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INSTITUTE OF ECONOMICS
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MŰHELYTANULMÁNYOK **DISCUSSION PAPERS**

MT–**DP.** 2004/1

THE SOCIO-ECONOMIC IMPACTS OF FRAMEWORK PROGRAMMES IN TRANSITION COUNTRIES: A SYSTEMIC APPROACH OF ASSESSMENT METHODS

ATTILA HAVAS
LAJOS NYIRI

Institute of Economics
Hungarian Academy of Sciences

Budapest

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Author: Attila HAVAS, Senior Research Fellow at the Institute of Economics of the Hungarian Academy of Sciences
H–1112 Budapest, Budaörsi út 45. E-mail: havasatt@econ.core.hu

Lajos NYIRI, Manager Director at the Zinnia Group Bt
H–1106 Budapest, Rézvirág u. 5/b. E-mail: zinnia@mail.datanet.hu

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THE SOCIO-ECONOMIC IMPACTS OF FRAMEWORK PROGRAMMES IN TRANSITION COUNTRIES: A SYSTEMIC APPROACH OF ASSESSMENT METHODS

BY ATTILA HAVAS, LAJOS NYIRI

a revised version forthcoming in: L. Georghiou, J. Rigby, H. Cameron (eds.):
Assessing the Socio-Economic Impact of the Framework Programme,
Cheltenham: Edward Elgar

Abstract

This paper assesses the socio-economic impacts stemming from Research, Technological Development and Demonstration Framework Programmes (FPs) project participation in a transition economy. Some of the most significant impacts of Central and Eastern European participation in FPs can only be understood in the context of the changing national innovation systems (NIS). In other words, when assessing impacts, besides the 'usual' questions on product and process development, job creation, etc., a broader set of questions should be asked, concerning competences: managerial, project development, network and collaboration-building capabilities, i.e. the process, and elements, of organisational learning, broadly defined.

Our main methodological argument is based on two underlying characteristics of the Hungarian NIS. First, it had been fragmented during the planned economy the academy-industry relations had been rather weak. Second, due to the overall socio-economic transition it is also in flux, some former links have been further damaged, while new players have appeared and new, stronger incentives have been put in place to form new partnerships.Behavioural and organisational 'effects' of FP participation are likely to be crucial – besides the 'usual' outputs and impacts.

Our main policy conclusion is that it would well worth the effort to apply – a broader framework for impacts and effects to a larger, statistically representative sample. Thus a reliable description could be obtained, on which basis sound policy conclusions could also be drawn.

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MAGYAR TUDOMÁNYOS AKADÉMIA
KÖZGAZDASÁGTUDOMÁNYI KUTATÓKÖZPONT

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MŰHELYTANULMÁNYOK **DISCUSSION PAPERS**

MT–**DP.** 2004/1

HAVAS ATTILA – NYIRI LAJOS

AZ EU KUTATÁS-FEJLESZTÉSI KERETPROGRAMJAINAK TÁRSADALMI-GAZDASÁGI HATÁSA AZ ÁTALAKULÓ ORSZÁGOKBAN

Az értékelés módszerei

átdolgozott változata megjelenik: L. Georghiou, J. Rigby, H. Cameron (eds.):
Assessing the Socio-Economic Impact of the Framework Programme,
Cheltenham: Edward Elgar

Összefoglalás

A kutatás célja az EU 5. kutatási és technológiafejlesztési keretprogramjának (FP5) különböző típusú hatásait jellemző mutatók kidolgozása és az adatgyűjtési, mérési módszerek kipróbálása volt, az átalakuló országok innovációs rendszerének fejlettségéhez igazodva.

A magyar innovációs a rendszer a tervgazdaság időszakában töredezett, a gazdaság és a tudományos kutatói szektor közti kapcsolat gyenge volt. A társadalmi-gazdasági átalakulási folyamat eredményeképpen a szálak egy része tovább gyengült, miközben új szereplők jelentek meg színen, akik új típusú partneri viszonyokat hoztak létre, erősítették az együttműködést a kutatók és a vállalatok között. Ilyen körülmények között az FP részvételek „puha", azaz viselkedési (kulturális) és intézményi hatásai – a piacgazdaságokban „szokásos" eredményekkel és közvetett hatásokkal együtt – rendkívül fontosak. Ezért azt is vizsgáltuk, javul-e az FP5-ben résztvevő személyek és szervezetek az innovációs folyamat gazdasági, szervezeti nem műszaki jellegű problémáit megoldó képessége. Ezt összefoglalóan szervezeti-vezetési tanulásnak hívhatjuk.

A gazdaságpolitikai intézkedések megalapozásához szükséges lenne a módszertan fejlesztését és kipróbálását szolgáló kutatás megismétlése egy nagyobb, reprezentatív mintán.

1. INTRODUCTION

The recent systemic changes in Central and Eastern Europe (CEE) have created new opportunities for the European research community. Policy-makers first opened up EUREKA and COST for new members from CEE, and then other organisations, e.g. CERN and EMBO, followed suit. The European Union (EU) opted for a gradual approach when inviting CEE nations to participate in its R&D actions. In the beginning new funding schemes (e.g. Phare and COPERNICUS) were created to facilitate the co-operation with CEE R&D communities. Then it took less than a decade to achieve full integration from the first individual project participation in Research, Technological Development and Demonstration Framework Programmes (FPs) to the full participation in FP5, in which it was possible for the first time for all the associated countries to participate at the programme level.

During the same period, however, CEE countries have gone through a major socio-economic transformation, affecting all aspects of their national systems of innovation (NIS). This chapter illustrates the socio-economic impacts stemming from FP project participation in a country in transition, and assesses the indicators developed to measure these impacts, using case studies.

Our hypothesis has been that some of the most significant impacts of CEE participation in FPs can only be understood in the context of the changing NIS. In other words, when assessing impacts, besides the 'usual' questions on product and process development, job creation, etc., a broader set of questions should be asked, concerning competences: managerial, project development, network and collaboration-building capabilities, i.e. the process, and elements, of organisational learning, broadly defined.

Against the backdrop of these considerations first the transition process itself and the changing Hungarian NIS is characterised. Then some basic statistics on the Hungarian participation in FP5 are presented. This is followed by a brief section on the methodologies applied, before the case studies are discussed in detail. Finally, the concluding section sums up the lessons learnt, and suggests questions for further research.

2. TRANSITION IN HUNGARY AND ITS IMPACT ON THE NIS

2.1. Systemic changes, stabilisation and microeconomic adjustment

The first phase of the transition process in Hungary is over by now. The most important political and economic institutions have been re-established: e.g. a parliamentary democracy based on a multi-party system, private ownership of assets, free factor and commodity markets and the stock exchange.[1] A harsh macroeconomic stabilisation programme, introduced in 1995-96, has undeniably contributed to the significantly improved macroeconomic performance.[2] Another crucial factor should also be highlighted, however, namely the costly and painful microeconomic adjustment. Most companies have been privatised, and fundamentally restructured in terms of their products, markets, production processes, organisational forms and operation (managerial techniques). In short, gales of creative destruction have been strong and effective.

2.2. Fragmented National System of Innovation

In market economies networking, that is, communication and co-operation among innovative firms and other organisations involved in knowledge production plays a crucial role. (Freeman 1994, 1995, Freeman and Soete, 1997, Lundvall and Borrás, 1999, special issue of *Research Policy* on innovation systems [volume 31, No. 2]) In Hungary, however, exploitation of scientific results for economic and social purposes was rarely a success until the end of 1980s, in spite of a relatively strong and successful research system (reflected by publication and citation indices). Academia-industry links were rather weak and *ad hoc*, alike communication and co-operation among other players. Moreover, crucial organisations required for a strong national innovation system either did not exist, or did so only in a distorted form (the so-called bridging institutions, as well as financial, trade and legal services specialising in meeting the needs of innovative enterprises). In brief, innovation was not regarded important, and hence it did not receive adequate

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[1] Some crucial economic institutions – e.g. a two-tier banking system, a 'Western-type' taxation system (VAT and personal income taxes) – were introduced as early as 1987, that is, preceding the systemic changes. The stock exchange was also re-opened prior to the political transition, namely in 1989.

[2] For data and assessment see, e.g., Halpern and Wyplosz (1998) and Havas (2002).

attention, resources and institutional backing. (Hanson and Pavitt, 1987, Havas, 1999)

In the early years of transition this fragile system was further weakened: former links were cut off as firms were privatised, R&D institutes reorganised, and R&D expenditures – both public and private – drastically reduced. Since the mid-1990s, favourable developments have occurred, however. Some bridging institutions have been set up and international R&D co-operation has intensified. Foreign firms have brought new technologies in, and diffused them among their suppliers. The number of business R&D units has increased – some of them have been set up by multinational companies –, and firms have launched again joint projects with universities and research institutes. (Havas, 1999, 2001, Inzelt, 1996, OECD, 1993, TEP, 2001) Yet, attempts to devise and implement a coherent set of policy tools to strengthen the innovation system have failed. (Havas, 2002)

In sum, the Hungarian innovation system has changed to a significant extent since the early 1990s. However the process to transform the previously ineffective system into a well functioning, efficient one has proved to be a much longer and demanding one that many policy-makers expected in the beginning.

3. HUNGARIAN PARTICIPATION IN FP5

The total number of FP5 projects (contracted or in retained status) with at least one Hungarian participant has reached 373 by September 2001. (*Table 1*) With this figure Hungary was among the top three associate members.

The large number of project proposals demonstrates the relatively high level of FP5 awareness in the country. The IST programme has proved to be the most popular, while it has produced the lowest approval rate. The weight of the Hungarian participation may be assessed by the EU funding granted to Hungarian participants as a percentage of the total programme budgets. This indicator is usually between 0,24 (IST) and 0,29 (QoL). It is significantly higher in the case of INCO (1,09) and very low in the case of EURATOM (0,11).

Table 1

Hungarian participation in FP5 (from 1999 to mid 2001)

Programmes	Applications with at least one participant from Hungary		Total EU funding for projects in contracted or retained status (million euro)
	Total number of applications	Applications approved (contracted or retained for funding)	
IST	480	61	8.597
QoL	370	64	6.993
Growth	265	62	6.990
EESD	302	44	5.895
INCO	68	19	5.200
Innovation & SME promotion	76	26	0.660
IHP	241	80	5.978
EURATOM	50	17	1.424
Total	**1852**	**373**	**41.737**

Source: Ministry of Education, Hungary, September 2001

FP5 has generated a strong interest in associated CEE countries, especially in the academic community. The low level of domestic resources for research has significantly increased the relative value of EU funding. The participation of businesses is much lower than the EU average, and that hints at the modest innovation capacities of enterprises. Hungary follows this general CEE pattern. The major beneficiaries of FP5 funding have been the research institutes of the Hungarian Academy of Sciences (HAS) with a nearly 50% weight in the total EU support to Hungarian participants. The business community has obtained about a 20% share. In general, Hungarian SMEs have achieved more modest results in the various actions than the EU

average, however in the Co-operative Research funding scheme their success rate is higher than the EU average.[3]

4. CASE STUDIES AND TYPES OF IMPACTS CONSIDERED

Exploratory case studies were used to understand the full impact of FPs on the Hungarian NIS. The unit of analysis was the organisation itself participating in different FP projects, that is, not individual research projects. One institute of the HAS and three SMEs were chosen as subjects of the case studies.[4] During the interview phase we realised the importance of other types of insights, and thus one expert of an EU FP5 consultancy service and a policy-maker were also interviewed.

Three different types of impacts were considered when studying the impacts of FP participation: scientific and technological aspects, economic aspects and broader societal outputs and impacts. Thus outputs are understood here as *direct* impacts of FP participation (short- or medium-term ones), while impacts are defined as *indirect* results/ consequences (short- or long-term ones).

In line with our underlying hypothesis – that some of the most significant impacts of CEE participation in FP5 can only be understood in the context of the changing NIS – we tested whether there was yet another type of impact. In other words, a third category, what we may call '*effects',* was introduced. By this we addressed the effects of FP projects on the participants in the form of managerial and organisational learning and cultural change, that is, new managerial techniques, decision-making methods introduced, new organisational forms and new way of thinking applied.[5] These effects are all the more important as they might diffuse into a broader circle of institutes and firms, and thus can be beneficial when applying for domestic or inter-

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[3] For a more detailed description and policy analysis see Nyiri [2002].

[4] To draw well-substantiated conclusions a much larger sample would be needed, of course.

[5] The questionnaire, together with the list of interviewees, and a more detailed version of the case studies can be found in the final project report: Georghiou, Luke, John Rigby and Hugh Cameron (eds) [2002]: Assessing the Socio-Economic Impact of the Framework Programme, Manchester: The University of Manchester (also available at http://les1.man.ac.uk/PREST/Publications/ASIF_report.html).

national (EU) funding (project development and project management skills), building networks, commercialising S&T results (relevant innovation management techniques), etc. Our results confirmed that this set of questions on 'effects' is certainly relevant if one is to identify the socio-economic impacts of FP participation in the case of partners from transition countries.

5. FINDINGS

5.1. The Institute Case Study

SZTAKI, the Computer and Automation Research Institute of the HAS, was established in 1973 by merging two research institutes in the field of computer sciences and automation. The institute soon became one of the major Hungarian basic research organisations in its fields, and gained a strong reputation not only in Central and Eastern Europe, but in Western Europe and the US as well.

SZTAKI has 320 employees in total, of which 225 are with university degrees. More than 40 senior researchers teach at universities on a regular basis, and the institute runs postgraduate programmes jointly with Hungarian universities.

SZTAKI does not operate as a typical academic institute. A major restructuring in 1991 created 'cost centres' working independently from each other. The basic research labs are financed by the Academy's budget, while the application-oriented research activities are contract-based.

5.1.1. EU-related activities of SZTAKI

The first project participation of SZTAKI in EU funded R&D programmes dates back to 1994. Since that time the institute has participated in 99 consortia, which applied for EU grants and received support in 31 cases. Not taking into consideration the 8 applications under evaluation, the success rate is 34% (31 contracts out of 91 applications). The total cost of all these projects was 47 million euros. SZTAKI received 2,65 million euros and its own contribution was 1 million euros. The institute is one of the 6 Hungarian winners of the Centre of Excellence, INCO 2000 action, receiving 600 thousand euros for 3 years. SZTAKI hosts the IST programme national liaison office, which runs the IDEAL-EAST activity.

Table 2

SZTAKI's participation in different EU RTD Framework Programmes

FP4 statistics	Number of applications submitted	as co-ordinator	0
		as partner	57
	Approved		19
		completed	18
		on-going	1
FP5 statistics	Number of applications submitted	as co-ordinator	9
		as partner	33
	under evaluation		8
	Approved		12
		completed	0
		on-going	12

Source: interviews

SZTAKI has established contacts with 58 business and 86 academic partners from the EU through the different EU projects until late 2001. (The same figures related to CEE are: 12 business and 66 academic partners.)

The motivations of SZTAKI's foreign partners changed in the past decade. At the very beginning of the 1990s CEE, and Hungary as a part of it, was considered by many potential EU partners as a 'mysterious' area. The specific international funding schemes, however, created good conditions for strengthening the links between the two parts of Europe. That time the close personal relationships between the leading scientists played a decisive role in starting joint projects.

The relatively low labour costs of researchers in Hungary have created more interest for the potential foreign partners, at least in the initial phases of co-operation. It has been an important motivation of EU project co-ordinators looking for CEE partners that the highly labour intensive parts of research activities ("hack-work") can be executed reliably by them. Other factors have also positively contributed to a higher level of CEE participation: the extra funding provided for the project co-ordinator as well as further formal or informal incentives, e.g. 'extra points' if CEE participants have been involved in a consortium. However, special knowledge and available unique skills form the strongest basis for long-term collaborations. SZTAKI has acquired such skills e.g. in the field of Cellular Neural Networks technologies.

Economic considerations, however, have played hardly any role for the potential Western partners. So far SZTAKI has not come across a Western

European partner purely or mainly motivated by business interests in CEE or Hungary.

5.1.2. Outputs and impacts

Scientific and technological outputs are much higher valued by an academic research institute than any other aspects. The major outputs of SZTAKI's EU project collaborations can be measured in the form of new knowledge generated, new skills and know-how developed. Good examples of scientific and technological fields in which SZTAKI developed brand new knowledge and skills through EU project participation are as follows: agent-based production control (in FP4) and grid computing technologies (in FP5). The EU projects alone are not sufficient to complete this learning process. Yet, they are good starting points to produce scientific knowledge, what is essential to grasp the problem, and to navigate the research team when later moving into the depth of the search process.

Economic output cannot be measured in SZTAKI's cases directly, and in their view it seems to be a general phenomenon. The underlying principle of public R&D is that taxpayers should fund even market-oriented research activities if those are not financed fully by the private sector because of their size and/or the level of risk. The main question in relation with the impacts of FP5 would be how risk-taking is managed. Compared to the US where even very high-risk projects may find funding relatively easily, the EU funding policy and methodology is not appropriate. The reason probably is that the funds granted to EU projects are too low to produce scientific or technological outputs immediately applicable in the industry. Thus the number of directly business-oriented projects is very limited.

In one of the SZTAKI's research fields, global market forecasts suggest that the current efforts on Cellular Neural Networks technologies may produce a real breakthrough in a few years, creating opportunities for establishing spin-off companies. That is, one form of medium- to long-term economic impact might be observed. Yet, the project is funded by many international sources, including the FP5. Therefore it would be difficult, if not impossible, to account for the exact economic impacts of the FP5 in this case. In general, we can assume successfully completed EU-funded projects, followed by new business entities to manufacture the products based on the newly developed technologies. Yet, it would be very hard to measure, to

what extent the various funding sources have contributed to this hypothetical economic success.[6]

A more direct *economic effect* of FP participation has been the establishment of spin-off firms: SZTAKI has founded SMEs to perform business activities necessary for the implementation of given FP projects, but considered as 'alien' in a typical academic institute (like preparation of demonstration, conference/fair services, etc.). The EU FP projects also contribute to hiring young scientists – PhD students and post-docs – and developing the institute's infrastructure by purchasing special hardware and software tools.

As far as *societal outputs* are concerned, it should be underlined that the creation of new knowledge and development of new skills – as a result of FP projects – has a special importance in an organisation like SZTAKI due to its nation-wide dissemination function. The strong inter-relationships with the national education system are likely to result in a fast diffusion of new knowledge.

In sum, SZTAKI has improved its international competitive position in the 'research market' by participating in EU R&D projects. It has been able to keep its previous leading position in the local 'market', too, while boosting its image and credibility not only in Europe, but both in the USA and in Asia. However, the institute has not set up any important business relations in the European market as a result of EU-funded R&D project.

The interviews with firms have also demonstrated that SZTAKI plays a certain liaison-like role in bringing Hungarian SMEs close and into FP5. (see later) Two firms have first heard of the EU R&D programmes by having daily relations with the institute. SZTAKI, as an experienced actor has demonstrated the benefits and difficulties of participation, and helped these firms take the first steps in preparing applications as well as finding project partners.

5.1.3. Benefits of FP participation

At SZTAKI, improving the international and domestic partnerships has been considered the most important result of EU-funded collaborations. The prestige provided by the EU labelled projects may also improve to a large

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[6] A rather crude estimation could simply take the ratio of different funding sources so as to establish their 'weight' in terms of contributing to economic success.

extent the market position of the organisation. Potential benefits, closer to business aspects, however, are less important for SZTAKI. Access to new markets, or gaining new knowledge on existing or future, emerging markets, for example, do not play any role in the institute's decisions joining an FP5 project.

Funding obtained through the EU FP projects does not form a crucial part of SZTAKI's budget. It represents only about 5% of the total annual budget. In spite of this fact, the managers of the institute consider this source as a very important one. They are convinced that raising funds is a motivation to prepare FP project proposals so frequently. Researchers feel that the EU sources can be spent for activities poorly financed from state funds.

The participation in EU actions has largely contributed to the cultural changes, which has taken place at the institute during the past decade. The old-fashioned academic approach has disappeared; most of the research staff learnt the importance of 'selling' their results. An experienced core group has been built, with strong capabilities in international project proposal development and tendering. These skills have also benefited the institute while competing for national funds. Capabilities to manage international research projects have also developed significantly.

5.1.4. Main obstacles to FP participation and capitalising on FP project results

One of the major obstacles to increase SZTAKI's participation in FP projects is the lack of human resources to manage these projects. Those who are experienced in international project management are overburdened. The dilemma they face is as follows: should they opt for a larger number of small projects or fewer big ones? The Centre of Excellence project pushes the institute to prefer the latter one, but it challenges the existing in-house FP5 management structure, which leaves the labs and departments acting individually.

The academia-business links in general are poor in Hungary, but some promising changes are occurring more recently. It is expected that closer relations between local firms and the institute will improve SZTAKI's chances when applying for EU FP funding.

The low level of commercialising skills is the main obstacle to exploiting the project results. It is a general problem, not only related to FP5 projects, and hence SZTAKI plans to improve these skills. The local market is not developed enough, either, especially in those areas where SZTAKI is active.

5.2. Firms

Three firms were interviewed – Applied Logic Laboratories (ALL), MT System and IQSOFT – each specialising in IST. Two of them closely co-operate under the same FP5 projects, while the third one represents a rare case where a Hungarian organisation co-ordinates an FP5 project.

ALL was established in 1986 as a spin-off company. Previously its core group worked on applied logic as a research department of SZÁMALK, then one of the biggest Hungarian IT companies. The company is owned by Hungarian private investors, most of them are ALL's employees. ALL is an SME, having altogether 14 employees. Half of them have scientific degree, mostly in mathematics and computer science related engineering. Most of them are active in higher education, too. The annual turnover in 2000 was 60 million HUF (around 240 thousand euros).

ALL has gained of international reputation being included in a wide network of scientific co-operation, including R&D groups in Moscow and Kiev. The key researchers have been members of various global networks since the 1980s, collaborating – among others – with Japanese firms, the Aerospace Institute (CERT ONRIA) of the Ministry of Defence, France, Digital Equipment Corporation (DEC), and further US partners.

MT System was established in 1995 by a large Hungarian firm, Műszertechnika (MT) Holding. It is 100% owned by this firm. It provides consultancy in the field of system integration, develops services in distance learning, and runs training programmes in IST related areas. The company only operates in the Hungarian market. This company is also an SME (with 12 employees), but 'virtually' expanded by a large number of permanent subcontractors. All the employees hold university degrees. They have traditionally good relationship with the related Hungarian research institutes and university departments. The annual turnover in 2000 was about 100 million HUF (roughly 400 thousand euros).

IQSOFT was established in 1990 as a spin-off company, when the Theoretical Laboratory of SZKI (Computer Research and Innovation Centre) was reorganised. Its majority owner is the KFKI Group[7] (55%), while the man-

[7] The business activities of KFKI, Central Physics Institute of the Hungarian Academy of Sciences in the field of computer and other IT related areas were taken out of the

agement and employees hold a 37% stake. Its 94 employees all have university degrees, 86 staff members are scientists (mostly mathematicians) or engineers. Many of the researchers also teach at universities. The annual turnover in 2000 was 1,57 billion HUF (about 6.3 million euros).

Core staff members have been involved in international co-operations since the early 1980s, e.g. working on the development of MPROLOG with partners from Germany and Canada. In 1990 IQSOFT joined the international Gigalips collaboration, partnering with the Argonne National Laboratory (USA), University of Bristol (UK) and the Swedish Institute of Computer Science. This research project was followed by a number of EU supported R&D projects in the area of logic and constraint programming, knowledge-based systems and object oriented technologies. The results of these projects are used in commercial projects both in Hungary and abroad. IQSOFT is developing software for Western customers, including NOKIA, Astra Zeneca and DEC.

5.2.1. EU-related activities of the firms

All the three firms are involved in FP5 projects, having been active in previous EU R&D programmes, too. They have submitted 50 project applications under FP4 and FP5. EU support has been granted in 18 cases, resulting in a very good success rate (36%). Most of the projects have been co-ordinated by non-Hungarian participants. IQSOFT is the only organisation co-ordinating EU project.

The total size of the 18 projects approved so far is over 30 million euros, and the interviewed Hungarian firms have been granted more than 1,8 million euros, an average of 100 thousand euros per project. Assuming that the firms' own contribution is about the same amount, the Hungarian partners have a 12% share in the projects' funds.

As it is expected most of the project partners came from business (64%): 47 companies from the EU and 5 ones from CEE. The partnership with academic institutes seems to be more typical in demonstration and networking projects. (The academic participants are more balanced between the EU and CEE – 17 from the EU and 12 from CEE).

None of these firms has a separate in-house unit for facilitating and preparing EU project proposals. ALL used to have one person dedicated exclusively to this job, but at the end of FP4 the management evaluated this ac-

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academic network in the early 1990s. The KFKI Group is a holding consisting of 5 firms (all together 560 employees and about 60 million euro revenues in 2000).

tivity (10 proposals submitted, all failed), and decided not to keep this position, i.e. that person should conduct research activities. Both at MT System and IQSOFT, however, there is one co-ordinator for the EU activities.

Table 3

Participation in different EU RTD Framework Programmes

		ALL	MT System	IQSOFT
FP4 statistics	Number of applications submitted	10	3	17
	approved	0	3	7
	completed	0	3	6*
	on-going	0	0	0
FP5 statistics	Number of applications submitted	5	9	6
	approved	3	4	1
	under evaluation	2	0	0
	completed	0	0	0
	on-going	3	4	1

Source: interviews

Note: * One project has been stopped before its completion due to the co-ordinator's financial difficulties.

The 3 firms' experience concerning the motivations of the EU partners in EU-funded R&D collaboration is very similar to that of SZTAKI. Especially at the very beginning the good personal relations played a decisive role. For example the current chief scientist of IQSOFT spent years in the UK in late 1980s working on a research project partially funded by the EU. When new support schemes started to facilitate the preparation of research projects with CEE countries, this good personal relation immediately created new proposals. In another case a Hungarian origin, by that time US citizen, expert has assisted in forming a consortium with the participation of MT System.

All the firms mentioned that they have enjoyed the benefits of the sympathy toward Hungary and the appreciation of the successful economic and social transition. As for professional factors, the firms pointed out two strong motivations for EU partners: special knowledge available in CEE; and the relatively cheap and reliable scientific services what CEE partners can offer.

5.2.2. Outputs and impacts

As expected, economic outputs and impacts appear to have more or less an equal weight as the scientific and technological ones. It is important to note that the managers do *not* consider these two factors in a hierarchical way (in which the economic factors would be at the top).

Knowledge acquired and/or skills developed through FP participation are considered as the major *scientific and technological outputs*. For some of these firms, the EU actions they participated in provided their companies the major source of new skills and knowledge in the 1990s. IQSOFT introduced both the object-oriented technologies and the constraint programming in its business activities having participated in relevant FP projects. MT System has learnt web-based application integration, supply chain management and ERP (Enterprise Resource Process) technologies and tools through participating in FP4 and FP5 projects. All these now form the knowledge base of the company's services provided in the domestic market. In the case of a highly research-oriented firm, like ALL, scientific publications as outputs of EU projects are of vital importance, as those may improve globally the 'visibility' of its accumulated special knowledge. That, in turn, may contribute to gain a better international market position.

Economic outputs of FP participation could hardly be detected. Even in the case of those projects, in which the original targets were to develop well-defined products or services, the consortia did not take the final steps to transform the project results into profit. Some managers acknowledged that during the FP4 they were not experienced enough in managing intellectual property rights, and thus they signed inappropriate contracts. Obviously, under FP5 they do not want to repeat the same mistake.

In the majority of the FP projects the original aim was to stop R&D activities at the pre-product phase. This fact underlines the importance of indirect results, that is, *economic impacts*. The competitive position of firms has improved due to FP project participation. IQSOFT has become the local market leader in the application of object-oriented technologies. MT System is also convinced to have a direct correlation between its strong domestic market position and the skills acquired through FP projects. ALL managers, however, feel that in the area they focus on, the Hungarian market is too small and underdeveloped, and thus the impacts on their competition position cannot be measured on the home markets, rather at the European and global level. They think that the EU grants have only had a very limited impact in this sense so far. The FP project participation have improved the other two firms' knowledge on European markets, and developed their in-

ternational business contacts. IQSOFT, as part of KFKI Group is even expected to contribute to the European expansion of the group in the near future by exploiting this knowledge.

There are three major *societal impacts* noted by the firms. First, because many of their employees teach at universities, the new knowledge is transmitted almost immediately through the education system. Second, the involvement in the European R&D activities may lead to a growing number of experts, who can better understand both global and European affairs, and this skill may be rather useful in devising firms' strategies, as well as in national policy formulation. The chairman of IQSOFT can be considered as an expert with these broader insights. Third, some of the FP projects have impacts not only on the participating firms, but also on a much wider community. For example the ESATT project, aiming at disseminating the communication networking technologies and routines in the CEE region has contributed to a large extent to the development of this culture in Hungary (and probably in other participating nations in the CEE region, too).

5.2.3. Benefits of FP participation

New knowledge on existing and future (technologically emerging) markets, improved business networking, learning how to manage international R&D projects and applying for EU grants were considered as the crucial benefits. Increasing the company's prestige either internationally or locally was highly scored only by IQSOFT. The importance of learning project management techniques and the EU funding mechanisms and rules is well reflected by the fact that MT System has opened a new business unit offering EU FP consultancy (partner search, consortium building, proposal writing, project management, etc.). Acquiring new technological knowledge and skills was also deemed as an important benefit, but slightly less so than the previous ones.

Access to new financial sources did not play a significant role in their decisions whether to join EU projects. Usually they did not think of this factor as a major benefit. However, IQSOFT stated that the EU projects significantly contributed to keeping alive their in-house research activities. As all their internal units are expected to produce income, the research group could satisfy this expectation thanks to the EU grants. While the FP project grants from the EU do not have a decisive share in the company's total annual turnover, the above factor increase the significance of the EU-sources.

5.2.4. Main obstacles to FP participation and capitalising on FP project results

The firms' own contribution required by the Commission did not constitute major difficulties. In a small company, however, even at the present size of the EU grants, the management should analyse carefully the actual cost/benefit of these projects. Not only the financial in-flow, but also its price – in terms of time and efforts required – must be taken into consideration. The lower financial risk-taking capacity of SMEs makes them very sensitive to this matter.

CORDIS has been used for searching partners by two of the firms, while the third one has a negative experience in finding partners through the Internet. The only project co-ordinated by a Hungarian team – in our sample – has been born as a result of CORDIS services.

IQSOFT was the only firm in our sample with experience in co-ordinating an FP project. Some of their experiences may be valuable a lesson for others: project management itself requires significant extra energy (and various forms of investments) by the co-ordinator. IQSOFT underestimated the management costs in the preparatory phase, and thus had to pay a high price during the implementation.

FP financing practices have also led to some negative experiences. Some 'guidance' is issued to the project co-ordinators advising them on CEE financial practices. Some pieces of this advice are not correct at all; others are irrelevant in certain countries. For example in the cost allocation process not only the human costs are calculated at a lower rate for CEE partners, but other costs as well, while there is no difference in travel or accommodation costs by citizenship. In Hungary the fees of internationally respected local experts, especially for those from the business sector, are about the same as in the EU countries, but nobody takes this fact into account in the cost planning process. The lack of information on the banking system in a given CEE country may also create major difficulties.[8]

The high level of bureaucracy is definitely a frightening factor for SMEs. Their usual pragmatic approach is far away from the practice of FP management processes. For example the extremely long closing phase (more

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[8] An extreme case: one project co-ordinator only transferred the grant to the local bank account of the participants if they provided official bank guarantee, which, of course, significantly increased the cost of participation.

than 9 months) may result in financial losses for the participating firms as at least 10% of the project costs is withheld until the Commission officially approves the final report. According to a very critical opinion the paper work is sometime more important, than the work itself.

The lack or low level of innovation management skills was considered by all the firms as the strongest factor hampering the commercialisation of their R&D results (not only those of the EU-funded projects).

CONCLUSIONS

The case studies summarised above only represent a minor share of the Hungarian participation in FP projects. Their role was to explore hypotheses developed to identify the various types of impacts of FP participation and validating the related indicators, rather than attempting to provide a representative, general overview. Therefore we cannot draw firm policy conclusions. However, it is our strong view that it would well worth the effort to apply this framework for impacts and effects – based on the techniques applied in current EU member states, and tailored to the systemic characteristics of a country in transition – to a larger, statistically representative sample. Thus a reliable description could be obtained, on which basis sound policy conclusions could also be drawn.

Our main hypothesis has emphasised the importance of the overall institutional context, namely two underlying characteristics of the Hungarian national system of innovation. First, it had been fragmented during the planned economy period, most importantly the academy-industry relations had been rather weak. Second, due to the overall socio-economic transition it is also in flux, some of the former – already weak – links have been further damaged, while new players have appeared on the scene (and old ones re-appeared significantly reshaped), and new, stronger incentives have been put in place to form new partnerships, and strengthen collaboration among the various actors. Against this background, ‘soft’, that is, behavioural and organisational ‘effects’ of FP participation are likely to be crucial – besides the ‘usual’ outputs and impacts. Impact studies, therefore, should ask a broad set of questions in order to identify a wide range of corollaries. Our methodology has been developed accordingly – introducing the above new category, namely ‘effects’ –, and the interviews have validated the relevance of this approach.

Not surprisingly, there are some differences between research institutes and businesses concerning the impacts of FP participation. *Scientific and technological outputs* are higher valued by **academic research institutes** than any other aspects. Closely related to that, intensified international and domestic partnerships and improved prestige are considered the most important results of FP projects. *Economic output* cannot be measured directly, and it seems to be a general phenomenon for the following reason: EU projects do not have the sufficient funds to produce scientific or technological outputs immediately applicable in the industry. New know-how, however, is generally produced as a result of FP projects, and when it is diffused to firms, it certainly contributes to the introduction of new/improved products, services and processes, and thus leads to increased sales and market share (or sales and market share at least can be maintained in spite of an intense competition). New knowledge is also diffused through teaching activities, and thus important indirect economic impacts are expected, albeit with considerable time gap.

The lack of human resources to develop project proposals and manage FP projects – or indeed any other major international ones – was a major obstacle in the early 1990s. Therefore experience accumulated and skills developed through participation in FP projects are crucial assets. These skills can also benefit the academic institutes while competing for other funds. As for commercialisation, the low level of the required managerial skills is one of the main obstacles to exploit S&T results.

As for **firms**, economic impacts are more or less as important as scientific and technological ones. New knowledge acquired and/or skills developed through FP participation are the major *scientific and technological outputs*. *Economic impacts*, that is, indirect results, are seem to be more important than *economic outputs*: the firms' competitive position has improved due to FP project participation through improved their knowledge on European markets as well as via intensified international business contacts. In general, it is a rather difficult – if not an impossible – task to attribute e.g. the extent of productivity change, or changes in sales or market shares to any individual FP project. Improved proposal writing and project management skills have been important for firms, too.

Various types of *societal impacts* have also been detected, e.g. diffusion of new knowledge through teaching activities of researchers employed by firms. Insights gained on EU R&D affairs are also important inputs for firms' strategy formulation and national policy-making. Finally, some of the

FP projects have impacts not only on the participating firms, but also on a broader community.

To generalise, there are some socio-economic impacts, which seem to be more significant in CEE countries than in the current EU-15 countries:

- FP project participation may be used as an 'intelligent' – that is, not a mechanistic – benchmarking tool. CEE participants may realise their true scientific and/or business values.
- Especially the academic sector can understand – through participating in FP projects – that commercialisation of R&D results is not a 'strange', but a normal activity. Learning the tools, management methods how to do this in an effective way should be considered as one of the most important benefits of FPs for countries in transition.
- The FP participation can make it visible that the necessary in-house co-ordination is lacking. This may induce the management to take the necessary steps.
- Some Hungarian managers have acknowledged that during the FP4 they were not experienced enough in dealing with intellectual property rights, and thus they signed inappropriate contracts. By now they have realised the importance of learning and using these specific skills.
- The lack of appropriate communication between policy-makers (including their advisors preparing decisions) and the 'shop floor' level actors (both at the academia and businesses) has become visible in several CEE countries due to the FP-oriented national actions. The S&T community is usually lacking important pieces of information on both EU and national policy schemes, while governments and other major national institutions (like the academies) do not pay attention to, and do not understand the challenges at micro level. The actual size of this gap may characterise the effectiveness of policy decisions and their implementation country by country. Participants of FP projects may contribute to narrowing this gap, by bringing their experience and understanding of the broader policy context of FPs into the respective national policy formulation processes.

The above analysis, focussing on methodological issues, and relying on limited empirical findings confined only to Hungary, could be broadened in a number of directions. Two of them are hinted at very briefly below.

One can ask whether there are significant differences between Hungary and the other accession countries, i.e. to what extent one can generalise the

above findings. Lacking the results of thorough research projects covering other accession countries, only some hypotheses can be formulated at this stage. One has to bear in mind that 'history does matter' not only in terms of defining certain technological trajectories and individual innovations, but even more so in the development of innovation systems. The evolution of institutions, norms and behaviour of the actors and their interactions is a cumulative process; the main characteristics cannot be changed overnight – even in the case of abrupt political and economic changes. Therefore the national innovation systems are far from identical in the CEE countries, and hence the impacts of FP participation can also differ. However, some 'stylised facts' are not that different: lack/ low level of a number of crucial skills (e.g. project development and international project management, innovation management, commercialisation). Therefore largely similar 'soft effects' can be expected (besides the 'conventional' outputs and impacts) as we have seen in Hungary. The former ones are likely to be more important in other CEE countries, too – of course with a different 'weight' country by country – but not necessarily more 'visible' than the 'traditional' outputs and impacts, at least not without a careful 'look'.

One might also be interested in an outlook: what can be expected in 5-10 years' time? Are the above special features likely to prevail, or Hungary – and other CEE countries – would move closer to the current EU15 countries? Of course one cannot predict the future impacts of FP participation, because all the elements of this 'interactive system' might change significantly. To start with, FPs themselves tend to be different when any of them is compared to the preceding one. Especially FP6 is aiming at pursuing a markedly different approach compared to FP5, as radically new tools are applied. Transition countries are still in the flux, especially their NIS, due to a few years lag between the starting date of the overall transition and that of the reshaping of their innovation system. With all these caveats in mind, one can develop scenarios as visions of possible futures. Given space limits, only the best case scenario is summarised here. Assuming a successful, relatively fast learning process on the side of CEE participants, one would expect overall a lessening relevance of the 'soft (organisational, behavioural and managerial) effects', and more visible and pronounced 'traditional' outputs and impacts. Specifically, academic institutes are envisaged to have a larger number and closer contacts with businesses, in projects with a stronger emphasis on socio-economic exploitation of S&T results. Firms, on the other hand, would enjoy more significant economic impacts than now. It is not a 'pre-programmed' trajectory, however, i.e. it can, and should, indeed, be assisted by relevant policies. Moreover, this scenario requires 'pa-

tient' policy-makers, focussing not only on 'hard' – easy to measure and understood – results (new products, processes, job creation, exports, etc.), let alone immediate 'financial returns' in terms of EU FP grants. In other words, it is of crucial importance that policy-makers – and not only those directly involved in RTDI issues – should understand the systemic nature of NIS.

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