BioPolis - Inventory and analysis of national public policies that stimulate research in biotechnology, its exploitation and commercialisation by industry in Europe in the period 2002–2005

National Report of HUNGARY

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Table of contents

Summary

Since the end of the last decade Hungary has been a successful transition economy with about 4% GDP growth and movement toward convergence with the EU average. One of the sources of this growth has been very high Foreign Direct Investment in the manufacturing sector.

After the demise of the communist regime Hungarian GERD as a percentage of GDP fell from 2.0% to 0.7%, only recovering to 1.0% after 2000. The Hungarian R&D system has a problematic divide between the public research institutes (in particular those of the Hungarian Academy of Sciences) conducting basic research, universities focusing mainly on education and an industrial base hardly investing in research (BERD is only one third of GERD).

Nevertheless, as a result of robust education and basic research systems and a history as an important pharmaceutical exporter in the communist bloc before 1991, Hungary can boast the biggest biotechnology sector in central and eastern Europe, although still in embryonic phase. Thus Hungarian performance in biotechnology has steadily improved in terms of publications since the mid 1990s, but its patenting remains at less than 20% of the EU average.

The STI governance system underwent a major reform in 2003 and 2004, with the creation of a Science Technology Policy Council that sets policies under the direction of both the Ministries of Education and Economy, the National Office of Research and Technology (NKTH) that designs policy instruments and an Agency for Research Fund Management and Research Exploitation (KPI) that manages and implements them. Unlike the predecessor organisation, the NKTH and KPI appear to have a stronger focus on technology development and transfer.

Biotechnology specific policy instruments became relevant after 1999, when a study set this field as one of the Hungarian research priorities. The first was the Biotechnology 2000 programme, that awarded 18M EUR between 2000 and 2002 for applied biotechnology in academia and industry. In 2005, two more biotechnology specific programmes were launched, one for the creation of bioincubators (4M EUR) and one supporting biotech innovation clusters.

Nevertheless, the largest expenditure on biotechnology research has come from generic policy-directed instruments, in particular the National Research and Development Programme, which spent about 25% of its 2002-2005 budget (45.8M EUR) in this area. The Applied R&D programme, launched in 2004 provided about 20M EUR more for collaborative research between academia and industry.

Non-policy-directed instruments have provided another estimated 31.4M EUR of biotechnology funding in 2002-2005. The most important are the Hungarian Scientific Research Fund which awarded basic research grants in response mode (10M EUR); in addition block grants were awarded to a number of institutions: two research centres under the Ministry of Agriculture (about 7.1M EUR), two research centres of the Hungarian Academy of Sciences (about 5.3M EUR), and for the Institute for Biotechnology of the Bay Zoltan Foundation targeting applied research (3.1 M EUR).

Policy-directed instruments have focused on fostering industry-oriented research and applied research (about 63% of expenditure), followed by basic research (17%). Transmission of knowledge from academia to industry and adoption of new industrial applications account for an estimated 12% of the total expenditure.

In terms of application areas, health biotechnology is the dominant field with more than 40% of expenditure and 55% of publications. Industrial biotechnology takes 15% whereas plant and food biotechnology, with about 11% and 10% of expenditure respectively (but 10% and 5% of publications) appear also as strategic fields in Hungary.

Overall, Hungarian policies appear to have moved towards more focused support for biotechnology, increasing the funding aimed at applied research and technology transfer. These developments might benefit the local nascent biotech industry. However, some analysts point to the need to improve coordination between public actors. In terms of specific instruments, subsidies to reverse the brain drain, especially of industrial researchers, and various support measures for start-ups, including public seed and venture capital, are seen as elements to be improved in the current policy mix.

1. Introduction and background

1.1 General introduction[1]

Hungary, which has a population of 10 million, has a well-diversified economy, both in agriculture (which accounts for 15% of its export earnings) and industry. Major products include steel, chemicals, pharmaceuticals, cement, processed food, textiles, and motor vehicles. Since 1997, Hungarian GDP has grown at an approximate annual rate of 4%, which has allowed remarkable progress towards EU convergence in a short period: Hungarian GDP per capita in PPP has increased from 50.3% of the EU average in 1997 to 61% in 2004. One of the engines of growth has been Foreign Direct Investment (FDI), which amounted to 70% of the sales and 50% of employment in manufacturing industry in 2001. To keep this FDI flow, in 2005 Hungary lowered the corporate tax rate to 16%, one of the lowest in Europe (lower than neighbouring countries such as Poland, Slovakia and Czech Republic). The black spot among Hungary's macroeconomic indicators is the high government deficit (at 6.2% in 2003, 4.5% in 2004, estimated between 3.6% and 6.1% in 2005 and predicted to be up to 8% in 2006). This high deficit poses problems for meeting the so-called Maastricht Criteria to join the Eurozone and for increasing public expenditure on R&D.

Before the demise of the communist regime, Hungarian GERD stood at 2% of GDP. After 1989, it immediately collapsed to 1.1% and then decreased steadily to 0.7%, during the mid 1990s. GERD finally rebounded in 2000, reaching 1.0% in 2002 (about 700M EUR). State expenditure covers 59% of GERD, with another 10% coming from international organisations (Eurostat, 2005). Thus, BERD is still very low, less than one third of national expenditure. In terms of the execution of research, about 34% is performed in public research organisations (PROs) and 28% in higher education (Romanowicz, 2004).

Hungary has a strong scientific tradition, with a good educational system (which nevertheless provides too few S&T graduates) and internationally renowned research institutes. The term biotechnology, for example was first used in 1917 by a Hungarian agricultural engineer.

Hungary has the biggest biotechnology sector in central and eastern Europe, although it is still in an embryonic phase. It has about 100 firms of which 30 are intensely biotech-focused, that earn about 50M EUR in sales per year (Buonamico, 2004) and have employment of 800-1000 in core biotech jobs (Hungarian Biotech Association, 2005). It has built on a tradition of pharmaceutical manufacturing – during the Cold War, it provided two thirds of COMECON[2]'s pharmaceuticals (Schiermeier, 2004).

In 2005, biotechnology employs 2.6% of the industrial workforce, it generates 4.1% of industrial added value and 5.2% of industrial exports representing 70% of its sales

[1] This chapter draws heavily on the Hungary report of the European Trend Chart on Innovation by Attila Havas (2005). This excellent report has an analytical depth that is lacking in some other Trend Chart national reports.

[2] COMECON (*Council for Mutual Economic Assistance*) was the equivalent of the CEE in the eastern European communist block between 1949 and 1991.

(ITD, 2005). It is estimated that its R&D activities in 2002 amounted to 100M EUR. Most of the Hungarian biotech companies appear to provide services or tools to the international pharmaceutical industry. There are some transnational corporations established in Hungary in the sectors related to biotechnology, in pharmaceuticals (Sanofi-Chinoin, Astra, Teva-Biogal, Akzo Nobel/Organon) and agrofood (Novartis/Sandoz seeds). The lack of a tradition of industry-university collaboration is perceived as an important obstacle.

R&D is heavily centralised in the region of Central Hungary (Budapest), taking 69% of the expenditure and 65% of employment. This region also accounts for 45% of national GDP. This concentration in Budapest also applies to biotechnology (28 biotech firms). Other biotechnology clusters are Debrecen (13 biotech firms) in the east, Szeged (9) in the south and Pécs (7) in the south-west (PCA, 2004, p.27).

1.2 Characteristics of national S&T and innovation system

Hungarian S&T suffered a major crisis with the transition to capitalism in the early 1990s. As explained, GERD fell dramatically and the total number of researchers in Hungary nowadays, at 23,300, is still much lower than the 45,100 in 1988, although higher than 19,600 in 1995. This lack of support for S&T has resulted in a significant emigration of researcher to Western Europe and the US. During the communist era the majority of public research was carried out by Hungarian Academy of Science (HAS) institutes, with a focus on basic research; universities focused on education, not research. Since 1994 the HAS has supported university-affiliated research groups as well as its Institutes and the Ministry of Education also provides universities with funds for research (Balázs, 1998). The research system suffers from an entrenched divide between academia and industry that is seen as hindering the technological development of industry. Many policy measures since 2003 aim to improve technology diffusion from public institutes and university to private firms.

Before 1990 science and technology policies were designed and managed by the National Committee for Technological Development (Oeszagos Muszaki fejlesztesi Bizottsag, OMBF), which used to be a prominent Ministry in its own right. During the 1990s the OMBF progressively lost its status until it became a division of the Ministry of Education in 2000.

In 1999 the *Széchenyi plan* advised a shift of paradigm in Hungarian economic policy towards the strengthening of R&D efforts. Between 2000 and 2003, science and technology policies were directed by the Ministry of Education, through the following main programmes or funds:

- National Scientific Research Fund (Országos Tudományos Kutatasi Alapprogramok, OTKA) – funding basic research
- National R&D Programme (Nemzeti Kutatási és Fejlesztési Programok, NKFP) – funding applied research.
- National Technological Development Programme (Központi Müszaki Fejlesztési Alapprogram, KMUFA) – funding technological development.

In 2003, a major reform took place, giving birth to the current governance system. Most of bodies described below were newly created in 2003 and became fully functional in 2004.

The Science and Technology Policy Council (Tudomány- és Technológiapolitikai Kollégium, TTPK) is the highest body in the STI policies. It is chaired by the Prime Minister, and the Vice-Chairs are the Minister of Economy and Transport, and the Minister of Education. It is attended by the President of Hungarian Academy of Sciences (HAS) as well as other ministers with S&T interests. **The Science and Technology Advisory Committee** (Tudomány- és Technológiapolitikai Tanácsadó Testület, TTTT) is an advisory body to the TTPK.

The **Research and Technology Innovation Fund** was set up in 2003 with the funds formerly allocated by NKFP and KMUFA, plus those arising from a special innovation tax charged on medium and large sized enterprises. This innovation contribution was set at 0.2% in 2004, 0.25% in 2005 and 0.3% in 2006 of their net revenues paid by medium and large size enterprises. Small firms were taxed only 0.05% in 2004, 0.1% in 2005, 0.15% in 2006; from 2007 onwards it will rise to 0.20%. The revenue of this tax appears to have improved significantly the availability of funds, facilitating an increase in S&T expenditure.

The **National Office of Research and Technology** (Nemzeti Kutatasi es Technologiai Hivatal, NKTH) is the governmental organisation entrusted with the design, implementation and evaluation of science and technology policy. It participates in the preparation of new legislation for STI, the coordination of international co-operation and EU integration in STI and the evaluation of R&D programmes. Thus, the NKTH is the main public financing and expert organisation for applied research and technological development in Hungary. The **Research and Technological Innovation Council** (Kutatasi es Technologiai Innovacios Tanacs, KTIT) takes the main decisions about the Research and Technological Innovation Fund. Its 15 member bodies include high officials from different ministries and representatives of industry and the R&D community.

The Agency for Research Fund Management and Research Exploitation (Kutatás-fejlesztési Pályázati és Kutatáshasznosítási Iroda, KPI) is the government agency under the NKTH that implements the government's policy in the field of innovation strategy and programmes, and has responsibility for the management of the Research and Technology Innovation Fund. Since its creation in 2003, KPI managed about ten Hungarian funds in 2004, another twenty in 2005, as well as managing R&D expenditure of the EU structural funds in 2004-55.

The Hungarian government supports basic research through the **Hungarian Scientific Research Fund Programme Committee** (Országos Tudományos Kutatasi Alapprogramok, OTKA). OTKA's grants are awarded in response mode and appear to be very small (Sansom, 2004).

In order to qualify for EU Structural Funds and Cohesion Fund, Hungary prepared and submitted in 2003 the **National Development Plan** (Nemzeti Fejlesztési Terv, NFT) for 2004-2006. One of the Five Operative Programmes of the NFT is the Economic Competitiveness Operative Programme (Gazdasági Versenyképesség

Operatív Programja, GVOP), run by the Ministry of Economy and Transport focusing on:

- investment promotion,
- development of SMEs,
- development of the information society and e-economy,
- technical assistance.
- R&D, innovation, with a budget of 35,000M HUF (around 140M EUR) for the fiscal year of 2005.

Although the GVOP is not formally linked to other parts of the S&T governance system, its activities have an impact in innovation policy.

The **Hungarian Academy of Sciences** (HAS) is an autonomous body financed by the state and formally under the Hungarian Parliament but endowed with self-governing rights. Although the HAS' share of total research activity is around 10%, it plays a very important role in natural sciences, conducting about half of the national effort in R&D (NKHT, 2004, p. 3). Currently about 60% of the Academy's budget is from public block grants; the remaining 40% is obtained from competitive grants or research contracts.

Finally, there are a variety of research centres or institutes associated with various Ministries that carry research on topical issues. Those related to biotechnology will be presented in section 0.

A number of legislative initiatives have been passed to shape and support the new institutional framework, the most important being the Law on Research and Technological Innovation to foster university-industry collaboration, commercialisation of publicly funded research and increase private investment in research in December 2004, and a law on Higher Education that was passed in 2005 in order to join the European Higher Education Area in accordance with the Bologna Process (Havas, 2005).

Although in 2004 there have been some developments towards the promotion of innovation processes at a regional level, Hungary is a small centralised country of a size comparable to the regions in many EU states and the relevant S&T policies are likely to stay at the national level.

The current institutional framework and the number of policy instruments created in these last years are seen as very positive developments by policy analysts. The main weakness is that the system remains fragmented. According to Havas 'a coherent policy framework for innovation is yet to be developed in Hungary' (2004, p. 387).

1.3 National support and framework conditions for biotechnology

Biotechnology has been one of the targets of Hungarian S&T policy, given that it is viewed as a means to regenerate their pharmaceutical industry, which was a leading exporter in COMECON countries and had a history dating back to the early 20th century.

In 1998-1999 a national study on biotechnology was carried out in order to identify research priorities in the sector. On the basis of this study, the government launched the Programme Biotechnology 2000, under the Ministry of Education, probably the largest biotechnology initiative in Hungary, with 4,500M HUF of funds from the KMUFA between 2000 to 2002.

With the reorganisation of the S&T funding system in 2003, NKTH is now the primary agency providing funding for biotechnology. Biotechnology is one of NKTH's priorities, as shown both by policy statements and budget commitments. It is estimated that between 2002 and 2005, NKTH awarded grants for a total of 24.2M HUF (96.8M EUR) in the area of life sciences, mainly in the areas of health (30%) and plant research (20%).

The legal conditions for biotechnology research in Hungary are set by the Hungarian law on biotechnology activities (Act No. XXVII of 1998) and its enacting clauses 1/1999 (I.14) FVM and 44/1999 (IV.30.) FVM, which were modelled on the EC directives 90/219 and 90/220 but cover a wider scope of activities, not just GMOs. The Decree No. 1/1999 (I.14.) FVM gave details of implementation in agriculture and the foodindustry.

The key features of the law are:

- Laboratories need accreditation for engaging in genetic engineering experiments.
- Genetic modification is subject to risk analysis and can only be carried out by researchers with a licence to do it.
- Industries using genetic engineering are subject to liability rules common for other hazardous industries.
- GMOs and all food containing it should be registered and labelled.
- The establishment of an advisory body, the Committee for Evaluating Biotechnology Procedures, which includes academic, industrial and public interest group representatives.

Ethical questions concerning experiments on humans are evaluated by three ethical committee under the Medical Research Council (Egészségügyi Tudományos Tanács, ETT):

- Ethical Committee of Clinical Pharmacology
- Ethical Committee for Human Reproduction
- Research and Ethics Committee (covering those areas not addressed by the former two committees).

Public perception of biotechnology in Hungary is significantly more positive than in the EU average (74% of the population see it as having a positive effect, compared to 65% in the EU). High technologies in agriculture are also seen as positive by a large majority (81% versus 66% in the EU). Hungarians are among the most ready to accept a variety of uses of biotechnology, including animal cloning (54% vs. EU of 43%), human cloning to avoid disease (27% vs. EU of 19%) and cloning from embryos for therapeutic reasons (57% vs. EU of 52%).

1.4 Main biotech policy and research actors

The biotechnology ST&I policy actors are described in the previous sections and shown in Figure 1.1.

To meet its objectives to promote the competitiveness of the Hungarian industry and the service sector of the economy, the **National Office of Research and Technology** (NKTH) has developed policy instruments specifically to support the biotechnology industry. Its Department for Advanced Technologies Unit for Bio- and Agro-technologies is responsible for research and development activities for the food sector in general, in cooperation with the Ministry of Agriculture and Rural Development.

The **Hungarian Scientific Research Fund Programme Committee** (OTKA) funds basic research in response mode but biotechnology is not one of its research priorities.

The **Hungarian Academy of Sciences** (HAS) has a role in biotechnology through two of its research institutes funded by block grants, the **Biological Research Centre** and the **Experimental Medicine Institute**.

The Bay Zoltan[3] Foundation for Applied Research was established in 1992 by the National Committee for Technological Development (OMFB), with the aim of creating an institute to conduct applied technological and scientific research and development. The Foundation operates as a non-profit organisation and its research and development activity is carried out in the institutes that it has established and owns. Its first institute was the Institute for Biotechnology in Szeged, presented below in section 0.

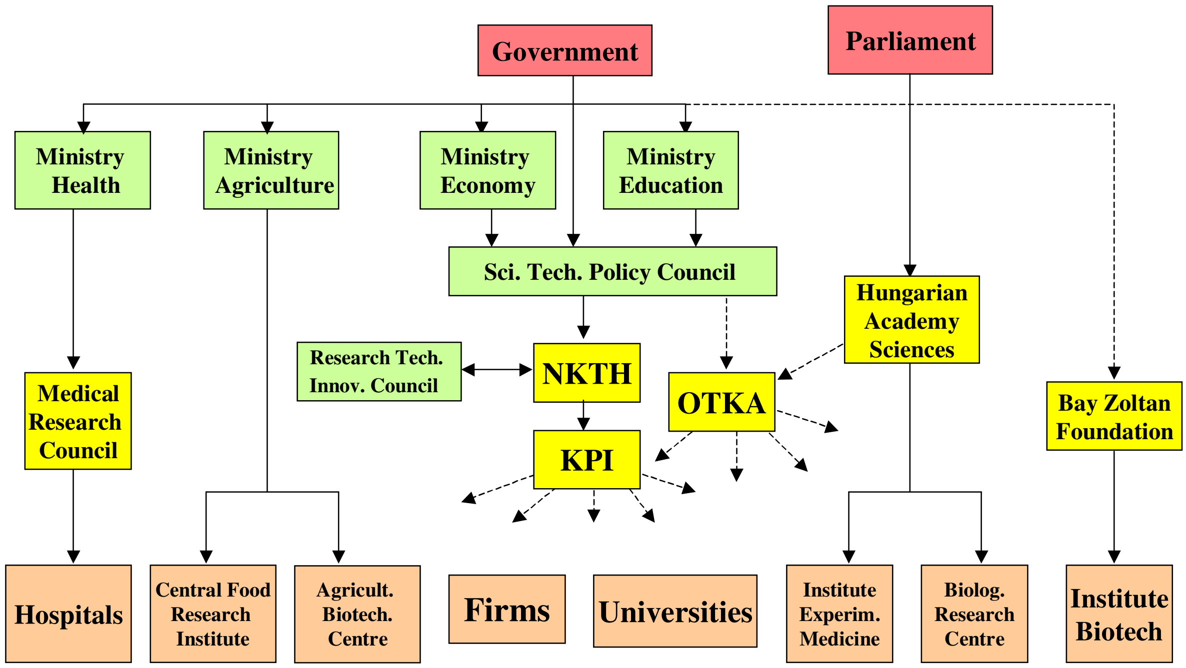
A variety of research centres or institutes associated with various Ministries carry out research on topical issues. The **Ministry of Agriculture** supports the **Agricultural Biotechnology Ce**ntre and the **Central Food Research Institute**, which play a relevant role in Hungarian biotechnology. The activities of the **Medical Research Council** in biotechnology under the **Ministry of Health** are small relative to the total activities of Council and mainly focus on reproductive biotechnology. In addition there are nine universities involved in biotechnology-related R&D (Anon, 2004).

The **Hungarian Investment and Trade Development Agency** (Magyar Befektetési és Kereskedelemfejlesztési, ITD)[4] promotes investment in Hungary and has a specific platform for biotechnology. However, since it does not play an active role in funding for biotechnology, its activities are not included in this report.

Finally, the **Hungarian Biotechnology Association** (Magyar Biotechnológiai Szövetség) is very active in representing and promoting the development of the biotechnology sector.

[3] The Foundation is named after Zoltan Bay, a renowned Hungarian scientist that made major contributions in applied nuclear physics.
[4] See www.itd.hu accessed 27-05-06.

Figure 0.1. Main policy-making organisations, funding agencies and research performing institutions in the Hungarian biotechnology system.



*The central institutions are the **National Office for Research and Technology (NKTH)** and the **Agency for Research Fund Management and Research Exploitation (KPI)**, which set the policies and manage, respectively, applied research followed the **Hungarian Scientific Research Fund (OTKA)**, in charge of basic research.*

2. Funding for biotechnology R&D, transfer and commercialisation

2.1 Introduction

This report reviews the funding of biotechnology research and commercialisation. In the report we make a distinction between policy-directed funding and non-policy-directed funding of biotechnology.

Policy-directed funding includes funding which was directed by explicit policy decision making about installing a specific instrument, such as specific R&D programmes, programmes encouraging collaboration, industrial research grants, support for centres of excellence, support for commercialisation of research, support for start-ups, programmes encouraging mobility of researchers, programmes with open calls, etc. This policy-directed funding can include biotechnology specific policy instruments and generic policy instruments. Biotechnology specific policy instruments are instruments that have been specifically set up to stimulate biotechnology. Generic policy instruments are instruments that are not dedicated to a specific technology, but which in principle stimulate all technologies, also including biotechnology. In the BioPolis project, only those generic instruments are included if a reference is made to (the stimulation of) biotechnology activities in the policy of the funding organisation that runs the program, or of the ministry/government department that funds the funding organisations or that runs the program itself.

Non-policy-directed funding of research includes funding which is part of the structural governmental support for scientific education, research and research infrastructure. This type of funding is mainly given through block grants to universities and (government) research institutes, the open-call system of research councils etc. Research councils, research institutes and government research institutes develop their own programmes through which biotechnology may be supported. In the BioPolis project only the funds for block grants to (government) research institutes and through the open-call system of research councils are included.

In this chapter the funding of biotechnology research through policy and non-policy-directed instruments and of biotechnology commercialisation through policy-directed instruments is presented. Data were collected through desk research (publications, documents, websites of national public funding organisations and/or governmental departments), surveys completed by representatives of funding organisations that manage the generic and biotech specific programs, interviews with representatives of organisations that are involved in non-policy-directed and policy-directed funding. The website of the funding organisations and their programs and the names of contact persons that participated in the survey and/or who have been interviewed can be found in Annex 3 (List of Contact Persons), footnotes and Annex 4 (References). Section 2.2 presents the non-policy-directed funding and section 2.3 the policy-directed funding. The final section provides a short overview of the European funding of biotechnology research in the Hungary through the 6th Framework Program.

2.2 Non-policy-directed funding for biotechnology research

About one third of the non-policy-directed funding for biotechnology is awarded by OTKA's basic research grants. The other half comes from block grants awarded by the Ministries or the HAS to research institutes specialised in biotechnology or related areas. Table 2.1 provides an overview of the funding organisations that supported non-policy-directed funding of biotechnology research in the period 2002-2005.

Table 0.1 Non-policy-directed funding of biotechnology research

Funding organisation	Programme/PRO	Funds M HUF	Funds M EUR	%
Min. Education	OTKA (Response mode)	2500	10.0	31.0%
Min. Agriculture	Agricultural Biotechnology Centre	1620	6.5	20.1%
Min. Agriculture	Central Food Research Institute	373	1.5	4.6%
Min. Health	Medical Research Council	1500	6.0	18.6%
Hungarian Acad.Sci.	Biological Research Centre	1040	4.2	12.9%
Hungarian Acad.Sci.	Institute of Experimental Medicine	280	1.1	3.5%
Bay Zoltan Found.	Institute for Biotechnology	763	3.1	9.4%
Total		**7876**	**32.3**	**100.0%**

Source: BioPolis Research

2.2.1 Hungarian Scientific Research Fund Programme Committee (OTKA)

OTKA's annual budget decreased from about 6800M HUF (28M EUR) in 2002, to 6450M HUF (2.58M EUR) in 2003, 5675M HUF (22.7M EUR) in 2004 and 5850M HUF (23.7M EUR) in 2005. Life sciences received about one third of this funding. We have estimated that about 10% of the total is closely related to biotechnology. This suggests that 2500M HUF (10M EUR) was allocated to biotechnology funding in the period 2002-2005.

2.2.2 Research Centres of the Ministry of Agriculture

The Ministry of Agriculture and Regional Development (Földművelésügyi és Vidékfejlesztési Minisztérium) gives block grants to 24 research institutes to conduct research on agro-food topics. Two of these institutes have an important biotechnology focus.

Agricultural Biotechnology Center

The Agricultural Biotechnology Center [5] (Mezögazdasági Biotechnológiai Kutatóközpont, ABC) was founded by the Ministry of Agriculture in 1989 on the premise that biotechnology and its application were key factors to the future competitiveness of Hungarian agriculture. The centre focuses on biotechnology research for an environmentally sound Hungarian agriculture, participates in the

[5] See www.abc.hu accessed 28-05-06.

training of biotechnologists and coordinates biotechnology research activities sponsored by the Ministry of Agriculture. Today the ABC is the largest research institute of this ministry with 180 employees, 120 of which belong to the scientific staff, including 30-40 graduate students in various PhD programmes.. The focus of its activity is on Animal and Plant (40% each) and Environment (20%) biotechnologies. This is a centre of excellence aimed at conducting applied research, but it has an important training activity as well as significant activities as a centre of technology transfer and start-up creation.

The total budget for 2005 is 1 500M HUF (6.0M EUR), of which 40% (600M HUF, 2.4M EUR) comes from national public funding. Of this, 350M HUF (1.4M EUR) corresponds to block grants from the Ministry of Agriculture and the remainder to competitive grants. Considering that the grants from the Ministry have been decreasing at about 10% each year, we estimate support in block grants had a value of 1 620M HUF (6.4M EUR) between 2002 and 2005. Regarding the other income sources, 40% of support is from EU sources and the remaining 20% from various sources such as charities and contract research.

Central Food Research Institute
The Central Food Research Institute[6] (Központi Élelmiszer-tudományi Kutatóintézet) was established in 1959 to carry out research and development in the field of the food industry. There are currently more than 120 people employed at the institute, of which 44 are scientists. Its main goal is to guarantee safety in the food chain in accordance with the priorities of Ministry of Agriculture.

The institute has an annual budget of about 800M HUF (3.2M EUR) with block grants from the Ministry of Agriculture representing about 300M HUF (1.2M EUR) per year. Estimating that about 30% of the budget is spent on biotechnology, suggests an approximate expenditure in block grants for biotechnology of 360M HUF (1.44M EUR) for 2002-2005.

2.2.3 Medical Research Council

The equivalent of the Medical Research Council in Hungary is the agency Egészségügyi Tudományos Tanács (ETT) under the Ministry of Health, which focuses on clinical research. Research associated with biotechnology represents only a small percentage of this council's activities, mainly in reproductive biotechnology, around 375M HUF (1.5M EUR) per year.

2.2.4 Centres of Excellence of the Hungarian Academy of Sciences (HAS)

The research centres of the Hungarian Academy of Sciences (Magyar Tudományos Akadémia, HAS) comprise five of the six Hungarian centres of excellence recognised in 2001 by the EU. Two of them are related to biotechnology:

Biological Research Centre
The Biological Research Centre (Szegedi Biológiai Központ, BRC) of the HAS has 500 staff and 240 researchers distributed among five institutes (biophysics,

[6] See www.cfri.hu accessed 30-05-06.

biochemistry, genetics, plant biology, enzymology). However its main activity in biotechnology is carried out in the central laboratories which provide services in:

- Proteomics
- DNA sequencing
- Functional genomics
- Bioinformatics
- Nucleic acid synthesis.

The main strengths of the BRC are in the fields of developmental genetics, enzymology and plant biology. It has a total annual budget of 2 600M HUF (10.4M EUR) of which 1 300M HUF (5.2M EUR) are block grants from the HAS. This income from HAS has been stable over the 2002-2005 period. About 20% of their activities fall into biotechnology, yielding an approximate annual expenditure of 260M HUF per year (1.0M EUR).

The BRC initiated and is the main driver of the Biopolisz Life Science Consortium in Szeged, which integrates the BRC, the University of Szeged, the Bay Zoltan Foundation, the Cereal Research Non-Profit Company, local government and a regional holding. Thus, although the Consortium is legally a private firm that has not been supported by a specific policy instrument or funding[7] (and therefore is not included as such in this report), most of the investors are public. The consortium focuses on proteomics, genomics and environmental biotechnology (PCA, 2004).

Institute of Experimental Medicine

The Institute of Experimental Medicine (Kísérleti Orvostudományi Kutatóintézet) focuses on brain function, from molecular and cellular to systems and behavioural analyses. Its main biotechnology activity is the 'Medical Gene Technological Unit', which includes a laboratory of transgenics and a transgenic facility. This Unit was created recently with funding from the Biotechnology 2000 programme and the National Research and Development Programme totalling 1 500M HUF (6.0M EUR), of which 900M HUF (3.6M EUR) was for biotechnology.[8] The stable block grants for the Institute of Experimental Medicine from the HAS represent about 70M HUF per year (less than 0.3M EUR).

2.2.5 Bay Zoltan Foundation for Applied Research

The Institute for Biotechnology of the Bay Zoltan Foundation for Applied Research (BAYBIO) was the first institute to be established by this government Foundation in 1993. It is part of the Szeged Consortium of biotechnology. The main line of research since 2000 is the bioremediation of polluted waters and soils, an area of environmental biotechnology. Between 2002 and 2005 it received block grants to a value of 762M HUF (3.1M EUR).

[7] It has not even been supported by the 2005 bioincubator call of the NKTH (see section 0 for details).
[8] This funding is not counted in this section, but included in the programmes mentioned in section 0.

2.3 Policy-directed funding for biotechnology research and commercialisation

Since 2003 most policy-directed funding for biotechnology has been managed by the NKTH/KPI. The most important programmes are generic but include biotechnology as one of their priorities. Thus far, there are no relevant policy instruments at the regional level. This section also includes policy-directed funding prior to 2003, before the reform of the STI system.

Table 0.2 National public policy-directed biotechnology stimulating instruments in 2002-2005

Instrument	Funding organisation	Budget M HUF	Budget M EUR	% of total	Use of DF/SF
National					
Generic					
National R&D	NKTH	11,446	45.8	55.1%	n.a.
Applied R&D	NKTH	4,907	19.6	23.6%	Yes
Hungary Enterprise Promotion	Min. Economy	296	1.2	1.4%	n.a.
Subtotal Generic		**16,649**	**66.6**	**80.1%**	
Biotech specific					
Biotechnology 2000	Min. Education	1,500	6.0	7.2%	n.a.
Innovation Clusters	NKTH	1,625	6.5	7.8%	n.a.
Bioincubators	NKTH	1,000	4.0	4.8%	n.a.
Subtotal Specific		**4,125**	**16.5**	**19.9%**	
Total		**20,774**	**83.1**	**100.0%**	

Source: BioPolis Research

2.3.1 Biotechnology 2000 Programme

On the basis of a national report on biotechnology conducted in 1998-99, in order to define the research and development priorities within this sector, the Hungarian government launched in 1999 the *Biotechnology 2000 programme* (Biotechnology 2000 Programme, 2003), which lasted until 2002. The aim of the programme was to enhance the knowledge base for research and development in the field of biotechnology, to increase the competitiveness of companies and to develop new methods and services. The programme gave subsidies to successful applicants to encourage the introduction of newly developed, advanced, high-value and competitive biotechnology products.

Biotechnology 2000 set the following priority areas: food safety, phytotechnology, bioconversion, bioremediation, application of biotechnology to environmental issues, biotechnology in animal breeding, biomedicine, biopharmacology, and bionformatics-genomics. Between 2000 and 2002, 4 500M HUF (18M EUR) were spent on this programme, yielding an approximate expenditure of 1 500 HUF (6M EUR) in 2002.

2.3.2 National Research and Development Programme (NKFP)

The National Research and Development Programmes (Nemzeti Kutatási és Fejlesztési Programok, NKFP) were launched in 2000 and renamed Anyos Jedlik Programme in 2005. Biotechnology has been one of the thematic areas specifically supported in recent years. Currently there are six thematic fields, one of them being *Life sciences*, *Agri-food industries & Biotechnology.* Thus, although it is a generic programme run on a competitive basis, NKFP has a clear biotechnology focus.

Given that the goal of the NKFP is to achieve long term economic development, the projects funded are carried out by consortia that can be composed of enterprises, PROs or other non-profit organisations, with industry-led consortia given priority. It expected to fund 30 to 50 projects in 2005, costing about 250HUF (1M EUR) over a three-year project.

The total budget of the NKFP was 10 000M HUF (40M EUR) in 2002; 7 600M HUF (30.4M EUR) in 2003, 15 000M HUF (60M EUR) in 2004 and 11 000M HUF (44M EUR) in 2005. Funding for biotechnology has increased from 1 040M HUF (4.2M EUR) in 2002 to 5 774M HUF (23.1M EUR) in 2004 and 4 632M HUF (18.5M EUR) in 2005. No biotechnology funding was allocated in 2003. In terms of policy goals, the NKFP has focused on the promotion of basic (30%) and applied (70%) research. Half the expenditure has been given to health biotechnology related projects, with the remainder evenly spread among other application areas.

2.3.3 Applied R&D

The Applied R&D Programme (Alkamazott K+F) of the NKTH fosters collaborative research between academia and industry in order to enhance economic competitiveness or prevent environmental pollution. In the period considered, there was only a call in 2004, with biotechnology being granted 4 907M HUF (19.6M EUR), almost one third of the total. Among the biotechnology projects, one third was for industrial and the remainder for plant, animal, food and health biotechnology in similar proportions. Projects run for 3 years and in the case of firms, they have to contribute 40% of the budget (65% for pre-market development).

2.3.3 Innovation Cluster Programme

The Asboth Oszkar programme of the NKTH aims to set up of technology platforms and innovation clusters in the following high-tech industries: (i) health, (ii) biotechnology, (iii) agriculture-based renewable energy-resources. The funding is for a maximum of 48 months. The applicants are consortia formed by businesses, universities and other PROs as well as industrial lobbying bodies active in innovation.

The total budget is 6 500M HUF (about 26M EUR) for 4 years. Although the call was not biotechnology-specific it appears that all the clusters have been awarded to biotechnology-related areas, including bioenergetic innovation, therapeutic vaccines, and multidrug resistance reversal drug (treatment for cancer) and covers health (65%) and industrial (35%) biotechnology.

The rate of support is 100% for PROs and basic research in industry, 60% for applied research, but only 35% for experimental development.

2.3.5 Bioincubator programme

The Bioincubator programme launched by the NKTH in 2005 is a competitive call supporting the creation of incubators for SME enterprises in biotechnology. The investment goes to infrastructure and equipment for the creation of the incubator during a 2-year period with the commitment to provide services to assist entrepreneurship and innovation activities for a period of at least five years. It awarded 1 000M HUF (about 4M EUR) for two incubators in 2005, one in Budapest and another in Debrecen.

2.3.6 Hungarian Enterprise Promotion Agency

The Hungarian Enterprise Promotion Agency (Magyar Vállalkozásfejlesztési Kht, MVf Kht), under the Ministry of Economy and Transport, promotes the licensing of activities and commercialisation of Hungarian inventions abroad. It supports patent filing and also foreign market penetration of Hungarian inventions. It aims to help Hungarian inventors, who cannot generally cover the costs of obtaining and maintaining a licence abroad, so as to realise profits generated by their invention. It had a budget of 592M HUF (2.4M EUR) between 2002-2005, of which 296M HUF (1.2M EUR) were used in the biotechnology area.

2.4 Charities

No charities were found to play a significant role in biotechnology in Hungary.

2.5 Participation in 6th FP and use of development funds

Table 0.3 Involvement of Hungary in biotechnology/life sciences programmes of the 6th Framework Programme

Sixth Framework Programme[1] Thematic priority	**Participation as project manager in # of projects (% of total)**	Participations as member of the project team (% of total)
1. Life sciences, genomics and biotechnology for health	7(0.9)	107 (1.3)
2. Nanotechnologies, section bionanotechnology	0 (0)	0 (0)
5. Food quality and safety	3 (3.3)	42 (2.6)

[1] First and second call, all types of projects.
Source: BioPolis Research

The overall participation of Hungary in the 6th FP is lower than its demographic weight in the EU (2.2%). It is worth noticing, however, that its participation is higher in relation to food quality and safety, areas relevant to maintaining Hungarian competitiveness in agriculture and food

3. Performance indicators

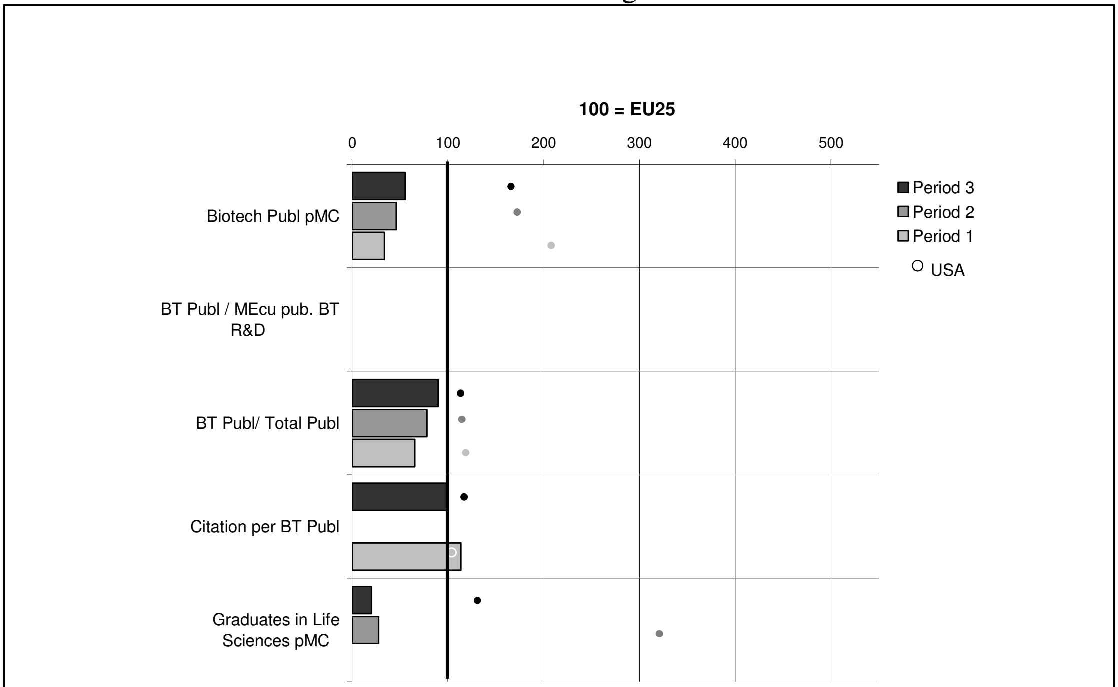
3.1 Introduction

This section analyses the performance of the Hungarian biotechnology innovation system for two or three time periods (depending on data availability) as shown by a range of indicators for scientific and commercialisation performance[9]. Each time period includes several years, to avoid capturing erratic trends. National trends are benchmarked against the performance of the EU-25 Member States and the US. For each area, data are shown for a number of different indicators for Hungary, the USA and EU25. The values of EU25 have been chosen as reference in each indicator. The absolute figures that are used to calculate the values for the indicators presented and the sources for the data can be found in Annex 5. In principle, for each indicator data are presented for three periods. The periods chosen can vary considerably between the indicators; table A.5.1 presents for each indicator the specific years for each period.

3.2 Performance in creating a knowledge base and supporting the availability of human resources

The number of biotechnology publications by Hungary has increased rapidly in the last ten years, probably owing to a switch in publication patterns towards predominantly English-language journals included in the ISI database. However, the number of graduates in the life sciences is surprisingly low.

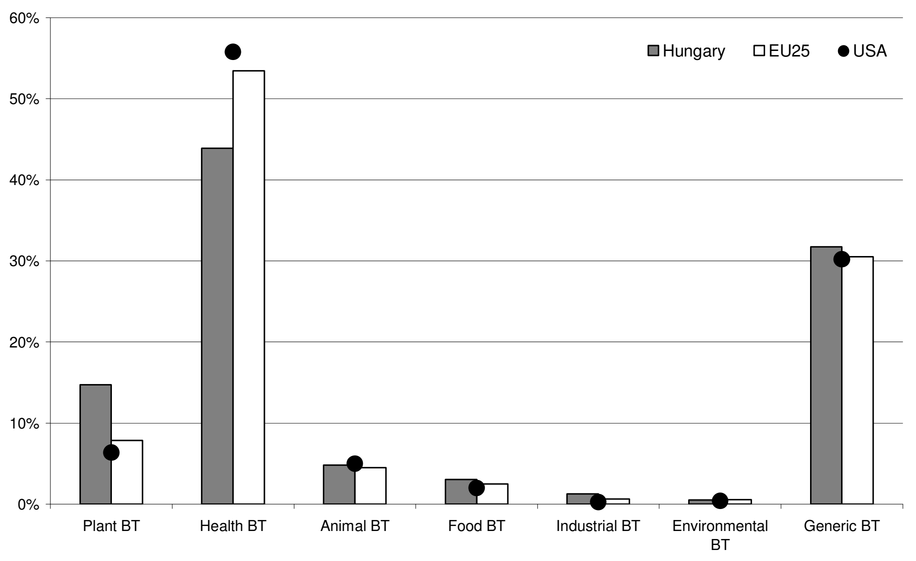
Chart 0.1. Performance Indicators. The knowledge base



Source: BioPolis Research

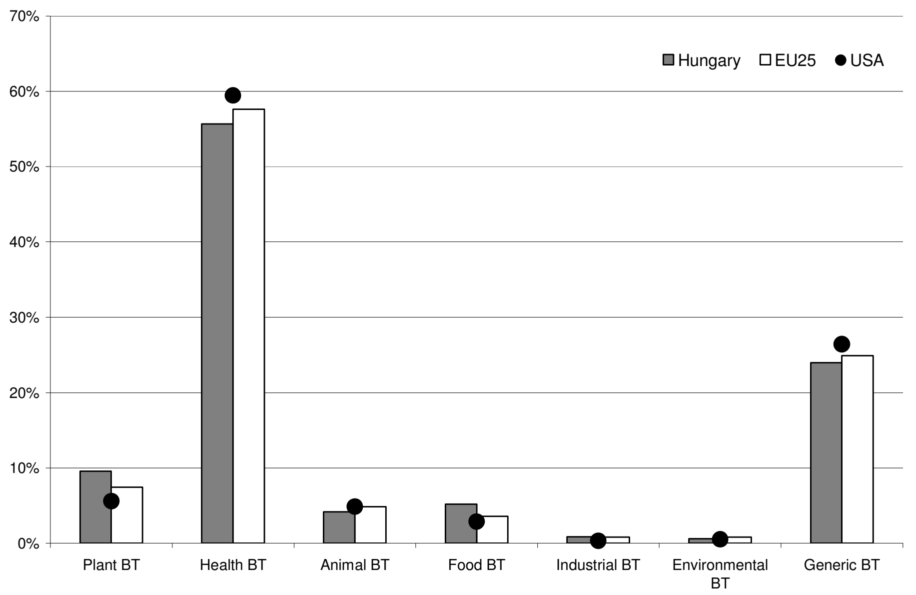
[9] For a detailed discussion on the strengths and limitations of science and technology indicators see Moed et al (2004).

Chart 0.2.1 Share of biotechnology subfields in 1994-96



Source: BioPolis Research

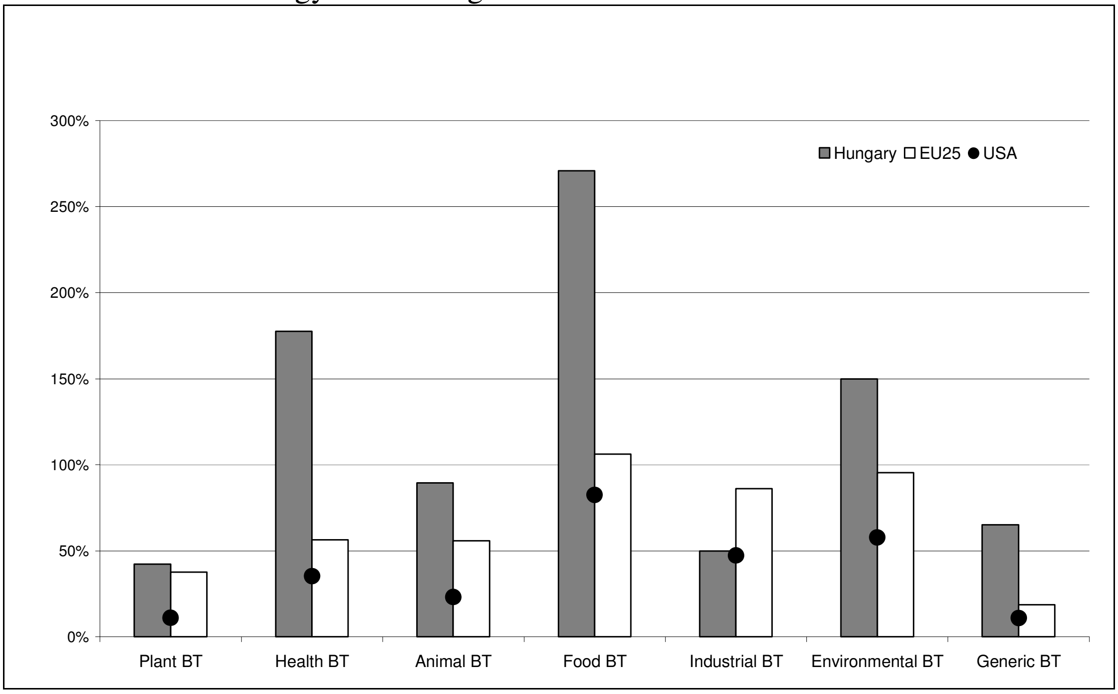
Chart 3.2.2 Share of biotechnology subfields in 2002-04



Source: BioPolis Research

Charts 3.2.1 and 3.2.2 show that Hungarian areas of publication fall neatly into the EU and US averages.

Chart 0.3. Biotechnology subfields: growth rates between 1994-1996 and 2002-2004.



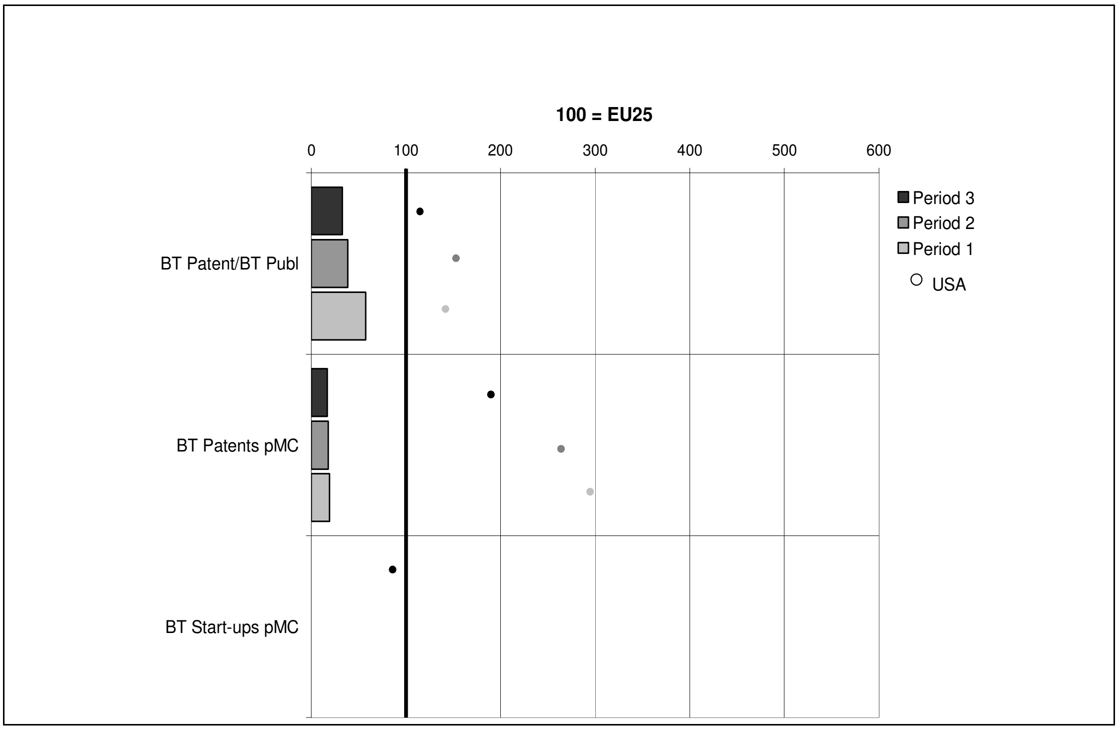
Source: BioPolis Research

Chart 3.3 shows that the growth rate of publications has been faster than the EU-25 for most biotechnology fields, and is particularly fast in health and food.

3.3 Performance in knowledge transmission and application

Knowledge transmission indicators have not grown as quickly as publication indicators. In spite a substantial increase in absolute terms, patents per million capita in Hungary remained at a very low level in comparison to the EU average. This could result from limited policies to promote technology transfer. Recent efforts to encourage public-private research links may improve future performance.

Chart 0.4. Performance indicators. Knowledge transmission and application.



Source: BioPolis Research

The absence of data in Chart 3.4 on biotech companies in Hungary is caused by absence of comparable official biotechnology statistics, based on a common definition, for European countries. The only comparative data on biotech firms in Europe is provided by Ernst & Young reports which do not cover Hungary. However, the Hungarian Biotech Association (2005) estimates there are 100 firms in the country, of which 30 are intensely biotech-focused (see section 1.1).

The indicators used by this study for biotechnology commercialisation[10] or market conditions[11] do not record any achievements for Hungary. However, it is generally acknowledged that Hungary has the largest biotechnology sector in central and eastern Europe, although it is still in an embryonic phase.

[10] Measured by number of biotechnology companies pMC (Ernst & Young data), biotech Initial Public Offerings pMC and Venture Capital in € pC
[11] Measured by field trials and approved biomedicines

4. Conclusions

4.1 Introduction

Since 2000 biotechnology has been a clearly priority within S&T policies in Hungary, not just in rhetoric as is sometimes the case in countries with low R&D expenditure (e.g. Italy), but with financial support either from specific programmes or generic programmes that include biotechnology as one a target area. With the new S&T governance system in place since 2004, policies appear to be more focused on technology transfer. This can be seen from the new instruments developed by NKTH that are more geared to applied research and open to both PROs and firms. One third of the funding goes to public research institutions and response mode grants. Most of the remainder goes to generic policies.

4.2 Public funding of biotechnology through policy instruments

Table 0.1 shows the funding allocated per year between 2002 and 2005 to the different policy modes. Funding for biotechnology in Hungary is conducted through policy-directed instruments, with generic instruments alone accounting for more than half the total funding. Non-directed instruments are relatively small: one fifth of the funding is for block grants and about one tenth for response mode. Overall, it is possible to trace some tendency towards increasing policy-directed funding and slightly decreasing block grant funding which is consistent with the new R&D policies. The sharp decrease in policy-directed funding in 2003 was probably due to the change in the R&D governance system that year, which was compensated for in 2004.

Table 0.1 Public funding of biotechnology through non-policy-directed and policy-directed instruments in the period 2002-2005 (in M EUR)

	2002	2003	2004	2005	Total
RESEARCH					
1. *Non-policy-directed*					
Public Research Institutes	5.6	5.6	5.6	5.5	22.3
Response Mode	2.8	2.6	2.3	2.4	10.0
Total	8.4	8.2	7.9	7.9	**32.3**
2a. *Policy-directed Generic*					
National	4.2	0.0	42.7	16.5	**63.4**
2b. *Policy-directed Biotech-specific*					
National	6.0	0.0	0.0	4.0	**10.0**
COMMERCIALISATION[12]					
1a. *Policy-directed Generic*					
National	0.4	0.4	0.2	6.6	**7.7**
OTHER					
1a. *Policy-directed Generic*					
National	-	-	-	2.0	**2.0**
GRAND TOTALS	18.9	8.6	50.8	37.1	**115.4**

[12] The total for commercialisation policies is lower than that shown in Table 4.3 for commercialisation policy goals 5,6,7 and 9 because it reflects those instruments that were solely or mainly oriented towards commercialisation. However, many of policy-directed research instruments had many policy goals, including some minor commercialisation activities.

Source: BioPolis Research

4.3 Specific features of the instruments

Table 0.2 displays the recipients of the policy-directed funding for biotechnology. In accordance with the idea that Hungary needs a stronger linkage between academia and research, all policy-directed funding targets both PROs and firms.

Table 0.2 Participants/recipients and co-financing requirements of policy-directed programs that fund biotech activities in the period 2002-2005

Instrument	**Funding agency**	**Participants/Recipients**			**Financial contribution required (%)**	
		PRO's	**SME's**	**LFs**	**Recipients**	**Other Public authorities**
National						
Generic						
National R&D Programme	NKTH	√	√	√		
Applied R&D	NKTH	√	√	√	√	
Hungary Enterprise Promotion	Min. Econ.	√	√	√	√	
Biotech specific						
Biotechnology 2000	Min. Edu.	√	√	√		
Innovation Clusters	NKTH	√	√	√		
Bioincubators	NKTH	√	√	√		

Legend: PROs Public Research Organisation. SME: Small and Medium Enterprise. LF: Large Firm.
Source: BioPolis Research

4.4 Policy goals

Table 4.3 presents the coverage and funding allocated to the different policy goals through the mix of policy-directed instruments. The majority of the policy-directed funding is used for applied research, followed by a high level of biotechnology research. Knowledge transmission from academia into industry and adoption of biotechnology in industrial applications are the only other goals with substantial support. Technology transfer goals are relatively more prominent in biotechnology specific policies.

Table 4.3 Coverage of policy goals and funding by goal by policy-directed instruments in the period 2002-2005 (in M EUR)

	Policy goals									
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
National										
Generic										
National R&D Programme	√	√			√	√				
Applied R&D		√			√	√				√
Hungary Enterprise Promotion					√					
Subtotal Generic	**13.7**	**43.8**	**0.0**	**0.0**	**5.1**	**2.0**	**0.0**	**0.0**	**0.0**	**2.0**

	Policy goals									
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Biotech specific										
Biotechnology 2000		√								
Innovation Clusters		√	√	√	√	√	√		√	
Bioincubators		√			√	√	√			
Subtotal Specific	**0.0**	**8.8**	**1.3**	**0.7**	**1.6**	**1.6**	**1.3**	**0.0**	**1.3**	**0.0**
Grand Total	**13.7**	**52.6**	**1.3**	**0.7**	**6.7**	**3.6**	**1.3**	**0.0**	**1.3**	**2.0**

The figures in this table should be read as merely indicative of the relative expenditure allocated to the various policy goals. Since many goals overlap in one instrument, the split of expenditure between goals is only a rough estimate and/or informed guess. On the other hand, it is important to bear in mind that instruments of some goals (e.g. social acceptance programmes) may require less expenditure than others even if they are set as a policy priority.

* Legend
1 = High level of biotechnology research
2 = High level of industry-oriented (and applied) research
3 = Knowledge flow and collaboration among scientific disciplines
4 = Availability of human resources
5 = Transmission of knowledge from academia to industry and its application to industrial resources
6 = The adoption of biotechnology for new industrial applications
7 = Firm creation
8 = Social acceptance of biotechnology
9 = Business investment in R&D
10 = Bio-safety, risk assessment

Source: BioPolis Research

4.5 Biotech research application areas

Table 4.4 shows the applications areas covered by the policy-directed instruments. As in most other countries, health biotechnology receives the most support. The high percentage awarded to food and plant technology highlights the importance given to agriculture-related biotechnology in a country where the agriculture, hunting, forestry and fishing economic sector account for 6.6% of the GDP (EUROSTAT, 2004).

Table 0.4 Coverage of biotech application areas and funding through policy-directed instruments by biotech application research area in the period 2002-2005 (in M EUR)

	Biotech application areas								
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
National									
Generic									
National R&D Programme	√	√	√	√	√	√		√	
Applied R&D	√	√		√	√	√			
Hungary Enterprise Promotion									√
Subtotal Generic	**8.4**	**6.7**	**4.7**	**27.1**	**8.2**	**9.0**	**0.0**	**1.3**	**1.2**
Biotech specific									
Biotechnology 2000	√	√	√	√	√	√		√	
Innovation Clusters				√		√			
Bioincubators									√
Subtotal Specific	**0.7**	**0.2**	**0.7**	**7.2**	**0.5**	**3.0**	**0.0**	**0.2**	**4.0**

	Biotech application areas								
	1*	2	3	4	5	6	7	8	9
Grand Total	**9.1**	**7.0**	**5.3**	**34.3**	**8.7**	**12.0**	**0.0**	**1.5**	**5.2**

* Legend:
1 = Plant biotechnology
2 = Animal biotechnology
3 = Environmental biotechnology
4 = Health biotechnology
5 = Food biotechnology
6 = Industrial biotechnology
7 = Basic biotechnology
8 = Ethical, legal, social aspects of biotechnology
9 = General (funding covers all areas or is not area-specific)

Source: BioPolis Research

4.6 Stimulation of biotech activities through the instruments

In terms of biotechnology activities, we can see again that generic instruments focus more on basic and applied research, whereas biotechnology specific instruments tend to cover activities for technological transfer.

Table 0.5 Coverage and funding of biotech activities in the period 2002-2005 through policy-directed instruments (in M EUR)

	Biotech activities										
	1*	2	4	7	8	9	11	12	13	14	15
National											
Generic											
National R&D Programme	√	√									
Applied R&D	√	√			√						
Hungary Enterprise Promotion								√			
Biotech specific											
Biotechnology 2000	√	√									
Innovation Clusters			√	√		√	√	√	√	√	
Bioincubators								√	√	√	√

1 Basic research
2 Applied research orgasnisations
3 Centres of excellence
4 Research network
5 Mobility of researchers among disciplines
6 Biotechnology training
7 Mobility of researchers between academia and industry
8 Collaborative research between industry and public research organisations
9 Set up research institute/centre of industrial interest
10 Technology transfer office
11 Science and technology park
12 Protection of IPR in public research
13 Financial support for start-ups
14 Non-financial support for start-ups
15 Creation of incubators
16 Awareness of biotech by companies not yet active in it.
17 Grants for industrial research
18 Other incentives for business investment
19 Support for public discourse activities

Source: BioPolis Research

5. Future developments

Given that the Hungarian R&D governance system underwent a major reform in 2003 which was only fully implemented after 2004 (as shown by the decrease of funding in 2003, compensated for in the following year), no major changes can be expected in the short to medium-term.

In line with the recommendations of the Hungarian Biotechnology Association (2005), the NKTH might aim to pursue a more systemic and well-coordinated approach in the linkages between industry and academia. In terms of specific instruments, subsidies to reverse the brain drain, especially of industrial researchers, and various support measures for start-ups, including public seed and venture capital, are seen as elements to be improved in the current policy mix.

The new funding system, derived directly from taxing industrial activities may provide more funds and focus more on technology transfer activities, as shown for example in the new measures that commenced in March 2006[13]. These changes will hardly be radical, since STI policy is not seen as a priority in Hungary according to experts (Havas, 2004; 2005). However, these measures could result in higher patenting activity over the course of the next few years.

[13] See *Innovation and Innovation Policy in Hungary* at Trendchart homepage: http://trendchart.cordis.lu/
accessed 27-05-06.

Annex 1 List of tables

Annex 2 List of figures and charts

Annex 3 List of contact persons

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Jozsef Mandel	Medical Research Council
Ferenc Nagy	Agricultural Biotechnology Centre

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Annex 5 Performance

Introduction

This Annex includes the data that was used to develop the indicators discussed in Chapter 3. Chapter 3 describes four sets of indicators used to measure the performance of the national biotechnology system of innovation, in terms of:

1. Creating a knowledge base and supporting the availability of human resources: Charts 3.1, 3.2.1, 3.2.2 and 3.3
2. Knowledge transmission and application: Chart 3.4
3. Industrial development: Chart 3.5
4. Market conditions: Chart 3.6

The indicators aim to capture trends in performance and compare the national situation with that of a reference region. To present trends in performance, most indicators are provided for three or two different time periods, depending on data availability. To avoid capturing erratic trends, each time period includes several years, again depending on data availability. Information on which years have been captured for each period and comments concerning the index used can be found in the last two columns of Table A5.1.

Table A5.1. Performance indicators, charts, comments and time periods

	Indicator	Chart	Comments	Time periods
Ind. 1	Biotech publications per million capita (pMC)	3.1	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996, (2) 1998-2000, (3) 2002-2004
Ind. 2	Biotech publications per BT public R&D expenditure	3.1	Only for those countries included in the inventory Index: Reference Region EU25 =100	BT Pub. 2002-2004 / Total Pub. Expenditure 1994-1998 M Ecu
Ind. 3	BT patents / BT publications	3.4	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 4	BT publications / Total pub.	3.1	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2002-2004
Ind. 5	Citations to BT publications	3.1	Index: Reference Region EU25 =100 and US data for comparison Small country effect	(1) 1994-1998 (3) 2000-2004
Ind. 6	Graduates in life sciences pMC	3.1	Index: Reference Region EU17 =100	(2) 1998 (3) 2002

	Indicator	Chart	Comments	Time periods
			and US data for comparison	
Ind. 7	BT publications in subfields, as % of total BT publications	3.2.1	Data in % EU25 and US data for comparison	1994-1996
		3.2.2		2002-2004
Ind. 8	Growth rate of BT publications in subfields	3.3	EU25 and US data for comparison Small field effect	Growth rate between 1994-96 (period 1) and 2002-04 (period 3)
Ind. 9	Biotech patent applications pMC	3.4	EU25 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 10	Number of biotechnology companies pMC	3.5	European (data available) and US data for comparison	(2) 2001 (3) 2004
Ind. 11	Number of biotech start-ups pMC	3.4	European (data available) and US data for comparison	(3) 2001-2003 (only one period)
Ind. 12	Number of biotech IPOs pMC	3.5	European (data available) and US data for comparison	(3) 2002-2005
Ind. 13	Venture capital in € pC	3.5	European (data available) and US data for comparison	(2) 2002 (3) 2004
Ind. 14	BT acceptance index	No Chart - Discussed in text of chapter 3	Source: BT Policy Benchmarking 2005. The biotechnology acceptance index is a composite index and draws on questions Q.12, Q.13.1 and Q14.01 and Q14.09 of the Eurobarometer 58.0	2002
Ind. 15	Eurobarometer 225	No Chart - discussed in text of chapter 3	See section 3.3 and sections 3.4.1, 3.4.2, and 3.4.3 of the Special Eurobarometer 225[14]	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for comparison	1995-2002
Ind. 17	Field trials	3.6	Source: Biotechnology Innovation Scoreboard 2002 Index: Reference Region EU15 =100	1996-2001

14 http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf

	Indicator	Chart	Comments	Time periods
			US data for comparison	

The following methodological issues are related to some of the indicators:

- Indicator 3 (Patent BT / Publications BT) replaces the indicator *BT publications basic research/ BT publications applied research*. Results of the EPOHITE project have shown that the original indicator does not differ significantly in the case of old EU member states. This might be the result of methodological problems associated with the indicator, since the definition of basic and applied research is based on a journal classification made by SCI. The explanatory power of this indicator is therefore questionable.
- To calculate the citation rate first the publications for the period 1994-1996 (set 1) were searched and all the publications in 1994-1998 that cited any publications in set 1 (set 2). Citation rate has been calculated by (number of publications in set 2) / (number of publications in set 1). However, many of the articles in set 2 cited not only one article in set 1 and these duplicated citations are not taken into account in our calculation. For example, if there are 2 articles in set 1 and they each has one citation but cited by the same article, there is only 1 article in set 2. The citation rate for the 2 articles in set 1 is 0.5 instead of 1. This depreciation is more obvious in countries with more publications such as USA and EU25 since the possibility to cite multiple articles in set 1 is large. Accordingly the citation rates of USA and EU25 are a bit underestimated.
- The indicator 'Citations to BT publications' seems to have a 'small country effect' bias. Small countries show a relatively large citation rate. A possible explanation might be that, as far as number of publications is concerned, larger countries usually have a larger 'middle quality' share of research results (in terms of impact) while smaller countries usually have a 'low in number but good in quality' publications impact. This can be explained by the concentration of resources allocated to selected research groups in small countries. Small countries may concentrate resources in outstanding research units. Accordingly, fewer publications may have greater impact.
- The EU25=100 index is applicable in the indicator 'Graduates in life sciences pMC' since data was only available for 17 member states.
- For those countries starting from zero in period 1 (1994/1996), the growth rate of BT publications in subfields was set to 100% if the number of publications in period 3 (2002-2004) was larger than zero. On the other hand, if the country reduced the number of publications to zero in the period 2002-2004, the growth rate was -100%.Given that a relative growth rate was used, small fields tended to have relatively larger growth rates.
- To benchmark each country we chose EU25 (or EU15 if data was not fully available) as the reference region. In those cases where data for EU25 or EU15 were not available, the reference corresponds to the sum of national data available. Moreover, to ease the presentation of indicators with different scales in a given chart, an index value was used.

Raw data for the Figures in chapter 3

Raw data for Chart 3.1. BT publications per million capita (pMC): absolute and indexed values

	BT publications			Population (million)		
	94-96	**98-00**	**02-04**	**1996**	**2000**	**2004**
EU25	97521	128716	145646	447	451	457
Hungary	757	1347	1791	10	10	10
USA	119802	135508	154402	264	276	292
	BT publications/pMC			**Index EU25=100**		
	94-96	**98-00**	**02-04**	**94-96**	**98-00**	**02-04**
EU25	218	285	319	100	100	100
Hungary	73	132	177	34	46	56
USA	454	492	529	208	172	166

Source: BIOPOLIS research
Publication data: Science Citation Index (through online database vendor STN International)
Population data: EUROSTAT and OECD

Raw data for Chart 3.1. BT publications per BT public R&D expenditure

	BT Publi-cations	Non-policy-directed funding	Policy-directed funding		Total public spending on BT (Mecu)	BT publications/ Mecu BT public expenditure	Index
			Biotech specific	**Generic**			
	2002-2004	**1994-1998**	**1994-1998**	**1994-1998**	**1994-1998**	**2002-2004/ 1994-1998**	
EU25	145646				n.a.		
Hungary	1791				n.a.		n.a.
USA	154402				n.a.		n.a.

Source: BIOPOLIS research
Publication data: Science Citation Index (through online database vendor STN International)
BT public expenditures in research: Inventory Project, Table 3.4 Executive Summary

Raw data for Chart 3.1. BT publications, as share of total publications: absolute and indexed values

	BT publications			Total publications		
	94-96	**98-00**	**02-04**	**94-96**	**98-00**	**02-04**
EU25	97521	128716	145646	860652	1024327	1117392
Hungary	757	1347	1791	10187	13742	15258
USA	119802	135508	154402	889506	941191	1045894
	Share of BT publication			**Index EU25=100**		
	94-96	**98-00**	**02-04**	**94-96**	**98-00**	**02-04**
EU25	11%	13%	13%	100	100	100
Hungary	7%	10%	12%	66	78	90

USA	13%	14%	15%	119	115	113

Source: BIOPOLIS research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.1. Citations to BT publications: absolute and indexed values

	Citations to BT publications		Index EU25=100	
	94-98	**00-04**	**94-98**	**00-04**
EU25	6.14	7].28	100	100
Hungary	6.98	7.18	114	99
USA	6.39	8.54	104	117

Source: BIOPOLIS research
Citations data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.1. Graduates in life sciences pMC: absolute and indexed values

	Graduates in Life Sciences		Population (million)	
	1998 / 1999	**2002**	**1998 / 1999**	**2002**
EU17	46,859**	81,316	552**	431
Hungary	244*	393*	10*	10*
USA	75,253*	70,950	276*	288
	Graduates pMC		**Index EU17=100**	
	1998 / 1999	**2002**	**1998 / 1999**	**2002**
EU17	85**	189	100	100
Hungary	24*	39	28	20
USA	273*	246	321	131

Index EU17=100 for 1998 is EU-16, because for Portugal no data available
* data for 1998; ** data for 1999
Source: BIOPOLIS Research
Graduates data OECD Education Database
Population source for US is the OECD

Raw data for Chart 3.2.1. BT publications in subfields, as share of total number of BT publications for the period 1994-1996

	1994-1996							
	Total	**Plant**	**Health**	**Animal**	**Food**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Hungary	100%	15%	44%	5%	3%	1%	1%	32%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data forChart 3.2.2. BT publications in subfields, as share of total number of BT publications for the period 2002-2004

	2002-2004							
	Total	Plant	Health	Animal	Food	Indus-trial	Environ-mental	Generic
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Hungary	100%	10%	56%	4%	5%	1%	1%	24%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.2.1 BT publications in subfields for the period 1994-1996

	1994-1996							
	Total	Plant	Health	Animal	Food	Indus-trial	Environ-mental	Generic
EU25	97217	7629	51944	4375	2434	624	576	29635
Hungary	788	116	346	38	24	10	4	250
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.2.2 BT publications in subfields for the period 2002-2004

	2002-2004							
	Total	Plant	Health	Animal	Food	Indus-trial	Environ-mental	Generic
EU25	140984	10494	81220	6821	5017	1162	1126	35144
Hungary	1724	165	960	72	89	15	10	413
USA	141680	7910	84234	6872	4070	436	724	37434

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.3. Growth rate of BT publications in subfields 1994-96 and 2002-04

	1994-1996/2002-2004						
	Plant	Health	Animal	Food	Industrial	Environ-mental	Generic
EU25	38%	56%	56%	106%	86%	95%	19%
Hungary	42%	177%	89%	271%	50%	150%	65%
USA	11%	35%	23%	83%	47%	58%	11%

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.4. BT Patents pMC: absolute and indexed values

	BT Patents			Population (million)		
	94-96	**98-00**	**01-03**	**1996**	**2000**	**2003**
EU25	4924	8921	10119	447	451	455
Hungary	22	36	38	10	10	10
USA	8590	14396	12348	264	276	292*
	BT Patents/pMC			**Index**		
	94-96	**98-00**	**01-03**	**94-96**	**98-00**	**01-03**
EU25	11	20	22	100	100	100
Hungary	2	4	4	19	18	17
USA	33	52	42	295	264	190

Source: BIOPOLIS Research
Publication data: Science Citation Index (through online database vendor STN International)
Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

Raw data for Chart 3.4. BT Patents per BT publications: absolute and indexed values

	BT patents			BT publications		
	94-96	**98-00**	**01-03**	**94-96**	**98-00**	**01-03**
EU25	4924	8921	10119	97521	128716	140219
Hungary	22	36	38	757	1347	1618
USA	8590	14396	12348	119802	135508	148853
	BT patents/ BT publications			**Index EU25=100**		
	94-96	**98-00**	**01-03**	**94-96**	**98-00**	**01-03**
EU25	0,05	0,07	0,07	100	100	100
Hungary	0.03	0.03	0.02	58	39	33
USA	0,07	0,11	0,08	142	153	115

Source: BIOPOLIS research
Publication data: Science Citation Index (through online database vendor STN International)
Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

Raw data for Number of BT IPO's pMC: absolute and indexed values

	BT IPO	Population T				
	2002-2005	**2002**	**2003**	**2004**	**2005**	**2002-2005**
EU Available	29	452927	454869	457154	461593	456636
Hungary	0	16105	16193	16258	16306	16215
USA	52	287941	290789	291685		290138

	IPO /pMC	Index
	2002-2005	**2002-2005**
EU Available	0.00	100
Hungary	0.00	0
USA	0.00	282

Note: EU Available is the result of the sum of available EU member states
Source: BIOPOLIS Research
IPO data: Ernst and Young 2002-20046 London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burril & Company

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Burril & Company	http://www.burrillandco.com/
EuropaBio	http://www.europabio.org/
EUROSTAT	http://epp.eurostat.cec.eu.int/
OECD Education Database	http://www.oecd.org/
OECD Statistics	http://www.oecd.org/
STN International	http://www.stn-international.de/
Questel Orbit	http://www.questel.orbit.com/index.htm

Annex 6 Abbreviations

BERD	Business Expenditure in R&D
ETT	Egészségügyi Tudományos Tanács (Medical Research Council)
FDI	Foreign Direct Investment
GERD	Gross Expenditure R&D
GVOP	Gazdasági Versenyképesség Operatív Programja (Economic Competitiveness Operative Programme)
HAS	Hungarian Academy of Sciences
HUF	Hungaria Forint (currency) (exchange rate: 1 EUR = 250 HUF)
KMUFA	Központi Müszaki Fejlesztési Alapprogram (Central Technological Development Programme)
KPI	Kutatás-fejlesztési Pályázati és Kutatáshasznosítási Iroda (Agency for Research Fund Management and Research Exploitation)
KTIT	Kutatasi es Technologiai Innovacios Tanacs (Research and Technological Innovation Council)
NFT	Nemzeti Fejlesztési Terv (National Development Plan)
NKFP	Nemzeti Kutatási és Fejlesztési Programok (National Research and Development Programme)
NKTH	Nemzeti Kutatási és Technologiai Hivatal (National Office for Research and Technology)
OMFB	Oeszagos Muszaki fejlesztesi Bizottsag (National Committee for Technological Development)
OTKA	Országos Tudományos Kutatasi Alapprogramok (Hungarian Scientific Research Fund Programme Committee)
PRO	Public Research Organisation
RTIF	Research and Technological Innovation Fund