academic Publishers, Boston.

CEDEFOP (European Centre for the Development of Vocational Training) (2008), *Future Skill Needs in Europe: medium-term forecast*, CEDEFOP.

Cohen, W.M., R.R. Nelson and J.P. Walsh (2002), "Links and Impacts: The Influence of Public Research on Industrial R&D", *Management Science*, Vol. 48, pp. 1-23.

David, P.A. and L.C. Keely (2003), "The Economics of Scientific Research Coalitions: Collaborative Network Formation in the Presence of Multiple Funding Agencies", in A. Geuna, A.J. Salter and W.E. Steinmueller (eds), *Science and Innovation: Rethinking the Rationales for Funding and Governance*, Edward Elgar Publishing, Cheltenham, United Kingdom, pp. 251-308.

Dosi, G. (1982), "Technological Paradigms and Technological Trajectories: A Suggested Interpretation of Determinants and Directions of Technical Change", *Research Policy,* Vol. 11, pp. 147-162.

Dosi, G. (1984), *Technical Change and Industrial Transformation*, St. Martin Press, New York.

Edquist, C. (1997), *Systems of Innovation: Technologies, Institutions and Organizations,* Francis Pinter, New York.

European Commission (2000), *Toward a European Research Area*, COM (2000) 6, European Commission, Brussels.

European Commission (2002), *The European Research Area: An Internal Knowledge Market*, Office for Official Publications of the European Communities, Luxembourg.

European Commission (2003), *The Role of the Universities in the Europe of Knowledge*, COM (2003) 58, European Commission, Brussels.

European Commission (2004), *Proposal for a Decision of the European Parliament and the Council Establishing an Integrated Action Program in the Field of Lifelong Learning*, SEC (2004) 971, European Commission, Brussels.

European Commission (2005a), *Working Together for Growth and Jobs: A New Start for the Lisbon Strategy*, COM (2005) 24, European Commission, Brussels.

European Commission (2005b), *Common Actions for Growth and Employment: The Community Lisbon Programme*, COM (2005) 330, European Commission, Brussels.

European Commission (2005c), *Mobilising the Brainpower of Europe: Enabling Universities to Make Their Full Contribution to the Lisbon Strategy*, COM (2005) 152, European Commission, Brussels.

European Commission (2006), *Putting Knowledge into Practice: A Broad-based Innovation Strategy for the EU*, COM (2006) 502, European Commission, Brussels.

European Commission (2007a), *Improving Knowledge Transfer between Research Institutions and Industry, across Europe: Embracing Open Innovation*, COM (2007) 182, European Commission, Brussels.

European Commission (2007b), *Voluntary Guidelines for Universities and Other Research Institutions to Improve their Links with Industry across Europe*, SEC (2007) 449, European Commission, Brussels.

European Commission (2007c), *Commission Staff Working Document* (accompanying the Green Paper "The European Research Area: New Perspectives"), SEC 412/2, European Commission, Brussels.

European Commission (2008a), *Annual Policy Strategy for 2009*, COM (2008) 72, European Commission, Brussels.

European Commission (2008b), *Progress Towards the Lisbon Objectives in Education and Training, Indicators and Benchmarks 2008*, Commission Staff working document based on SEC (2008) 2293.

European Communities (2004), *Facing the Challenge: The Lisbon Strategy for Growth and Employment*, report from the high level group, chaired by Wim Kok, Office for Official Publications of the European Communities, Luxembourg.

European Communities (2005), *Key Figures 2005, Towards a European Research Area, Science, Technology and Innovation,* Office for Official Publications of the European Communities Luxembourg.

European Council (2000), *European Council Presidency Conclusions*, Nr. 100/1/00, European Council, Lisbon.

Freeman, C. (1982), *The Economics of Industrial Innovation*, Francis Pinter, London.

Frenken, K., J. Hoekman, and F. van Oort (2008), *Towards a European Research Area*, Institute for Spatial Research, NAI Publishers, Rotterdam.

Geuna, A. (1999), *The Economics of Knowledge Production: Funding and the Structure of University Research*, Edward Elgar Publishing, Cheltenham, United Kingdom.

Laredo, P. and P. Mustar (2001), *Research and Innovation Policies in the New Global Economy: An International Comparative Analysis*, Edward Elgar Publishing, Cheltenham, United Kingdom.

London Communiqué (2007), *Towards the European Higher Education Area: Responding to Challenges in a Globalised World,* Communiqué of the Conference of European Ministers Responsible for Higher Education, London.

Lundvall, B.-Å. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London.

Lundvall, B.-Å. and S. Borrás (2004), "Science, Technology, and Innovation Policy", in J. Fagerberg, D.C. Mowery and R.R. Nelson (eds), *Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp. 599-631.

Malerba, F. (2002), "Sectoral Systems of Innovation and Production", *Research Policy*, Vol. 31, pp. 247-264.

Mowery, D.C. and B.N. Sampat (2004), "Universities in National Innovation Systems", in J. Fagerberg, D.C. Mowery and R.R. Nelson (eds), *Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp 209-239.

Neave, G. (1984), *Education and the EEC,* Trentham Books, London.

Nelson, R. (1993), *National Innovation Systems: A Comparative Study*, Oxford University Press, Oxford.

Nelson, R. and S. Winter (1977), "In Search of a Useful Theory of Innovation", *Research Policy,* Vol. 6, pp. 36-76.

Rammer, C. (2006), "Trends in Innovation Policy: An International Comparison", in U. Schmoch, C. Rammer and H. Legler (eds), *National Systems of Innovation in Comparison: Structure and Performance Indicators for Knowledge Societies*, Springer, Dordrecht, the Netherlands, pp. 265-286.

Ritzen, J. (forthcoming), *A Chance for European Universities, or: Avoiding the Looming University Crisis in Europe*, Amsterdam University Press, Amsterdam.

Tinbergen, J. (1977), "Income Distribution: Analysis and Policies", *The Economist*, Vol. 125/2, June, London, pp. 161-173.

Weber, L.E. (2006), "European Strategy to Promote the Knowledge Society as a Source of Renewed Economic Dynamism and of Social Cohesio", in L.E. Weber and J.J. Duderstadt (eds), *Universities and Business: Partnering for the Knowledge Society*, Economica, London, pp. 3-18.