14 Overview of innovation policy affecting knowledge flows in EU member states

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14.1 Introduction

In Europe, public policies affecting the production and dissemination of innovation-related knowledge are implemented at various levels of governance: supranational (European Union – EU), national (member states) and local. Supranational policies have been especially useful for establishing dense science and technology intensive networks across the continent. Primary policy tools serving that purpose have been the international cooperative research programmes such as those organized through the Research and Technology Development (RTD) Framework Programmes and EUREKA.[1]

The Framework Programmes (FPs) encourage knowledge flows by limiting financial subsidies to collaborative research projects that involve multiple partners, drawn from either the private sector or from public research institutions (PRIs). The latter includes both universities and specialized research organizations such as the Fraunhofer Institutes in Germany and TNO in the Netherlands. Special emphasis has been placed on small and medium-sized enterprises (SMEs), universities and PRIs, considered key for innovation and yet facing particular problems with regards to their efficient integration in the European technical enterprise. In addition, the EU's Structural Funds subsidize infrastructural projects in Europe's less economically-developed regions. Some of the Structural Funds are used to develop the public research infrastructure and networks with other European research institutions.

The main responsibility for innovation policy and consequently for programmes to encourage innovation-related knowledge flows lies, however, with the EU member states. In the 1980s, national innovation policies often focused on supporting a few innovative leaders or 'national champions' via direct economic subsidies for research and development (R&D). During the 1990s, innovation policies in many EU countries shifted in response to three factors: the need to reduce direct R&D subsidies to firms both for budgetary reasons and to satisfy European competition policy; the adoption of evolutionary theories and system views of the

innovation process; and the widespread conviction that European firms failed to translate European strengths in basic research into economically successful innovations.

These three factors increased the popularity of policies to develop networks of innovative firms and PRIs in order to encourage knowledge flows between different parts of the innovation system. The system perspective also encouraged member states to establish framework conditions to support innovation and to reduce innovation subsidies for the private sector that were targeted towards strategic technologies such as information and communication technologies (ICT) or biotechnology. Instead, the trend in countries such as the Netherlands, the UK and Denmark was towards innovation programmes that did not favour specific technologies. However, this trend conflicted with the goal of increasing the commercial applications of public sector research, which has partly been met in several EU states through the use of technology forecasting techniques to target funding for public research towards technologies with commercial applications. From the late 1990s until 2003, innovation policy in many EU countries was going through a period of readjustment to bring policies for the private and public sectors into alignment. This has partly been achieved through increasing support for technology-specific networks and clusters, and through a concerted effort in many EU countries to increase linkages between the public research sector and private firms.

The KNOW survey, conducted in the Spring of 2000, occurred when this realignment was well underway in many EU countries, with the possible exception of Greece. Therefore, where applicable, we illustrate our policy overview with the results of survey questions that may have been influenced by policy.

Our overview of current policy is largely based on national reports on innovation policy that are available from the TrendChart website.[2] TrendChart is funded by the European Commission and provides a wealth of data on innovation performance and on innovation policies for each EU member state. At the time of writing, the most recent reports cover national innovation policy as of March 2003, plus major policy issues and programmes that are under development or consideration. This overview focuses on policies within the seven countries covered by the KNOW survey. However, since KNOW includes the four largest European economies, a representative country from the Nordic region, and two other smaller economies, this overview covers almost all current EU policy themes at the national level.

There are three main categories of innovation policies of relevance to knowledge flows. The first set of programmes is designed to improve the innovative capabilities of firms, usually SMEs, that lack internal research capabilities. The second set supports research collaboration between private firms, while the third group encourages linkages between the public research sector and private firms.

14.2 Improving the absorptive capacity of SMEs

Many EU member states maintain a range of programmes to improve the 'absorptive capacity' of firms, or their ability to successfully adopt and implement new technology and to develop innovations in-house. The absorptive capacity of a firm has two components. First, firms can innovate by adopting and modifying technologies developed by other organizations, including other firms and PRIs. This is often seen as an issue of diffusion or technology transfer from one organization to another. An example is the purchase of new computer-controlled manufacturing equipment. The ability of a firm to introduce this equipment into its production line depends on its understanding of the advantages and disadvantages of the new technology for its own needs and strategies. Second, firms can innovate by undertaking creative activities such as R&D to develop new or improved products and processes. Much of this work can benefit from discoveries made by other firms or PRIs. The capacity of a firm to use these discoveries depends on its ability to understand them and to assess their commercial applications. Any activity that a firm undertakes to deepen and widen its scientific and technological skills will also improve its capacity to absorb knowledge from external sources.

Most innovation programmes in this category are focused on the first type of absorptive capacity since the target audience largely consists of SMEs that only innovate when necessary and therefore have a low absorptive capacity. Many of the target firms, for example, will only perform R&D occasionally, if at all, and the occasional R&D performers will have low R&D intensities. Only 15 per cent of the KNOW respondent firms fit this description. The main goal of many of these programmes is to encourage SMEs to adopt existing technology, but many programmes also try to create a long-term improvement in the innovative capabilities of these firms.

The front-line programme in most EU member states to support innovative capabilities in SMEs is a system of regionally-based technology transfer or innovation offices to provide support and technical advice, such as the Manufacturing Advisory Service and the Innovative Manufacturing Research Centres (IMRCs) in the UK, ANVAR in France, and the TIC-net regional information and consulting centres in Denmark. Greece is currently establishing a network of 13 regional technology centres. Such offices may provide general educational programmes, customized assistance and consulting services, or provide firms with information on national assistance programmes.

General educational programmes include demonstration projects, courses on innovation management and visits to successful innovative firms. Demonstration centres provide information on, and demonstrations of, the specific technologies in use. The goal is to reduce the risk involved in their adoption by helping the firm make an informed

decision. These centres are usually located at research institutes with the relevant expertise. An example is the PEPER programme in Greece. The UK provides extensive educational programmes on how to manage innovation, using forums, seminars, conferences and workshops that focus specifically on this topic. Several countries run programmes where staff from SMEs can visit successful innovative firms in order to learn about best practice in their industry. The leading example, which has been copied by several other EU countries, is the Teaching Company Scheme in the UK.

Customized assistance programmes include evaluations of a firm's general innovation needs and subsidies to hire recent science and technical graduates. Evaluations often include technology audits or subsidies to conduct technology feasibility studies. Several of these programmes involve visits by a consultant to the firm. A fixed number of days of consultancy are usually provided for free, while the cost of additional days has to be partly paid for by the firm.

Customized evaluations are provided by expert consultants who assess the firm's technical problems and evaluate how innovation fits in with the firm's management and business plans. These services are provided by the Teknologisk Servicesystem in Denmark. In Italy, integrated aid programmes that cover both innovation consultancy and equipment investment are provided to firms in the Mezzogiorno region. Technology audits focus specifically on technical problems within the firm and make recommendations on how to solve the problem. Several of these programmes are linked to expertise at a public research institute (PRI). Technology feasibility programmes, such as SMART in the UK, subsidize the cost of evaluating the feasibility of adopting or developing an innovative technology. By reducing risk, they provide an incentive for SMEs that generally innovate infrequently to innovate, or an incentive to innovative SMEs to move into new areas. In addition to evaluating the technology, most programmes require the firm to develop a business plan for the use of the technology.

A programme common to many EU countries to improve the absorptive capacity of firms is a hiring subsidy for technical staff. In most EU countries the programme and pays up to 50 per cent of the wage costs, for between one and three years, to SMEs involved in employing a recent university graduate to assist the firm to innovate. Examples include the CORTECHS and CIFRE programmes in France and HERON in Greece. Several countries also design the subsidy so that the new employee provides a direct link between their university or technical institute and the firm. In Denmark, the subsidy pays 50 per cent of the cost of hiring a PhD student, whose doctoral research is in an area of interest to the firm. The student's university also receives state funding. The UK has gone the farthest in this direction. It subsidizes higher education institutions to place graduates in firms to transfer technology during a two-year project. Supervision is provided jointly by the firm and the education institute.

The question in the KNOW questionnaire on whether or not the firm hired new staff from a university or public research institute to work on its most important innovation is of relevance to this policy. Although we do not know whether the hiring was subsidized by a government programme, 21 per cent of KNOW respondents reported hiring a new scientist or engineer from the public research sector to work on this innovation. This was approximately the same as the percentage of firms that reported hiring from a supplier (22 per cent) and more than the percentage of firms that reported hiring from a consultant (16) or from a customer (10).

Most programmes to build absorptive capacity are not linked to specific technologies. However, a few countries offer programmes to encourage firms to adopt targeted technologies or even offer financial subsidies for this purpose. For example, France provides soft loans to SMEs for the adoption of computer integrated manufacturing equipment. An increasingly popular area consists of programmes to encourage SMEs to introduce e-commerce or otherwise develop Internet skills. Relevant programmes are currently available in Germany, Italy, France (PAGSI) and Greece. According to the results of the KNOW survey, the intensity of Internet use is lower in these four countries than in Denmark, the UK and the Netherlands. For example, the percentage of KNOW respondents that use the Internet for searching for scientific and technical information ranges between 73 per cent and 83 per cent in the four countries with programmes to encourage Internet use, and between 88 per cent and 91 per cent in the other three countries.

14.3 Research collaboration

Several programmes support knowledge flows by either encouraging or subsidizing technical collaboration and networking between firms, or between firms and PRIs. To the best of our knowledge, all EU member states subsidize the creation of sectoral or regional networks of firms. All of these programmes are designed to 'connect' different actors within the innovation system. Several countries also subsidize collaborative research between firms. All EU countries also offer subsidies for collaborative research between PRIs and firms, but these programmes constitute a major part of current innovation policy and are therefore discussed separately in Section 14.4 below.

Policies to promote networks and regional or sectoral clusters have been increasing in popularity in Europe over the last decade. The April 2002 German White Paper on innovation policy particularly stressed the value of networks, which are now explicitly recognized and constitute a 'significant change in innovation policy making in recent years'.[3] Relevant German programmes include InnoRegio, EXIST and BioRegio. The Italian programme PIA provides subsidies for the establishment of networks among firms in a similar sector. ANVAR in France promotes

networks between SMEs and large firms. Another programme, RRIT, supports research and innovation networks in strategic technologies. The Dutch policy to support clusters was established in the early 1990s. Furthermore, the Dutch government's procurement programmes for innovative technology favour networks between contractors. The UK gives a high priority to encouraging clusters, primarily at the local level, with most support provided by the Regional Development Agencies. These provide forums and workshops where staff from different firms can meet.

A powerful method for creating knowledge flows between firms is through collaborative research. Many collaborative research programmes are funded directly by the firms themselves without any government subsidy. Whether or not a member state provides a subsidy for interfirm collaboration depends on its general approach to supporting private R&D. Countries that primarily subsidize R&D through tax credits, such as the UK, the Netherlands and Denmark, rarely provide direct grants to subsidize cooperative R&D among firms. As an example, the UK only provides direct subsidies for collaborative pre-competitive R&D between firms in the aerospace and the pharmaceuticals sectors.[4] Otherwise, its innovation policy stresses support for a favourable economic framework for business rather than direct financial subsidies for private R&D.

Other EU countries provide direct grants for collaborative R&D between firms, though often with some limitations. Direct grants provide cash to fund part of the costs of an innovation project. They are usually limited to 50 per cent or less of the costs, with the firm required to fund the remaining 50 per cent. The major concern with direct grants is that firms may use them to replace private funds, for research that they would conduct anyway. For this reason, direct grants are often targeted to research that firms would be unlikely to conduct without a subsidy, such as basic research in Belgium, or they are targeted to SMEs that lack the financial resources to perform R&D. Germany, Italy and France provide direct grants, but tend to limit them to collaborative programmes that include SMEs. The largest innovation finance programme in Germany provides direct grants for research within 250 thematic areas.

Several countries provide soft loans for private R&D. In most countries, soft loans do not require collaborative research, although they could promote knowledge flows by increasing the innovative capabilities of firms. France, Germany, the Netherlands and the UK only offer soft loans to SMEs.

In total, 30 per cent of KNOW respondents report receiving some form of public subsidy for R&D. Subsidies are more frequently reported by firms in the three manufacturing sectors (37 per cent) than by firms in the two service sectors (21 per cent). Even though more subsidies are available to SMEs than to large firms, larger firms in the manufacturing sector are more likely to report a subsidy (43 per cent of firms with over 250 employees compared to 34 per cent of firms with less than 250 employees). There is no difference by firm size in the service sector.

14.4 Commercializing publicly-funded research

Current innovation policy in five of the seven KNOW countries stresses the need for greater collaboration and knowledge flows between PRIs and firms in order to help turn public investment in research into successful innovations.[5] The two exceptions, Italy and Greece, recognize the importance of PRI-firm collaboration, but place greater emphasis on other areas due to the structure of their innovation system. For example, the focus of Greek innovation policy is on innovation finance and supporting start-ups in order to build up basic levels of innovative capabilities, while Italy's efforts are focused on major reforms to the public education and research system and developing a strategic vision for R&D that will meet Italy's future needs.

The increased policy attention to PRI-firm collaboration is partly due to the fact that PRIs receive the largest slice of government funding and have no choice about implementing government policy. In contrast, it is both difficult and undesirable for governments to try to coerce firms to perform R&D in specific areas that the government may view as strategic, or to take part in collaborative research.

Two main types of policies are widely used to encourage the commercialization of publicly funded research. The first consists of incentives for PRIs to conduct research of value to the private sector. These incentives are often designed to influence the activities of universities or institutions where the research agenda has traditionally been determined by academic criteria rather than by the needs of government or industry. The second policy area, which has attracted an enormous amount of attention and funding over the last decade, consists of financial support for collaboration between firms and PRIs.

14.4.1 Incentives for PRIs

Many member states support institutions with a specific mandate to conduct research of value to industry. The classic example is the Fraunhofer Institutes in Germany. Nevertheless, many of these institutions are under pressure to further increase the commercial relevance of their work, the efficiency with which technology is transferred to firms and the percentage of their operating costs that is funded by contract research.

Long-established public research institutes often specialize in innovation of relevance to low or medium technology sectors such as agriculture or machinery with many SMEs. These firms often lack the financial resources or expertise to solve technical problems in-house. The applied research institutes offer SMEs basic technical services for free or for a small fee.

Ongoing concerns in Europe about being left behind in strategic or enabling technologies have led to the establishment of new research

institutes in advanced technologies such as ICT, nanotechnology and biotechnology, where commercial applications are fed by scientific advances. Many of them are virtual research institutes that link researchers from several universities, PRIs and firms. This results in considerable savings and is expected to increase the efficiency of existing expertise by improving knowledge flows and cooperation. Virtual research institutes can also encompass both basic and applied research, since there is no existing 'research culture' that must be overcome. Examples include Denmark's 'Large Cross-Disciplinary Research Groups' and the Thematic Research and Innovation Networks (RRIT) in France. In addition, basic and pre-competitive research institutes are usually established in strategic technologies such as biotechnology or microelectronics.

Other programmes to encourage PRIs to conduct research of relevance to business include both programmes that actively direct research into business relevant research and passive programmes that establish the potential for contacts between academic researchers and firms. As an example of the latter programme, all EU countries now provide technology transfer offices (TTO) that can assist academics with establishing a commercial spin-off, patenting an invention or arranging a licensing agreement with a firm (OECD 2003). Both TTOs and science parks can also provide opportunities for contacts between industry researchers and academics.

A few EU member states have introduced mechanisms to deliberately target academic research funds towards areas of value to industry. For example, the research councils in the UK are responsible for distributing funds for academic research. They use two mechanisms to target research towards areas of value to industry. First, they include representatives from industry who take part in the funding decisions and second, they use the results of the Technology Foresight reports to identify promising technologies with potentially large markets. Technology Foresight programmes have recently been established in the six KNOW countries, including FUTUR in Germany and QuickScan in the Netherlands. In some countries, such as Denmark, the Foresight exercises directly influence research priorities in PRIs, while in other countries the link is either not yet worked out or is indirect. In the Netherlands, PRIs can receive extra public funding if they have projects that are partly funded by a private firm. Over time, PRIs are expected to fund a percentage of their research from 'third stream' or private sources. Both the Netherlands and Denmark have revised legislation covering the mission of universities to include the dissemination and application of knowledge.

14.4.2 PRI-firm research collaboration

All KNOW countries subsidize firms to either contract out research to PRIs or conduct collaborative research with PRIs. Examples include

InnoNet and ProInno in Germany, with a focus on SME-PRI linkages, MURST in Italy, IOP in the Netherlands, LINK in the UK and the Innovation Consortiums in Denmark. In many programmes, the firms pay all of their own research costs, but government funds the PRI costs (up to 50 per cent of the total). This type of subsidy is justified by the need to overcome some of the disadvantages of contracting out research or collaborating with universities and PRIs. These include concerns over confidentiality, higher risks for the basic and pre-competitive research where the expertise of many PRIs lies, and a preference for firms to keep more applied and commercial research in-house. In addition to producing research output of value to industry, these programmes can assist in developing expertise within universities and PRIs on problems of importance to industry.

With such a diversity of programmes to encourage and finance PRI-firm linkages, one would expect PRIs to be an important source of knowledge for the innovative projects of firms. An encouraging result from KNOW is that 38 per cent of the respondent firms report one or more research project that involved PRIs. However, other KNOW questions show that PRIs are relatively unimportant, compared to other information sources. For example, only 11 per cent of firms report that PRIs contributed to the idea behind their most important innovation, compared to 31 per cent that cite their suppliers, 32 per cent that cite competitors and 49 per cent that cite customers. The results are similar in terms of who contributed to the completion of this innovation. Twelve per cent of the firms cite PRIs, compared to 35 per cent that cite customers and 39 per cent that cite suppliers. Overall, only 5 per cent of the KNOW respondents stated that PRIs were their most important contributor to the completion of this innovation. The lack of importance of PRIs could be due to the recent implementation of many policies to encourage PRI-firm links, or these links may not be particularly valuable for smaller firms or for firms in the five sectors covered by KNOW.

14.4 Conclusions

The increasing sophistication of science and technology (S&T) policy in Europe has led to a gradual refocusing of the overall policy target from passive support for the creation of new ideas to a concerted effort to ensure that these ideas find their way to firms that can apply them to their new products, processes and services. One consequence of this change in S&T policy, due to the adoption of a systems approach to innovation, is that all EU member states emphasize the need to promote knowledge flows between firms and between firms and PRIs. The current policy focus in many EU member states is to encourage universities and government research institutes to direct their research efforts to areas that are of interest to private firms and to improve the transfer of their expertise and

knowledge to firms, particularly SMEs. Nevertheless, the KNOW results show that these policies do not appear to have had much of an effect on the use of PRIs as a source of knowledge for SMEs.

Another thrust of innovation policy in many EU countries is to support regional and sectoral networks of innovation that include firms and PRIs. Other programmes maintain a longstanding technology transfer infrastructure to improve the absorptive capacity of SMEs. These provide basic educational courses on innovation management and technology audits and are designed to help firms identify technical problems and develop innovative solutions.

Notes

1 See Caloghirou and Vonortas (2000), Caloghirou *et al.* (2004) and Peterson and Sharp (1998) for extensive discussions of cooperative R&D and related policies in Europe.
2 The country policy reports are available at www.trendchart.org under 'Country Pages' (last accessed 7 January 2004). See EC (2002) for a policy overview for 2002. Diederen (1999) also provides a policy overview for EU member states in the late 1990s.
3 TrendChart Country Report for Germany, October 2002.
4 This is stressed by UK policy documents as part of the UK's 'free market' approach to innovation. However, it is interesting to note that aerospace and pharmaceuticals account for almost half of all manufacturing R&D in the UK. Therefore, the UK still manages to provide direct subsidies to its most innovative manufacturing industries.
5 Such cooperation is a major emphasis of recent policy documents in Germany (BMBF 2002), France (Journal Officiel 1999) and the Netherlands (EZ 2002).

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