Institut für Höhere Studien (IHS), Wien
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Reihe Osteuropa / East European Series No. 32

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Reihe Osteuropa / East European Series No. 32

May 1996

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Abstract

Since the beginning of the transition from realsocialism to capitalism the Hungarian innovation system has been going through a number of changes. The turbulences the industrial research and development (R&D) system has been facing have been even heftier than the changes the rest of the innovation system has had to put up with. Despite a number of revisions of governance and funding mechanisms as well as a more realistic approach of government towards short and medium term goals for R&D in Hungary, industrial R&D still is neglected. For an explanation of this fact the interest group structures of the R&D system are analyzed. The results of the analysis imply already a solution for the problem. Finally, a few measures are suggested, which should help to realize Hungary's economic potential.

Keywords

Hungary, research and development, transition economies

JEL-Classifications

O3, P41, O52

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1. Introduction

Realising Our Potential - A Strategy for Science, Engineering and Technology"was the title of a White Paper of the UK's Office for Science and Technology presented to Parliament in 1993. The paper relates three factors: science and technology, economic development and the future of the country. In fact this is most likely the central relationship for the socio-economic development of societies in the upcoming 21st century.

While industrialists as well as researchers have recognized the importance of this relationship, it is not always clear if policy makers are giving the topic priority only because it is fashionable, because they can use it for the fulfillment of short term goals not originally related to science and technology or because they are convinced that government, industry and academia really should work closely together to secure the future of a country[1]. These doubts on policy maker's rationales hold for Western industrialized countries as well as for countries in transition from realsocialism to capitalism.

This paper takes a brief look at the current situation of the Hungarian industrial research and development (R&D) system. The focus is on the recent changes in the latest phase of transition, beginning with the end of 1993. The main question is: Does Hungary realize her industrial R&D potential ?

Before an answer to the question is attempted, five sections address topics related to the industrial R&D system. First, three phases of government policies addressing R&D during the transition period are distinguished. Second, general trends in the development of the industrial R&D system during the latest phase are identified. Third, institutions of governance of the industrial R&D system are described cursorily. Fourth, financing mechanisms for the industrial R&D system are looked upon. Fifth, a few central conflicts of interest in the Hungarian R&D system are described. Finally, a few suggestions in respect to the above stated question are made.

Mainly two perspectives are used for the description and analysis of the topics. During the first four sections the Hungarian industrial R&D system, sparing the systems-notion admittedly in the very center of the discussion, is looked upon through the spectacles of neo-institutionalism. For the purpose of a short paper this seemed to be a suitable choice, even if it meant not to deal with questions of cultures and ideologies looming large behind the institutions. The fifth section has adopted a group theoretical perspective, as it seemed that the current situation on the policy scene was not explainable without such an analysis.

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[1]Henry Etzkowitz recently has coined the term 'corporatism American style"when describing recent developments in US Academic-Industry-Government Relations. See Etzkowitz 1996.

In addition, in this section an old model is taken from the shelves of social science modeling, the patron-client model from the 1970s, which is helpful for an explanation of the central actors' relationships in the Hungarian R&D system.

An omission due to the brevity of the paper is the missing analysis of the national economy of Hungary, which obviously is interlinked with the industrial R&D system. However, such an analysis has been done recently by Andreas Wörgötter et al with the study "The Pioneer of Reforms - Hungary".

Before the description of the Hungarian industrial R&D system is begun, a few terms at the center of interest for this paper have to be defined: in contrast to the "innovation system" [2], a somewhat more all-encompassing term, the "R&D system" as it is used here consists of the research, development and experimental development (R, D & E) institutions of a national economy. The "industrial R&D" system consists of institutions with the purpose to plan and engage in industrial R&D, regardless of the private or public, profit or non-profit nature of these institutions, and the political structures directly related to these organizations. "Directly related" means for example - and most significantly - the political superstructure as councils, ministries and agencies that supervise the R, D & E institutions. Excluded from the term industrial R&D system are organizations as unions, chambers of commerce or associations of which the institutions are members or the institution's members are members that would be also included in the broader term innovation system. An exception to the rule are intermediary institutions with the function of aiding the knowledge transfer between basic and applied science as well as industry and academic institutions, which are included in the industrial R&D system. The industrial R&D system is part of the larger innovation system.

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[2] For a discussion of this term see among others Lundvall, B.-A., Product Innovation and User-Producer Interaction, Aalborg University Press, 1985; Nelson, Richard/Rosenberg, Nathan, "Technical Innovation and National Systems", in: Nelson, Richard (ed), National Innovation Systems, Oxford University Press, 1993, pp.4; Niosi, Jorge et al, "National Systems of Innovation: In Search of a Workable Concept", in: Technology in Society, 2/1993, pp.207; Niosi, Jorge/Bellon, Bertrand, "The Global Interdependence of National Innovation Systems: Evidence, Limits and Implications", in: Technology in Society, 2/1994, pp. 173; Wijnberg, Nachoem, "National Systems of Innovation: Selection Environments and Selection Processes", in: Technology in Society, 3/1994, pp.313.

2. 1990-1996: Three Phases of R&D Policies

Three phases can be distinguished in an analysis of the R&D policies implemented since the Hungarian elections in 1990[3]. 1990 and the first months of 1991 were marked by the same euphoria that flooded Europe, East and West, immediately after the fall of the iron curtain. The expectations of policy makers and the general public was that the market forces, once unleashed, would generate an order on its own[4].

During this phase of euphoria the Hungarian government was reacting to the problems of the R&D system primarily by changes in the structure of the system. Best visible, two new ministers were part of the cabinet, one for science, one for technological development[5]. R&D funding, however, decreased. The government expected Adam Smith's invisible hand of the market leading to a balance of supply and demand for R&D.

The next phase was characterized by the realization that the obstacles on the road to a market economy were bigger than expected. In this phase of frustration during the second half of 1991, in 1992 and during the first half of 1993 the decline in levels of production due to the political upheaval in the area of the (former) USSR, the subsequent loss of markets, the rising unemployment levels and various interlocked economic, social and political problems led not only in Hungary, but in all of Europe to a widespread frustration about the prospects of the immediate future. In fact, living conditions in the transition countries were deteriorating for large parts of the societies. During the second half of this phase these developments led to a comeback to power for some of the political offsprings of the former Communist parties in the region.

The R&D policies of the Hungarian government during this phase were changing only marginally. At this point crisis management was the main task of government. Because of the weakness of industry and its inability to fund R&D, government was forced to step in and at least slow its decrease of the support for the R&D system. Policies were implemented that allocated funds primarily to near-market innovations. The total state expenditures were going up in absolute numbers beginning with 1992. The state was making an effort to come up for the loss of support by industry.

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[3]Compare the three phases considered here with the three time periods distinguished in Wedel, Janine, "Lessons of Western Technical Aid to Central and Eastern Europe", in: Transition, The World Bank, Vol. 5, 6/94, pp.14.

[4]This misbelief was fostered by the policies of different international agencies that assumed a spontaneous resurrection of the market from the ashes of the realsocialist planned economies. A detailed analysis of the problems arising in the transition economies from laissez faire politics has been given by Kregel, Jan/Matzner, Egon/Grabher, Gernot, The Market Shock - An Agenda for the Economic and Social Reconstruction of Central and Eastern Europe, Austrian Academy of Sciences/Research Unit for Socio-Economics, 1992, see especially pp.112.

[5]To be sure, the organizational structures were already there. OMFB, from 1990-94 the "technology ministry", was a governmental agency before, supervising the National Office of Measures, the National Patent Office and the National Bureau of Standards. The "science ministry", that existed from 1990-94, consisted of a small office and the restructured Science Policy Committee (TBP), headed now by a minister without portfolio.

The third phase may be called the phase of realism. Beginning with the second half of 1993 Eastern and Western[6] European governments and the general public have learned from the experience since the beginning of the transition period. Expectations are not unrealistically optimistic or pessimistic anymore. Medium term strategies of governments now slowly begin to take form.

In the arena of Hungarian R&D politics, government publications and statements of policy makers acknowledge the necessity to intervene in cases of market failure - which does not mean that authorities actually do step in, but that at least public discussion about the point seems to be possible[7]. The Hungarian policy makers have adopted a pragmatic mixture of policies taken in eclectic manner from other countries. With laws on higher education and the Academy of Sciences (MTA) the codification of the R&D system is making progress. Moreover, the government issued science policy guidelines in May 1993. The allocation of projects is becoming increasingly competitive and, despite criticisms, more open than before. Policy goals for issues of R&D still are primarily of short and medium range. The main emphasis, especially of the funds allocated from the Centralized Technical Development Fund (KMÜFA), now is on infrastructure programs. Some funds are used to counter the brain drain and target specifically young researchers.

3. The R&D Effort of the National Economy

A variety of new laws and decrees, especially the laws on higher education and the Academy of Sciences from 1994 are reforming the Hungarian innovation system - often along the lines of the recommendations of the OECD evaluation of 1992[8]. Most of the recent structural changes have been done in a considerate manner. However, little money has been spent on the innovation system either by government or private industry. The latest estimates speak of 0.6 to 0.8 % of the GDP as government expenditure on R&D and 0.3 % of the GDP as private industry expenditure on R&D[9]. It has been suggested the national R&D expenditure is now stabilizing at the level of 1 %[10].

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[6]As can be inferred from the funding strategies of Western European governments as well as international institutions, in respect to the prospects of reform the West was on the same emotional roler-coaster as the East of Europe.

[7]For example NCTD, MIT, Ministry of Finance, Innovation Policy of the Hungarian Government, Budapest, 1993, especially pp. 58.

[8]For an evaluation of the impact of the OECD report on Hungary's Innovation System see Biegelbauer, Peter, "Evaluation of the Effects of the OECD Report on 'Science, Technology and Innovation Policies in Hungary' on the Country - Report for the 'OECD Technology Audit for Hungary'", MIT, September 1994.

[9]See "Techno-Trophies", in: The Wall Street Journal's Central European Economic Review, Vol.2, Summer 1994, p.18; various interview partners gave me comparable numbers. Inzelt gives higher numbers for the business (0.53) and lower for the government (0.45) funding. She includes, however, a warning that the numbers are not accurate (footnote 3). See Inzelt, Annamária, 'Review of Recent Developments in Science and Technology in Hungary', Budapest, February 1995, p.5, document written for the 'OECD Technology Audit'; typescript.

[10]Inzelt 1995, p.4.

The most immediate reason for the shrinking of R&D expenditure is the dramatic fall of GDP and industrial production in Hungary during the beginning of the transition period. These two factors are shown in table 1.

Table 1: Indices of GDP and Industrial Production in Hungary, 1988-1992

	GDP	Industrial Production
	(1989 = 100)	
1988	99.6	102.1
1989	100.0	100.0
1990	96.7	92.3
1991	85.2	74.8
1992	80.9	63.8

Note: the data for 1992 are based on the preliminary calculations of the Central Statistical Office of Hungary.

Source: various, in:, János, Transformational Recession, Collegium Budapest/Institute for Advanced Studies, June 1993, p.4.

After a steep decline of the national R&D expenditures at the beginning of the transition, paralleling the development of GDP and industrial production, the decrease of national expenditures has been slowing down since 1992. This slowing decrease as shown in table 2 was mostly an effect of the Hungarian government trying to make up for the loss of support of R&D by industry.

Table 2: Total Expenditures on R&D in Percentage of Previous Year, Constant Prices, 1987-92

	1987	1988	1989	1990	1991	1992
Expenditure	106.4	85.4	87.4	69.0	45.7	94.1

Source: Current Prices from Pécsi, Kálmán (ed.), Selected Science Indicators of the Hungarian Academy of Sciences, Secretariat of Research Policy of the Hungarian Academy of Sciences, 1993, p.31; consumer price index from Pécsi (ed.) 1993, p.159; own calculation.

This development is better visible in the next table. Table 3 shows the share of the most substantial funding sources for Hungarian R&D expenditures for 1988 - 1992. KMÜFA (Központi Müszaki Fejlesztési Alap) is the Centralized Technical Development Fund, which is utilized by a variety of ministries. OTKA (Országos Tudományos Kutatási Alap) is the National Scientific Research Fund. As can be inferred from the rising levels of funding from foreign sources as well as other indicators not shown in table 3, the technology transfer from

foreign countries has intensified. Yet it is not clear whether or not the way in which the transfer is taking place is a promising development for the future. The trend has been hailed by some Hungarian researchers and decried by others[11].

Table 3: R&D Expenditures of Hungary in Percent, Broken Down by Sources, 1988-1992

Source	1988	1989	1990	1991	1992
State	16.5	20.3	23.7	33.5	34.8
KMÜFA	24.9	27.3	30.0	15.8	21.2
OTKA	1.8	2.5	2.4	3.8	5.2
Other Governmental	2.6	2.3	2.5	2.5	1.5
State Total	45.8	52.4	58.6	55.6	62.7
Company	52.0	45.5	38.8	40.5	31.5
Other Domestic	1.3	1.4	1.6	2.1	2.9
Foreign, International	0.9	0.7	1.0	1.8	2.9
Non-State Total	54.2	47.6	41.4	44.4	37.3

Source: Scientific Research and Experimental Development, Central Statistical Office, in: Information Map OMFB, Table 2, OMFB, 1994.

One of the most visible direct effects of the decline in R&D expenditure is a loss in R&D personnel. As is true for other formerly centrally planned realsocialist systems too, the number of scientists and engineers especially in company R&D units has fallen dramatically[12].

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[11]For a cautiously technology-import friendly account see Mádi, Cs., "Transfer of Technology - Hungary in the Eighties: Hungary's Trade in Intellectual Products", in: Acta Oeconomica 42, 1990, Akadémiai Kiadó, Budapest; for a cautiously critical view of the technology transfer as managed by foreign investors currently in Hungary see Inzelt, Annamária, "Privatization and Innovation in Hungary: First Experiences", in: Economic Systems, June 1994. The discussion is also reflected in Judit Mosoni-Fried's article 'Industrial Research in Hungary: A Victim of Structural Change", in: Social Studies of Science 25, November 1995. More on the role of FDI in Hungary in section 4. For a recent general evaluation of FDI in transition countries, see Stankovsky, Jan, 'Bedeutung ausländischer Direktinvestitionen in Osteuropa", in: WIFO Monatsberichte, 2/1996, pp.123.

[12]Compare these figures with the changes in the innovation system of the former GDR, where Werner Meske reported a loss of 70% of the researchers of the system - also already in 1993. See Meske, Werner, "The Restructuring of the East German Research System", in: Science and Public Policy, 5/92, pp. 298-312.

Table 4: Number of Scientists and Engineers in Company R&D Units and Total Number of Employed Scientists and Engineers in Hungary, 1987-1992

	1987	1988	1989	1990	1991	1992
Company	12,448	11,157	10,058	7,442	5,027	3,284
Total	36,453	35,268	33,836	30,256	26,763	24,110

Note: There was a reorganization of the R&D structure in 1990.

Source: Pécsi (ed.) 1993, p.24.

To hint at what has happened to R&D output, table 5 looks at the total numbers of patents registered in Hungary and abroad[13].

Table 5: Number of Patents Taken Out in Hungary and Abroad, 1990-1993

	1990	1991	1992	1993
Hungary	641	576	422	272
Abroad	838	556	539	467

Source: Hungarian Statistical Yearbook 1994, Central Statistical Office, Budapest, 1994, p.315.

Other output indicators of the national R&D effort will not be discussed here for the methods of statistical measurements often are not comparable since the beginning of the transition in Hungary. A variety of problems make the statistics - especially in relation to industrial R&D - unreliable, among them two changes in standards, first from the COMECON system to the UNESCO system, then to the OECD system. A bit more light shall be shed on the problems of Hungarian transition statistics in the discussion of the financing of R&D in industry.

4. Industrial R&D: Institutions of Governance

Since the beginning of the transition in Hungary, the governance structure of the national R&D system has been changed several times. A wave of changes came in the fall and winter of 1994/95 as a result of the newly elected government's reforms. During these reforms the 'Science Policy Collegium" was founded, an advisory body to Prime Minister Horn, who also chairs the board. As the predecessors of this board, the latest of which were the Science Policy Committee and the Science Policy Council, were not very successful, it

[13]Patent statistics should be taken with a grain of salt, due to the specifica of such numbers. However, the sheer size of the decline of patenting activity is telling.

remains to be seen if the institution will have an impact on the innovation system. At least the Collegium meets regularly, which was not always the case for its predecessors.

OMFB, the National Committee for Technical Development, was also reformed during the fall of 1994. After being scaled back from the ministerial level, it is now an independent agency headed by a council with a chairman. Following a struggle lasting several months OMFB now is supervised by the now again powerful Minister of Industry and Trade (IKM) without being an actual part of the ministry. However, OMFB had to hand over the control over the Office of Standardization, the National Meteorology Office and the National Patent Office to the Ministry of Industry and Trade.

OMFB is essential for the funding of industrial R&D. For this purpose the organization is utilizing the KMÜFA, the Centralized Technical Development Fund. KMÜFA, which again has been cut in size during 1994 and 1995, still is the single most important fund for industrial R&D in Hungary. Since the fall of 1994, KMÜFA is funded by the Economic Development Fund, a sort of "superfund" controlled by the Ministry of Industry and Trade. OMFB also is responsible for the elaboration and coordination of national innovation policies[14].

The Hungarian Academy of Sciences (MTA), went through the latest round of reforms during 1994, when in March of this year a new law[15] finally ended the organization's status as a semigovernmental body. In October 1994 the Academy's supreme body, the General Assembly, adopted new statutes reforming the organization[16].

The Academy's independence is now guaranteed by law. The organization governs a number of R&D institutions, most of them in the realm of basic science. A few former institutes now are independent firms, engaging in a variety of different specialized services[17]. Despite good contacts to one of the partners of the governing coalition, the MTA's funding has decreased again in 1995 and is expected to do so in 1996, too. At the end of 1995 an internal evaluation of the organization was on its way, which is expected to result in information on the decision of which units are to be downsized or cut and which are to stay.

During realsocialism, a large part of industrial R&D was performed by specialized R&D institutes supervised by several branch ministries. Around 40 institutes were responsible for

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[14]See Inzelt 1995a, pp. 30.

[15]Translated and reprinted in the Newsletter of the Hungarian Academy of Sciences, Number 6, September 1994.

[16]Translated and partially reprinted in the Newsletter of the Hungarian Academy of Sciences, Number 7, February 1995.

[17]See for example Balázs, Katalin/Plonsky, G.A., "Academy-Industry Relations in Middle-Income Countries: East Europe and Ibero-America", in: Science and Public Policy, April 1994.

high level industrial R&D, with the Ministry for Industry and Trade being the major supervising institution for these organizations. Nowadays, about a forth of these organizations have been closed, most of the others have been downsized, at times dramatically. A number of institutions are, years after the decision to do so has been made[18], still waiting for privatization. The activities of the organizations having survived until now are reduced to service, trading and production, with only 10-15 % of their activities R&D related[19].

The Ministry of Education and Culture is since 1994 among the major players of the innovation system[20]. Most notably, it has been endowed with the supervision of the newly founded Higher Education Research Council, the chairman of which is the Minister of Culture and Education. The task of this body is to reform the higher education institutions of the country. In addition, the ministry is supervising OTKA, the National Scientific Research Fund, and FEFA, the Higher Education Fund. OTKA is increasingly financing not only basic, but also applied research. FEFA has been established from World Bank loans for the purpose of modernizing Hungary's higher education institutions.

Amongst all the professional organizations founded in Hungary until the beginning of 1996, one seems to be most outstanding. In 1990 the 'Innovation Chamber"was founded. In 1995, due to changes in legislation concerning a variety of interest groups, the organization had to alter its name into the 'Hungarian Association for Innovation" (MISZ). It is a non-governmental initiative - which by itself makes it a wondrous creature. The organization represents the interests of its members, which are companies, innovation parks and R&D institutions from the realms of universities, the Academy of Sciences and higher education institutions. At the end of 1995 the Association counted 240 members.

Moreover, via the National Business and Innovation Center the organization tries to offer services to companies. Via the Grand Innovation Prize and the National Scientific and Innovation Contest for the Youth the association makes an effort to instigate innovations, publicize them and create an innovation-friendly culture. The highly active organization is involved in a number of projects concerned with technology transfer and is now cooperating also with government organizations.

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[18]And potentially is going to be partially reversed by government in the near future.

[19]Mosoni-Fried, Judith, "Industrial Research in Hungary: A Victim of Structural Change", in: Social Studies of Science, Vol 25, 4/1995, pp.777.

[20]See for example Abott, Alison, "Hungarian Coalition has Pro-Science Leanings", in: Nature, 1 September 1994, p.6A.

5. Industrial R&D: Financing

5.1 Government

Indirect financing of R&D, as it is practiced in all OECD countries to varying degrees, is not very common in Hungary[21]. Inzelt notes that 'It is mainly foreign investors who enjoy tax breaks"[22]. Moreover, the financing of R&D frequently is subject to negotiations between investors and government. Direct instruments as loans and subsidies are regularly employed. The already mentioned KMÜFA, the Centralized Technical Development Fund, is the most important means for government support of R&D. However, the fund has been cut to about 20 % of its original size since the beginning of transition in 1990.

The five programs under which the allocation of KMÜFA funds has taken place are listed in table 6. Regardless of the answer to the question if the funding scheme of the National Committee for Technical Development, OMFB, or the proposal of the OECD were first developed, it is obvious that the recommendations produced by the OECD regarding the allocation of funds and the actual allocation of KMÜFA funds are widely similar[23]. This is especially the case for OMFB's infrastructure improvement program, a central proposition of the OECD team.

Table 6: Allocation of KMÜFA funds in 1993 and 1994

Program Names	Funding Size 1993	Funding Size 1994
R&D Infrastructure Improvement Program	HUF million 3700	HUF million 2640
Applied R&D Program	HUF million 2087	HUF million 2000
National Projects Program	HUF million 1185	HUF million 1566
Export Promotion Program	HUF million 120	HUF million 343
Patent Licensing Program	HUF million 25	HUF million 32

Source: OMFB 1994, p.8, OMFB 1995, p.8.

The granting of support for the applied R&D program depends on the willingness of the applicants to invest their own funds, which is a prerequisite for funding by OMFB. The national projects are diverse in nature, among them are geographic information systems, the deposition of small and medium activity nuclear wastes and food processing

[21]As a result of the interviews I conducted in Hungary, it is my understanding that a systematic usage of certain policy tools as tax allowances and fiscal incentives of all sorts are being considered, but not given high priorities yet.

[22]Inzelt 1995a, p.32.

[23]See also footnote 8.

technologies. These projects are jointly administered by OMFB and other authorities on the national level. The export promotion program which aims at export-oriented product development is co-administered with the Ministry of Trade and Industry (IKM). Finally, the smallest and newest program, the patent licensing program, supports the licensing of Hungarian patent applications abroad.

The application review process for these programs has been mastered after the peer review system as to be found in the US National Science Foundation, with a board of experts making the final decision about the support of a project. OMFB points out that the funding of projects may either take the form of nonreimbursable support or preferential loans or a mixture of both, "depending on the degree of risk involved" [24]. Most funding through KMÜFA takes the form of loans. It is not entirely clear how "soft" the character of the KMÜFA loans for businesses actually is[25].

According to plans made public in the end of 1995, KMÜFA might finally be dissolved, but at least in the future is to be controlled by a body different from OMFB. In addition, plans to dissolve the national research fund, OTKA and the higher education fund, FEFA, in a larger fund were hotly debated.

OMFB is the institution from which the impetus to form a network of applied science institutes originated. In the fall of 1992 the Zoltán Bay Applied Science Research Foundation was set up by government. In 1993 two institutes have been initiated, a third followed in 1994. The institutional reference for this organization is the German Fraunhofer Gesellschaft, which in the German national innovation system has the role to form a linkage between academia and industry.

OTKA, the national research fund, has also expanded its number of programs and size of support. Although originally planned to be an additional support possibility for basic research projects, it now has become an indispensable income possibility for researchers in a variety of disciplines. The government has recognized the increasing importance of the program and has given it more support. In spite of this increase in funding and because of the large demand of the underfunded Hungarian innovation system, the average size of the grants is small. Since 1992 a program for the support of junior researchers is in effect. This program has been established to prevent young scientists from becoming part of the brain drain. Also, a postdoctoral training program has been established[26].

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[24] OMFB, OMFB - National Committee for Technological Development, OMFB, 1994, p.8.

[25] Whereas a senior expert at OMFB during an interview has indicated that KMÜFA loans have to be paid back only in the case of business success, a Hungarian social scientist doing research on the workings of the innovation system criticized the "hard" character of KMÜFA's loans.

[26] For data on OTKA see Pécsi Kálmán (ed), Selected Science Indicators of the Hungarian Academy of Sciences, Secretariat of Research Policy of the Hungarian Academy of Sciences, 1993 , pp. 93.

The way OTKA and KMÜFA are managed has been subject to criticism. The small amount of the individual grants given by OTKA makes it impossible for the researchers to sustain their projects. In addition, the fund has been charged with a supposedly non-effective review of the incoming applications[27]. OMFB support has been criticized with not sharing risks adequately. As has been said earlier, KMÜFA funds are used mostly for loans with a comparatively low interest rate. Critics insist that OMFB does not effectively share the risks of new investment by providing loans in most cases. Industrial partners often decide not to take their chances and do not invest adequately in innovative projects[28].

Although Hungary in this respect is better off than the other transition countries, a problem for start-up companies not overcome to the present is the lack of venture capital funds. It is questionable if high risk funds could be provided by private banks under the constraint of the current capital scarcity. Consequently, the IKM has, together with private entrepreneurs, set up two projects, IRCIL and Multinova Co. Ltd., both of which channel funds into start-up companies after carefully investigating their chances for success[29]. These two and Covent, another government backed fund, harvest high-tech and R&D companies. In addition, OMFB supports small and middle enterprise (SME) start-ups. These initiatives, together with a number of foreign private and government sources, have resulted in a small venture capital industry of a total estimated size of USD 300 million[30].

To raise funding and to enhance the technology transfer with foreign countries, cooperation with other countries has been expanded by the Hungarian government. Linkages have been established in private, public, profit, non-profit, scientific, technical and political forms. Besides foreign direct investment, which is to be addressed later on, international programs are noteworthy in this respect: Hungary has succeeded in entering a wide variety of partnerships and programs of bilateral as well as multilateral nature. For instance, the country is involved in programs of international organizations as the World Bank, the EBRD, NATO and the European Union, to name only a few of the most significant.

5.2 Industry

Of all parts of the national economy in transition, industry and the connected R&D system went through the most disruptive adjustment processes. In contrast, the part of the Hungarian innovation system concerned with basic research went comparatively slowly through its changes. Translated into quantitative data, the industrial R&D system, depending

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[27]Balázs, Katalin, "Transition Crisis in Hungary's R&D Sector", typescript, June 1994, pp.4, 15; Schimank, Uwe, "Transformation of Research Systems in Central and Eastern Europe: A Coincidence of Opportunities and Trouble", In: Social Studies of Science, Vol. 25, 4/1995, p.648.

[28]ibd., p.25. On risk-averting behavior amongst Hungarian entrepreneurs see also Inzelt, Annamària 1995b.

[29]OECD, Science, Technology and Innovation Policies: Hungary, Centre for Cooperation with European Economies in Transition, 1993, p.131.

[30]Meth-Cohn, Delia, "Hopes and Fears", in: Business Central Europe, February 1995, p.8.

on the sources used, released between two thirds and three fourths of its R&D personnel. The Hungarian Academy of Sciences (MTA), the central institution dealing with basic research, and data again will be different depending on the sources used[31], had to release about one third of its personnel[32].

At the moment it is difficult to translate comments on the development of the industrial R&D system during the transition period into quantitative data. The reliability of statistical data available on industrial R&D is lower than for the overall national innovation system. After all, the changes for the industrial R&D system have been more pronounced than for the rest of the system. Judit Mosoni states that the systematic and continuous efforts to get an overview of the development of the industrial R&D system by the National Committee for Technological Development, OMFB, were canceled in 1991. She describes the Statistical Bureau's project to question a year later 641 economic units that, when they were established, had stated to have R&D as their main task:

> *"61 questionnaires were mailed back as 'not known', 439 units answered that they did neither research nor development in 1992. Appreciable questionnaires (accounting reports) were sent back by altogether 22.6 % of the requested firms. They employed 1104 persons (non-permanent staff) for R&D work"*[33].

The data from this survey suggests that the actual R&D performed in industry may even be smaller than the large number of personnel that has been laid off would indicate.

Another survey done by the firm Szonda-Ipsos also indicates a low level of R&D activity in industry. In this project initiated by the Ministry for Trade and Industry managers from 2,000 industrial firms were polled. 57 % of the firms had no R&D effort. 30 % of the firm representatives said they had used in-house capabilities for their R&D, mostly consisting of occasional jobs for employed engineers. Only 20 % of the firms had in-house R&D units. A mere 15 % contracted R&D out to other institutions[34].

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[31]When using quantitative data generated on Hungary, one should keep in mind what a researcher in the field of scientometrics has said in an interview: "There are few islands of professionalism in this sea of social science in Hungary." In other words: data at times are unreliable and are good only for showing textures and general trends.

[32]László Kevicky, general secretary of the MTA in an interview, cited from Abott, Alison, "Hungarian Coalition has Pro-Science Leanings", in: Nature, 1 September 1994, p.6A.

[33]Mosoni, Judit, "Industrial Research Institutes in the Transition Period in Hungary", typescript, first version, Budapest 1994, in: Inzelt, Annamária(ed), "Institutional Support for Technological Improvement - Back to Cooperation from Rigid Separation", World Bank project "Institutional Support for Technological Improvement", p.6.

[34] Balázs, Katalin, "Transition Crisis in Hungary's R&D sector", 1994, unpublished typescript, p.8.

The latest survey was done in 1994 by the Budapest based Innovation Research Center (IKU). From 478 enterprises 110 responded, after being contacted by mail and telephone[35]. Perhaps most interesting is the ranking of factors hampering innovative activity given by the contacted companies. This ranking is reproduced in table 7.

Table 7: Ranking of Factors Hampering Innovative Activity in Hungarian Companies, Number of Firms with Answers of "Very Significant" and "Crucial" (Total = 110)

Economic Factors:	
Lack of Financial Resources	80
Innovation Costs too High	48
Pay-off Period too Long	40
Enterprise Factors:	
Innovation Potential too Small	36
Lack of Information on Markets	18
Innovation Costs Hard to Control	18
Organizational Structure of the Enterprise	18
Other Reasons:	
Legislation, Norms, Regulations, Standards, Taxation	28
Lack of Technological Opportunities	21

Source: Inzelt 1995, p. 14.

The primary factors identified as hampering innovativeness all appear to be linked to financing. The dearth for capital results not only from an undercapitalization of the companies, but also from a high inflation rate of 28 % for 1995 and, subsequently, high interest rates set by the banking sector. In addition, available funding from government decreases, just as the FDI influx became smaller during 1994[36].

[35]Inzelt, Annamària, For a Better Understanding of the Innovation Process in Hungary, STEEP Discussion Paper No.22, University of Sussex, June 1995.

[36]"Focus: Hungary", in: Business Central Europe, December 1995, p.28.

5.3 Foreign Direct Investment

Hungary absorbed more foreign direct investment than any other formerly realsocialist country in Central and Eastern Europe. A stream of foreign direct investment still (FDI) is still pouring into the country. On October 12, 1994 the German Audi company opened a Deutsche Mark (DM) 300 million motor-assembling factory in Györ, half an hour's drive from the Austrian border. Investments of a further DM 430 million are planned by the year 2000[37]. General Electric (GE), which bought Hungary's Tungsram in 1990, shifted European lightbulb production from other countries to Hungary, exporting now 90 % of the total production of the Hungarian plant[38]. GE's investment was the second highest of a foreign company in Hungary with a total of USD 550 million[39], part of which was put into the R&D facilities of Tungsram. However, according to an interview partner these investments resulted in the employment of just two new Hungarian researchers.

Partly as a result of the bad employment opportunities for Hungarian researchers at foreign owned facilities, a discussion has been incited on the usefulness of FDI for the Hungarian R&D potential. For the Hungarian company structure FDI seems to have had favorable effects. 'Deep restructuring" of companies has been led by Westerners bringing their business practices, which resulted in a stronger competition amongst Hungarian based firms leading to leaner companies[40]. Moreover, capital investments, export structure and size of sales as well as other variables were positively influenced by FDI. In addition, privatization in Hungary is often FDI led, as capital is missing in the country. This all might have an indirect effect on R&D. Direct investment into R&D seems to be low, however. And just as the profits of foreign companies seem to find imaginative ways out of the national economy[41], know-how might not stay in the country either.

FDI can become dangerous for the development of a country when the foreign companies have enough leverage to buy monopolistic markets from governments in dearth for capital. David Stark points at cigarette manufacturers and, more important for industrial R&D, to automobile producers, who seek 'state subsidies, preferential credits, and strict import

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[37]Oltay, Edith, "Audi Factory Opens in Hungary", Radio Free Europe/Radio Liberty, October 12, 1994, Internet Service of RFE/RL; Business Week gives somewhat smaller numbers, USD 195 million already invested and USD 280 million investment planned; see Smart, Tim et al, "Europe: The Push East", in: Business Week, November 7, 1994, p.48.

[38]Smart 1994, p.49.

[39]Wörgötter et al., "The Pioneer of Reforms - Hungary", Study commissioned by Bank Austria AG, December 1995, p.103.

[40]Papp, Bela, Survey Hungary: "Outside Push", in: Business Central Europe, December 1995/January 1996, pp.41

[41]Papp 1995/96 cites a Kopint-Datorg study coming to this conclusion on p.42.

restrictions to reduce competition"[42]. There are indicators that this has happened in Hungary, too. Jan Stankovsky cites a number of credible sources, amongst others, for Hungary[43].

A study by Annamária Inzelt gives a mixed picture from the activities of the foreign firms in Hungary. The new foreign owners of large economic units in Hungary tend to speed up innovation processes, but do not invest heavily in Hungarian R&D. Furthermore, the multinational companies (MNCs) in general tend to spend less on R&D than the nationalized firms during the realsocialist era, but more than the Hungarian firms in the transition period[44]. This does not come as a surprise, given that MNCs - especially in the automobile industry - have set up primarily assembly lines in Hungary. The parts used in the process are mostly imported[45], although the situation seems to change to the better[46].

A drastic example for the effects of FDI is the fate of the Institute for Telecommunication Research (TÁKI), which in the mid 1980s had a staff of 1300 and now consists of 200 people. In the meantime a US-German consortium has invested USD 875 million into telecommunications - the largest piece of FDI in Hungary[47]. While this investment brought a spur of activities in the telecommunication sector, finally leading to the much needed modernization of the Hungarian telecommunication infrastructure, it also destroyed lots of indigenous research capabilities. However, the money previously spent by government on R&D in the sector seems to have a lasting effect. The personnel of TÁKI - including the people now working for the foreign led companies - still hold contact to each other. Thus, a network of Hungarian researchers is formed, which develops and by itself stores knowledge. It will be interesting to see if this knowledge is going to lead to spin-off companies in the upcoming years.

5.4 Private Non-Profit Organizations

The Hungarian government is neither willing nor able to replace industry fully in the financing of R&D. In fully industrialized Western countries, private non profit organizations (NPOs) at times have an important role in stepping in when governments fail to provide

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[42]Stark, David, "The Hidden Character of East European Capitalism: Recombinant Ownership", in: Transition, World Bank, Vol.6, 11-12/1995, p.15.

[43]Jankovsky 1996, p.134.

[44]Inzelt 1994, pp. 154.

[45]However, it is reasonable to assume that MNCs use the expenditures on R&D more effectively than the nationalised industrial companies of the realsocialist era. Therefore the amount of money spent on R&D in Hungary by foreign MNCs is not a sufficient criterion for a judgement on the impact the companies have on the Hungarian R&D effort.

[46]An interview partner estimated that the Suzuki plant in Hungary by the end of 1995 had already around 30 local subcontractors. In addition, there are efforts under way to raise the local content level of goods produced in Hungary.

[47]Wörgötter et al. 1995, p. 105.

funding for R&D - especially in high-risk sectors[48]. Since 1987, following new regulations for NPOs, the number of foundations has been sharply increasing. Yet, although there is a vast number of NPOs in existence in Hungary - in 1991 there were around 6,000 R&D foundations - they have almost no impact on the industrial R&D system. The reason is that most of them direct minuscule funds[49]. Since 1994 a new law is in effect that gives NPOs in general, not only the for the innovation system essential foundations, a new legal basis. It is, however, questionable if the impact of these organizations will be felt strongly on the industrial R&D system in the near future.

6. Interest Groups in the R&D System

In any industrially developed country a number of interest groups can be identified in the sphere of industrial R&D. One way to define the basic groupings is to distinguish groups through their field of work. Consequently, one could talk of three classes of interest groups, which are

- researchers primarily concerned with academic fundamental science in elite institutions with the function of centers of excellency,
- researchers primarily concerned with academic fundamental and applied science as well as teaching in higher education institutions,
- researchers primarily concerned with applied science and experimental development in intermediary organizations and industry.

These interest groups have their corresponding partners in government, so that for example interests of researchers in industry are most likely to be represented in government by some sort of ministry for industry, international trade or economic affairs, in the Hungarian case the Ministry for Industry and Trade.

In most systems a number of these interest groups have additional representation in the form of professional organizations as chambers or associations of some kind, in the Hungarian case the Association for Innovation, primarily representing a number of groups concerned with some form of industrial R&D, or the Rector's Conference, representing the higher education institutions. In a number of countries all scientists are represented in a single organization, which regularly is captured by researchers primarily concerned with

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[48]For an account of the role of the German NPOs see Campbell, David, Strukturen und Modelle der Forschungsfinanzierung in Deutschland - Eine Policy-Analyse (Structures and Models of the Financing of Research in Germany - A Policy Analysis), Forschungsbericht Institut für Höhere Studien, 1993, especially pp.8.

[49]More than half of them had assets below one million Forint (about USD 13,000) ! These data are from an informative project edited by Darvas, György, "Transformation of the Science and Technological Development System in Hungary", Institute for Research Organization of the MTA, Budapest, 1994, typescript.

fundamental research, often from a narrower subset of disciplines, as these have more commonalties than the scattered interests of researchers in industry. For the Hungarian case to a certain extent this might be said about the Academy of Sciences, which, although originally conceptualized as purely basic research oriented, since a long time also has units working on industrial R&D. Since the early days of the People's Republic, the Academy has been dominated by the natural and technical sciences, reverting the situation prior to 1949.

In most countries these interest groups over time have built, have captured or have been captured by existing organizations. In the case of Hungary the institutional structure corresponding to the identified groups are:

- the Academy of Sciences and its research institutions for the elite group,
- the universities and other higher education units for the higher education group,
- a few scattered institutions, which often are either new, as the Bay Zoltan Institutes, or have been diminished in size and number as the R&D institutes, which in some instances belong to the branch ministries, for the intermediaries and the industrial R&D group.
- Corresponding governmental units are in the case of the Academy until 1994 a minister for science, since then personal linkages of leading personalities often stemming from political relations[50],
- in the case of the higher education institutions the Ministry for Culture and Education and to a minimal extent the National Committee for Technological Development OMFB,
- in the case of industrial R&D, especially for the Zoltan Bay Institutes, OMFB as well as the Ministry for Trade and Industry and in some cases branch ministries.

These relationships can be characterized also as patron-client groupings, in which the governmental units are extending their patronage over the clients, the R&D institutions. Jacek Tarkowski once remarked that for planned economies two forms of patron-client relations are prevalent: one in which individuals and one in which groups are partners in the relationship[51]. This seems to hold for economies in transition, too.

The relations between institutions and key personnel at government and at the R&D level are exchange oriented. While the governmental part offers patronage in the form of representation in the struggle for funding, the R&D part offers to be part of the clientele legitimizing the very existence of the bureaucratic patron. Table 8 makes an effort to stylize the relations between patrons and clients in Hungary's industrial R&D system.

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[50]Members of the Academy frequently were part of realsocialist governments. There has been an intimate relationship between the Academy of Sciences and the political regime.

[51]Tarkowski, Jacek, "Poland: Patrons and Clients in a Planned Economy", in: Eisenstadt, S.N./ Rene Lemarchand (eds), Political Clientelism, Patronage and Development, Sage: London, 1981, p.181.

Table 8: Patron-Client Relationships in the Hungarian R&D System

Subsystem	Client	Patron
Elite Function	Academy of Sciences	Minister of Science (up to 1994), Strong Personal Relationships
Higher Education	Higher Education Institutions	Ministry for Culture and Education
Industrial R&D	Industrial R&D Institutes, Intermediaries	National Committee for Technological Development, Ministry for Trade and Industry, Several Branch Ministries

If one analyzes the relationships between governmental and R&D institutions in this way, it is interesting to notice that a straightforward relation between a single patron and a single client exists only in the case of the higher education institutions, which, not coincidentally, are the "winners" in the gamble for resources during transition[52]. The Academy, since 1994 without an institutionalized patron, but not without (a) personal one(s), can be identified as a "loser", but in comparison to the third group, the industrial R&D institutes, has had to deal with modest losses only. The third group was the clear "loser" in the game for resources. Not coincidentally, the industrial R&D institutes were the only group with a larger number of patrons, who were endowed with more or less clout, depending on the rapidly changing situations they were faced with during transition. As a result of the patrons' conflicting interests, the industrial R&D institutes have been pushed around during the transition period. This clear division in "winners" and "losers" can be risked, because in times of resource constraints, as they are to be found during the transition period, the struggle for funding becomes a zero-sum game: Some win, others lose, but in the face of diminishing resources there are more losers than winners.

Besides the somewhat heftier struggle for resources, at first glance the groupings of interests in the Hungarian R&D system are comparable to what one can find in other R&D spheres, too. However, if one looks a bit closer, it becomes clear that four decades of realsocialism in Hungary have left their carvings in the system. Especially the previous compartmentalization of R&D during the existence of the People's Republic has led to weak linkages between the different interest groups. As the former regime did oppose any connections between the Academy of Sciences, the universities and industrial R&D institutes and company units for a long time, only minimal communication structures were

[52] To an extent that one can talk of "winners" in a situation of resources constraints. Moreover, since the Horn government came into power, the universities are not as privileged as they have been under the previous transition governments.

upheld[53]. This has a detrimental and negative effect on the relations between different interest groups, who all have difficulties to communicate with each other. Efforts to overcome these rifts, as the Athenaeum Project, which should foster cooperation between universities and the Academy of Sciences, have had modest effects so far.

The above described scattered structure of the industrial R&D grouping led during the transition to a minimal interest representation of this group. In addition, the Ministry for Trade and Industry (IKM), responsible for most industrial R&D institutes, was weakened during the conservative Antall and Boros governments. During this time, from 1990-94, the National Committee for Technological Development, OMFB, was strengthened. OMFB, however, did not directly represent the industrial R&D institutes. Even its funding activities were scarce, as it was feared the industrial R&D institutes would not be able to pay loans back[54].

This weak interest representation might be one of the reasons why the industrial R&D institutes were to be privatized via the State Assets Management Company (ÁV Rt.), with the state keeping 26 % of the organizations. The from the standpoint of industrial policy understandable decision of government to keep its fingers in the jar did not entice any prospective owners to invest large sums into the organizations, of which they would have had only partial control. This resulted in a lengthy privatization process confirming evidence from other privatization cases that a prolonged process of transformation for organizations is harmful to most of them for a variety of reasons: no investments are made in the meantime, decisions can be taken only in lieu of a short term horizon and assets are sold off to ensure the short term survival of the institutions. Efforts on the side of the branch ministries, especially the IKM, to influence the process were not effective.

In the framework of the new Horn coalition government the Ministry for Trade and Industry was clearly strengthened, partially at the cost of OMFB, which lost clout in the forms of competencies and funds as well as its status as an own ministry. Discussions about the future of the remaining industrial R&D institutes are ongoing, without a clear decision in reach[55].

The second organization identified above as a "loser" in the struggle for resources is the Academy of Sciences. As has been pointed out, the institution has been weakened to some extent by the changes in governance structure in 1994: in the Horn administrations there has been no minister of science anymore. This might be not a huge loss in terms of clout as

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[53]Much has been written about the problems, which have been arising from this compartmentalization of R&D in realsocialist countries. See for example Chiang, Jong-Tsong, "Management of Technology in Centrally Planned Economies", in: Technology in Society, Vol 12, pp.399, or, from a policy maker's point of view, Piskunov, Dimitry and Saltykov, Boris, "Transforming the Basic Structures and Operating Mechanisms in Soviet Science", in: Science and Public Policy, 92/4, pp.111.

[54]See Mosoni-Fried 1995.

[55]For a highly informative analysis of the industrial R&D institutions' situation see Mosoni 1995.

the minister for science had only a small office and no corresponding ministry and therefore was not too powerful in the previous governments. More significantly, there is a widespread feeling of insecurity among the personnel of the Academy stemming from the provision that Parliament yearly decides anew on the sum to be allocated for the organization.

This feeling of insecurity on the side of the Academy, formerly a powerful interest group representing the centers of scientific excellency of the country, has been strengthened when it became clear that in a capitalist Hungary the Academy would not be the only center of excellency anymore. Quite to the opposite, the institution would be lessened in importance in respect to the one group of institutions representing the researchers concerned with the same range of activities as the Academy: the universities.

7. Realizing Hungary's Potential

Hungary, for years in international financing world everybody's darling among the transition countries, has been increasingly rated differently during 1995. In the latest edition of the "Central European Economic Review" a panel of eight experts from Salomon Brothers International, Deutsche Bank to the Vienna Institute for Comparative Economic Studies have rated 26 transition economies in 11 categories. In the final rating the Czech Republic came out first, closely followed by Slovenia and Poland. Hungary finished as a distant fourth[56]. Shortly after that, an Austrian daily reported that every third company in Austria with more than 200 employees was interested in building up productive capacities in transition countries. 24 % of the 151 companies targeted the Czech Republic, 22 % Poland, but only 13 % Hungary[57].

What is the reason for the turning tides ? Partly it is simply macro-economic imbalances resulting from Hungary's huge debt load, which dates back to the People's Republic deficit spending policies. Ironically it is also the very countermeasures against these debts, the "Bokros-plan". The countermeasures of the former finance minister Lajos Bokros, probably the best hated person in the Hungarian R&D system, who unveiled in March 1995 a number of strict austerity measures. These policies seem to be successful in fighting the pile of debts - and in destroying the country's R&D potential.

Public servants earn 30-50 % of what they could earn in private industry. A mid-level official of the national bureaucracy suggested in an interview that the more qualified the personnel, the higher the likelihood to be targeted by headhunters. Recently, he said, the offers of private industry had led to a decrease in qualified personnel. Moreover, he was not sure

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[56]Reed, John, "The Great Growth Race", in: Central European Economic Review, December 1995/1996, pp.8.

[57]"Jeder dritte Betrieb will Teil der Produktion in den Osten verlegen", in: Der Standard, February 15th 1996, p.19

about his own future in the organization, despite his long career in public service, as he had received a tempting offer from a foreign company. While it might be necessary for the country to slowly reduce its central bureaucracy, the effects of losing the best people to industry might not help to improve governance.

One way of streamlining the R&D sphere is to enhance competitiveness. This can be achieved by utilizing competitive research grants administered by independent funds as OTKA, the National Scientific Research Fund. Researchers, who have a similar income as bureaucrats, in most cases are forced to apply for contract research. Therefore, with an incentive for the researchers and the necessary institutions already in place, the only components for an effective research sphere missing are appropriate funding levels and funding mechanisms. Both seem to be not adequate at the moment. Neither is the size of the grants satisfying, nor is it the way grants are given. Personal networks with a number of characteristics of patron-client relations seem to have a sizable influence on funding decisions.

An organization that has overcome these problems seems to be the National Committee for Technological Development, OMFB. The funding structures, especially for the Centralized Technical Development Fund, KMÜFA, installed by the former head of the organization, Ernö Pungor, are competition oriented and follow objective criteria. These structures, however, should also increasingly address the needs of those remaining R&D institutes, which are in strategic sectors. The industrial R&D capacities of Hungary are not large enough as that the country should single-handedly dismiss the industrial R&D institutes. They have been evaluated already. On the bases of these evaluations it should be possible to make a decision on which to keep for strategic reasons under state control and which to fully privatize.

Another decision, which would help to clarify the situation, is the reduction of potential patrons for the industrial R&D institutes. Regardless if they are put under the supervision of OMFB, perhaps in the form of new participants in the Bay Zoltan network as has been suggested[58], or returned under the supervision of the Ministry for Trade and Industry (IKM), the State Assets Management Company (ÁV Rt.) certainly is not a place to stay for an extended period of time, especially for a R&D institute with the need to invest into its future.

On one hand, it is not functional to feed R&D institutions for a prolonged period of time exclusively from state sources. On the other hand, the demand from industry for R&D is only very slowly building up again. From the experiences of the first five years of transition it seems to be established that foreign direct investment, despite all the good it does, will not raise demand for Hungarian R&D. Government will have to reach a decision on the issue. One possibility to increase the Hungarian industry's R&D demand is not to tax investments

[58] See, amongst others, Mosoni-Fried 1995, p.796.

into R&D. A series of additional tax incentives for R&D has been developed during the last decades in most industrialized countries. It may be worthwhile to evaluate these measures for Hungary.

In addition to deciding on structures and funding of industrial R&D, government should be called in on issues of the information infrastructure. Information centers as the National Technical Information Center and Library (OMIKK) in Budapest are advanced institutions, who could serve as central parts of a national information infrastructure, vulgo the data highway. Investments cut in information services are future chances cut. Therefore, information services should be carefully harvested.

An effort should be made, however, to provide information to small and medium companies (SMEs), who typically lack the time and resources to gather information economically. This might be hard for a larger organization. Often very small and rather cheap technology exchange centers have shown some success in industrialized countries. Such centers can help to cut red tape, provide personal networks, help with communication and information.

Statistics on R&D are an important source for reaching decisions. The data situation in Hungary in respect to industrial R&D is dissatisfying. Despite the efforts of individual persons, there is no general overview available on R&D in general, not to speak of industrial R&D. OMFB has stopped its research 1991, the MTA in 1995 and the Central Statistical Office's data are not extensive enough.

Another area of importance for industrial R&D is human capital. The importance of education for all economic success stories of the 20th century is paramount[59]. Hungary has done a lot to reform its higher education system, but there is still a lot to do. The number of students is low in international comparison. The international contacts have been intensified, but need even more impetus. Interdisciplinary research has to be fostered. The contacts with the MTA should be intensified and upgraded from a purely personal level.

Moreover, education does not stop with the entrance of a student into business life. Life-long learning has to be achieved through trainee programs for the private as well as the public sector. For this purpose national know-how from universities, the MTA or the Association for Innovation as well as international know-how through programs as PHARE or COPERNICUS from the EU might be utilized.

However, the success of the recent reforms will not only be a function of original organizational solutions, funding mechanisms, information provision services and the

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[59]See, for example, Peter Biegelbauer, "Structural Adjustment of the Science and Technology System: In Search for Models for Hungary" at the European Association for the Study of Science and Technology's "Conference on Science, Technology and Change: New Theories, Realities, Institutions", Budapest, August 28-31, 1994.

retraining effort. Of utmost importance will be the capability of government to facilitate the balancing of socioeconomic interests of this rapidly changing society.

Glossary

COCOM	Coordinating Committee for Export to Communist Area
COMECON	Communist Council for Mutual Economic Assistance (CMEA)
FDI	Foreign Direct Investment
FEFA	Higher Education Fund
GDP	Gross Domestic Product
HUF	Hungarian Forint
KMÜFA	Centralized Technical Development Fund (Központi Müszaki Fejlesztési Alap)
MNC	Multinational Corporation, also Transnational Corporation
MTA	Hungarian Academy of Sciences (Magyar Tudományos Akadémia)
NEM	New Economic Mechanism
NPO	Non-Profit Organization
OECD	Organisation for Economic Cooperation and Development
OMFB	National Committee for Technical Development (Országos Müszaki Fejlesztési Bizottság)
OMIKK	National Technical Information Center and Library
OTKA	National Scientific Research Fund (Országos Tudományos Kutatási Alap)
R, D&E	Research, Development and Experimental Development
TBP	Science Policy Committee (Tudománypolitikai Bizottság)
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USD	United States Dollar
IBRD	International Bank for Reconstruction and Development (World Bank)
WW II	World War II

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