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 Czech Republic

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Summary

The Czech Republic was formed on January 1, 1993, when Czechoslovakia was split into the Czech and Slovak republics. The Czech Republic joined NATO on March 12, 1999 and the European Union on May 1, 2004. With its 10.2 million inhabitants, it is one of the smaller countries in Europe. Its GDP is about 86 200M EUR. Although the inflation rate was very high, it has been under control for the last five years at a constant rate of about 2.5%. The Czech Republic's main economic sectors are metallurgy, machinery and equipment, motor vehicles, glass and armaments.

General expenditures on R&D (GERD) have been steadily rising since the foundation of the Czech Republic and represented 1.35% of the GDP in 2004, which is the second-highest share in the group of new EU member states (after Slovenia). About 43% of the GERD is funded by government, and about 53% by industry.

The pharmaceutical sector is the main sector in the Czech Republic where biotech companies are active. There are about 10 large and 15 smaller pharmaceutical companies and almost 20 small biotech companies in this sector that mainly produce monoclonal antibodies, antibody-based diagnostic kits and vaccines. There are also a few biotech companies that offer services in the environmental sector. With a few exceptions, biotech companies in the Czech Republic are rather small.

The Czech Republic has a rich history in biotechnology: Gregor Mendel, friar of the abbey of St. Thomas in Brno who studied the heritability of flower colour in the pea, discovered the principles of heredity in the 19th century. The country's R&D and innovation policy has a much shorter history. Molecular biology, biomedicine and biotechnologies encompass one of seven priority R&D sectors included in the Government Resolution amending the National Research and Development Policy of 2004.

The Czech Republic's performance in biotech research, in terms of biotechnology publications per million capita, increased over the period 1994-2004 (from index 46 in 1994-1996 to index 72 in 2002-2004), though it remained under the EU25 level (index = 100). The number of citations per biotechnology publication was lower than those for the USA and EU25, and slightly decreased over the ten–year period. Czech biotechnology publications can especially be found in the human health area, followed much further down by generic biotechnology. This picture has not really changed if one compares the figures for 1994-1996 and 2002-2004. The number of food biotechnology publications did nevertheless increase by 272% during the ten-year period, far exceeding health biotechnology publications (145%). The number of graduates in life sciences per million capita increased after 1998, but remained far below EU25 and USA levels.

Czech performance in the field of commercialisation in the same ten-year period was rather poor compared to EU25 and USA standards. Biotech patent applications per million capita dropped from index 18 in 1994-1996 to index 10 in 2002-2004. The Czech Republic had no biotechnology companies listed on the stock exchange and there was no

venture capital invested in Czech biotech firms in the period 1994-2004. Data on the number of Czech biotechnology companies pMC are not available in the source used for the performance analysis. Other sources indicate a total of 63 to 120 biotech companies. Indicators for performance in market conditions (approved biomedicines and field trials) do not record any achievements for the Czech Republic.

The funding of research in the Czech Republic is rather complicated, as there are 22 entities (mainly ministries) through which support of research, technology transfer, businesses, etc. is channelled from the state budget to public research organisations and companies. Part of this funding is categorised as so-called non-policy-directed funding, and includes the response mode type of funding of grant agencies (similar to research councils), such as the Grant Agency of the Czech Republic (Czech Science Foundation) and the Grant Academy of the Academy of Sciences. The Czech Republic has no programmes that specifically stimulate biotechnology activities; biotechnology is only funded through policy-directed generic instruments. The most relevant generic instruments that could be identified are the Research Centres Programme of the Ministry of Education, Youth and Sports, and a number of programmes of the Ministry of Industry and Trade. The most important are the Innovation Programme and Prosperity Programme. During the period 2002-2005, a budget of at least 38.7M EUR was spent on biotechnology research and commercialisation activities in the Czech Republic through these programmes and response mode programmes of a number of grant agencies.

The main goal of the policy-directed programmes is to stimulate a high-level of basic and applied research in biotechnology. The Research Centres Programme also deals with goals concerning the stimulation of interdisciplinary research and education. Other goals include technology transfer, adoption of biotechnology by industry and firm creation. Research centres in the biotechnology field that have been funded through the programme spend approximately half of the funds on basic research. Approximately 75% of the remaining half is spent on health biotechnology, and a much smaller portion on plant biotechnology and industrial biotechnology. The Innovation Programme has funded biotech projects in the fields of health and plant biotechnology, and a project on incubators. There are no data available about coverage of biotech areas in the other programmes.

Developments after 2005 are mainly a continuation of programmes initiated in the period 2002-2005. In 2006, other new research centres were set up. Most of the programmes of the Ministry of Industry and Trade (including those managed by CzechInvest) presented in this report are still running. In November 2006, the Academy of Science announced that it was planning to build a new biotechnology research centre in the field of diagnosis and treatment of serious diseases. The 71M EUR campus will be funded partly by structural and regional development funds and should open its doors at the beginning of 2011.

1. Introduction and background

1.1 General introduction

After Czechoslovakia regained its political independence from Soviet control in November 1989, through a peaceful 'Velvet Revolution', the country peacefully split into two on January 1, 1993, creating the independent Czech and Slovak Republics. The Czech Republic joined NATO on March 12, 1999 and the European Union on May 1, 2004.

The Czech Republic is a landlocked country, bordering Poland, Germany, Austria and Slovakia. With its 10.2 million inhabitants, it is one of the smaller countries in Europe. Its GDP was about 86 200M EUR and the inflation rate was very high (almost 10 %) in the second half of the 1990s. More recently, inflation has been under control at a constant rate of about 2.5% (Eurostat, 2004). The GDP composition by sector is 57.3% for services, 39.3% for industry and 3.4% for agriculture. The main economic sectors are metallurgy, machinery and equipment, motor vehicles, glass and armaments (CIA Factbook, 2005). Imports (57.24 billion EUR) were almost equal to exports (55.8 billion EUR) in 2004 (CIA Factbook, 2005). There is a slowly rising trend of privatisation of governmental-owned institutes, like the state-owned telecommunication firm.

General expenditures on R&D (GERD) have been steadily rising since the foundation of the Czech Republic and accounted for 1.35% of the GDP in 2004 (Eurostat, 2004). This is the second highest share among new EU member states (after Slovenia). About 43% of the GERD is funded by government and about 53% by industry. What remains is foreign funding (Eurostat, 2004).

The pharmaceutical sector is the main sector in the Czech Republic where biotech companies are active. There are about 10 large and 15 smaller pharmaceutical companies and almost 20 small biotech companies in this sector that mainly produce monoclonal antibodies, antibody-based diagnostic kits and vaccines. In addition, several firms conduct clinical testing of drugs. The biggest producer of immuno-analytical tools is Immunotech, which also has its own research laboratory. Then there are a few biotech companies that offer services in the environmental sector. With few exceptions, biotech companies in the Czech Republic are rather small (Vaněček, 2005). Other sources (including www.gate2biotech.com) mention 63 to 120 biotechnology companies in the Czech Republic. Most biotechnology companies are located in the Prague region (33.9%) and South Moravian region (18.9%). The most frequent activity is producer/manufacturer (75% of all companies). Dedicated companies and subsidiaries are also active in R&D. Diversified companies and business units are active in providing services.

The MediPark project of Masaryk University in Brno and the South Moravian region was initiated in 2005. It was financed by a European Investment Bank loan and by the university. The campus supports the creation of incubators and spin-off companies, as well as attracting foreign companies to the region in the fields of biology, medicine and chemistry. Next to the university building, the INBT incubator for biotechnology will be

available from 2007 (Euro/Biotech/News 2005). It includes a new campus and 15 hectares of space for hosting commercial partners. CzechInvest (2006) provides an overview of biotech activities in the regions and of major biotechnology companies in the Czech Republic. Well-established is the Technology Centre in Prague, which aims at promoting the commercialisation of university-based R&D and development of small life-science businesses.

More than 18.5% of all Czech graduates are in the life sciences sector (56 777 of in total 298 196).

1.2 Characteristics of national S&T and innovation system

In the period 1948-1990, the Czech Republic was shaped by two major macro-economic circumstances: on the one hand, the existence of high technology and intensity manufacturing branches (such as machinery, arms production and the chemical industry), on the other hand, relative openness to markets worldwide and intensive exports. This produced an educational system strong in engineering training and in-house R&D in manufacturing firms.

Until the beginning of the 1990s there was no specific governmental support for science, technology or innovation. This changed in the second half of the 1990s onwards, when a revision of technology strategies and economic reformation was developed. This essentially led to massive commercialisation, since this was believed to be the way to restructure the economy (European Commission, 2002). In 2000, the National R&D Policy of the Czech Republic specified the government's commitment to attain 0.7% of the GDP share of state budget expenditures on R&D by 2002. However, only 0.54% was realised. Subsequent policies aimed at a steady growth of this share, up to 0.6% in 2004, and an increase of 0.1% in the following years. This was necessary in order to become part of the European Research Area. Since that time, the Czech Republic has been actively trying to create and maintain an innovation, science and technology policy. This led in 2003 to its first policy document on R&D and innovation policy: 'Proposal to a National Research Programme'. The document is an explorative study specifying priority research directions and proposing a process for the implementation of the national research programme (European Commission, 2004).

In January 2004, the National Research and Development Policy for the years 2004-2008 was adopted by a government resolution. The resolution has three sections: the first describes the general priorities and objectives set for the period of the programme and how to evaluate these at the end of the programme; the second contains the long-term vision of the Czech Republic in terms of innovations and innovation policy; and the third describes the strategic instruments that will be used for research and development, as well as legal and informational aspects of those instruments (Ministry of Education, Youth and Sports, 2004).

The National R&D Policy defines priorities for the National Research Programme. This programme has five themes: life quality; information society; competitiveness in sustainable development; energy for the economy and society; and modern society and its transformation. It also has three cross-sectional programmes: human resources for research and development; integrated research and development; and regional and international cooperation in research and development. Each programme has a number of sub-programmes (Ministry of Education, Youth and Sports, 2004).

On June 1, 2005, seven so-called 'Long-term Principal Research Directions' were adopted by a government resolution, as an amendment to the National Research and Development Policy of 2004. They are: sustainable development, molecular biology, power sources, materials, competitive mechanical engineering, information society and security (European Commission, 2005).

The National Research Policy has set the stage for a shift towards a new policy model. In the old (post-) communist policy model, the government made the policy decisions and created the incentives, and was therefore the main driver of economic development. The new model that the Czech Republic is working towards is one where economic development is considered a collaborative process and involves more actors at all different levels, including government, companies, research institutes, educational institutes and networks, and collaboration organisations.

The National Innovation Strategy (adopted in March 2004) was the basis for the Innovation Concept for Industry and Business for 2005-2008 (also adopted in 2004). Centres proposed in the Innovation Concept are encourgaged to promote inter-branch and inter-departmental cooperation, relations with potential users of research results, international competition, support of qualitative changes in the equipment of perspective teams, effective utilisation of expensive and unique apparatuses and devices, as well as the hiring of young professionals (Ministry of Education, Youth and Sports, 2004).

In parallel, the National Innovation Strategy for the period 2005-2010 was formulated and adopted by the government on March 24, 2004.

The main strategic priorities of the National Innovation Strategy are:
- Infrastructure development for industrial research, development and innovation,
- Funding, development and cooperation of innovation companies, and
- Human Resources Development.

The basic framework for direct support of innovations through public funds is the Operational Programme for Industry and Enterprise (OPIE). This tool was announced publicly on May 12, 2004. The programme's funding is secured through the state budget and the European Regional Development Fund. Its major priorities are the development of the business environment and development of enterprise competitiveness. The programme includes eleven sub-programmes that support the development of the innovation environment in the Czech Republic. Two deal with direct business support (through subsidies) in innovation development: the Prosperity Programme and the

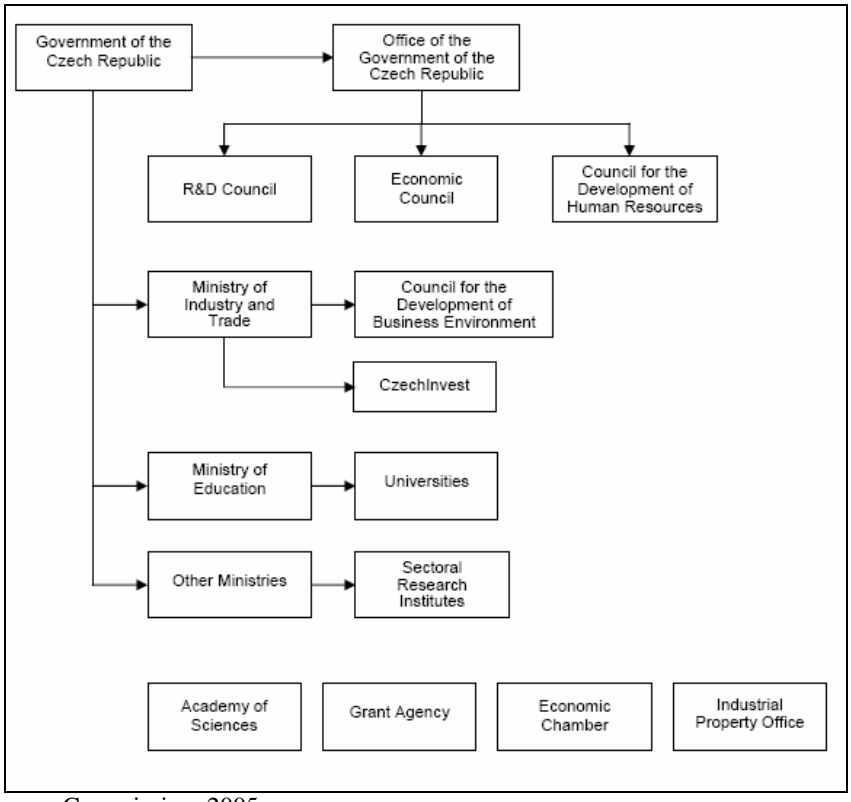
Innovation Programme. Other direct tools include loans and guarantees. An indirect tool is a law permitting companies to deduct their R&D expenses from their tax base (Ministry of Industry and Trade, 2004).

Main actors in the Czech innovation system

Figure 1.1 presents the R&D and Innovation governance system of the Czech Republic. The main government bodies that provide public funds for R&D, technology transfer and commercialisation are the Ministry of Education, Youth and Sports, the Ministry of Industry and Trade, the Academy of Science, and the Grant Agency.

An important advisory body in the field of science and technology policy is the Research and Development Council. These organisations and their role in RDI policy making and funding are presented in more detail in this section.

Figure 1.1 Organisational chart of the RDI governance system of the Czech Republic



Source: European Commission, 2005.

The Ministry of Education, Youth and Sports is responsible for formulating the National Research and Development Policy (and submitting it to the Government for approval) and for international cooperation in R&D. It administers university research programmes and other specific research programmes. The Ministry coordinates the National Research Programme and provides so-called 'institutional financing' of research proposals/plans submitted by both public and private legal entities, as opposed to project financing on the

basis of a research programme (European Commission, 2005; website of the Ministry of Education, Youth and Sports).

The Ministry of Industry and Trade is the central body of the government administration responsible for national industrial policy, trade policy, foreign economic policy, domestic trade and protection of consumer interests, foreign trade and supporting export industries, issues related to small- and medium-sized companies (except for regional business support and trading issues), technical standardisation, metrology and quality control, industrial research, and engineering and technology development (European Commission, 2005; website of the Ministry of Industry and Trade).

CzechInvest is an investment and business development agency of the Ministry of Industry and Trade. Its main objective is to advise and support existing and new entrepreneurs and foreign investors in the Czech Republic. The agency was established in 1992. Since then, it has contributed to attracting foreign investment and developing local companies through its services and development programmes. CzechInvest also promotes the Czech Republic abroad, and acts as an intermediary for small- and medium-sized enterprises implementing EU Structural Funds in the Czech Republic. CzechInvest is exclusively authorised to file applications for investment incentives to the competent governing bodies, and prepares draft offers to grant investment incentives. Its task is also to provide potential investors with current data and information on the business climate, investment environment and investment opportunities in the Czech Republic.

Other ministries with a role in R&D and Innovation policy making and funding are sectoral ministries, such as the Ministry of Agriculture, Ministry of Health and Ministry of the Environment.

The Research and Development Council (R&D Council) is an advisory body to the government of the Czech Republic in the field of R&D. Together with the Economic Council, the Council for the Development of Human Resources and a number of other councils, it falls directly under the Office of the Government of the Czech Republic. The latter provides professional and organisational support to the government and deals with innovation policy matters in two of its sections (Research, Development and Human Resources, and Economic Policy). The R&D Council was established by Act No. 13/2002 Coll. on Support to R&D from Public Funds on July 1, 2002. Under the new National Innovation Policy, its scope of activities extends to innovation issues.

The Council's responsibilities include (European Commission, 2005; website of the R&D Council, 2005):

- The preparation of R&D-related documents, including proposed long-term directions for Czech R&D, annual analyses and assessments of Czech R&D, mid-term prospects for support to R&D, proposals on total R&D expenditures covered by the state budget, proposals on R&D budget allocations to individual providers, and comments on documents submitted to the government in the field of R&D;
- The organisation of meetings with EC advisory bodies in the R&D sector, as well as with R&D councils of other countries;
- The administration of the R&D information system; and
- Proposals for the nomination of the Grant Agency Board.

The Council also estimates the total cost of research and development covered by individual budget chapters, and proposes their allocation.

The Academy of Sciences of the Czech Republic (ASCR) was established in 1992 by the Czech National Council, as the successor of the former Czechoslovak Academy of Sciences. ASCR is the leading non-university, basic research public institution in the Czech Republic. The academy formulates its own scientific policy, advises the state on major issues of R&D policy, administers national as well as international research programmes, and promotes cooperation with both applied research and industry to foster technology transfer and exploitation of scientific knowledge (website of the ASCR).

The Grant Agency of the Czech Republic (GACR), also known as the Czech Science Foundation, was established by Czech law No. 300/1992 in April 1993, as an independent institution promoting progress in scientific and technological development in the Czech Republic. The agency provides grants to Czech public and private research and development institutions, and to individual scientists who are Czech citizens and reside permanently in the Czech Republic. The major share of these funds is derived from the state budget, but there are contributions from other sources as well, such as industry, foundations, private donations, etc. Tenders are called at regular intervals for scientific and technological grants; the proposals are peer-reviewed and selected projects are funded. The general policy of the GACR stresses high-quality interdisciplinary projects involving several institutions (Academy of Sciences, universities, industrial research institutions, etc.), projects involving international cooperation and proposals addressing specified priority areas. The work of the GACR is monitored by a supervisory board, appointed by the Czech Parliament, which is independent of other GACR organs (European Commission, 2005; website of the GACR).

1.3 National support and framework conditions for biotechnology

The Czech Republic has a rich history in biotechnology: Gregor Mendel, the friar of the abbey of St. Thomas in Brno who studied the heritability of flower colour in the pea, discovered the principles of heredity in the 19th century (Vaněček, 2005). Vaněček argues that, while the Czech Republic does not belong to the pioneers of modern molecular biology, some Czech research labs are European-class. He mentions the laboratory of A.

Holý, which synthesised nucleotide derivates that are very effective inhibitors of reverse transcriptase, a drug widely used in therapy of serious viral diseases such as AIDS, hepatitis B and cytomegalic retinitis.

The country's R&D and Innovation policy has a much shorter history and does not include specific biotechnology programmes for R&D, technology transfer or commercialisation. However, molecular biology, biomedicine and biotechnologies are a national policy priority; together they represent one of seven priority R&D sectors.

Already in 1994, the campus of biological institutes of the Academy of Sciences in Praha-Krč included an incubator of high-tech companies. About 20 companies went through the incubator, including a number of biotechnology companies. However, the incubator suffered from insufficient space and finance, and was forced to close in 2002. The South Moravian Innovative Centre in Brno was also built in 2002. It was founded by four corporate bodies: the South Moravian region, the Technical University of Brno, Masaryk University, and the statutory town of Brno. In 2005, two new members were accepted: the University of Veterinary and Pharmaceutical Sciences in Brno and the Mendel University of Agriculture and Forestry in Brno. The cluster focuses mainly on biotech companies involved in environmental protection, decontamination of waste water and soil, etc. Smaller biotechnology parks are being established in Olomouc at the campus of the Institute of Experimental Botanic AS CR, and in Nové Hrady at the campus of the University of South Bohemia (Vaněček, 2005).

Gate2Biotech is a web-based organisation set up by the South Moravian Innovation Centre, with the support of CzechInvest. Gate2Biotech aims to facilitate communication within and outside the country through networking and develop the biotechnology sector in the Czech Republic.

The Gate2Biotech organisation includes sections dedicated to:
- Biotechnology companies based in the Czech Republic,
- Biotechnology research institutes and projects based in the Czech Republic,
- Potential founders or existing owners of biotechnology companies,
- Potential investors in Czech biotechnology,
- Education, training, development and recruitment of biotech human resources, and
- Biotechnology current affairs (with an emphasis on Czech biotech).

Biotrin is a non-profit organisation formed by the academic community for dissemination of information on modern biotechnology.

Regulation
The Czech Republic has a regulatory and patent environment that is harmonised with the EU (CzechInvest, 2006). EU guidelines on the use of GMOs were incorporated into Czech national law in 2000:
- 374 Decree (detailed conditions on the use of GMOs and products)
- 373 Decree (contained use of GMOs)
- 372 Decree (technical procedures that may or may not result in a GMO)

– Act. 153/2000 Coll. (use of GMOs in specified subject areas).

In early 2004, the pest-resistant maize variety MON810 was approved by the Czech government. This implied that Monsanto could continue its three-year testing programme in the Czech Republic. Greenpeace made a legal bid to impose a temporary ban on this testing, but this was rejected by the Czech Minister for the Environment. In 2005, GM maize was sown commercially for this first time in the Czech Republic (AgraEurope, 2005).

Czech legislation concerning intellectual property rights – including the protection of biotechnology inventions – has been harmonized with EU regulations. After the country's accession to the EU in 2004, the responsibility for drug registration was transferred from the State Institute for Drug Control to EU authorities (Euro/Biotech/News, 2005).

Public acceptance
That biotechnology research is also an issue in the Czech Republic can be concluded from the National Research and Development Policy published in 2004. This mentions the necessity for effective communication with the public and declares that special attention will be given to a number of biotechnological developments (genetic engineering, embryonic stem cells therapy, quality and health effects of foodstuffs), although other technologies are also mentioned.

A survey conducted by the Eurobarometer (2005) showed that 71% of Czech respondents believed that biotechnology and genetic engineering will have a positive effect on their way of life in the next 20 years. The Czech Republic belongs to the group of member states that are relatively positive about biotechnology, with Hungary having the highest score (74%), followed by Spain and Denmark (72%). With regard to specific applications, the Czech Republic belongs to the group of EU25 countries that in general are positive about most of the specific applications mentioned.

A USDA report asserts that Czech consumers are neither for nor against biotechnology. Those that support it value the price competitiveness of biotech products. Consumers against biotechnology argue that there is insufficient scientific evidence proving its safety. According to the report, Czech scientists are doing their best to promote biotechnology by disseminating information to the public. They produce documentaries, work with journalists and have developed websites (such as www.biotrin.cz). Newspaper articles are generally neutral, presenting views from all sides, including those of scientists, representatives of biotech multinationals, Greenpeace and consumer organisations (USDA, 2003).

1.4 Main biotech policy and research actors

Biotechnology is an integral part of the generic R&D and Innovation policy. There are no specific biotechnology policy actors in the Czech Republic.

Public biotechnology research is carried out in universities, research institutes of the Academy of Sciences and departmental research institutes directly related to a ministry such as the Food Research Institute and the National Institute of Public Health. This structure is complemented by scientific and technological parks and business centres where small high-tech firms are being established and developed.

By the end of 2005, 220 research entities were active in the field of biotechnology. Almost half (45.9%) of all these entities are located in the Prague region and another quarter in the South Moravian region (23.9%). The sector in which most research entities are active is plant biotechnology (36%): see www.gate2biotech.com.

There are 28 universities in the Czech Republic, 25 of which are state universities (European Commission, 2005). The biggest and most famous is Charles University in Prague, but universities of other large cities (Brno, Olomouc, Hradec Králové, Plzeň and České Budějovice) also have faculties and research groups in the field of biotechnology and life sciences (Vaněček, 2005).

The institutes of the Academy of Sciences conduct both fundamental and strategic applied research to create scientific knowledge that contributes to key areas of science and up-to-date solutions to contemporary problems of society. The academy currently manages a network of sixty research institutes and five supporting units staffed by a total of 6 400 employees. The head office of the academy and forty research institutes are located in Prague, with the remaining institutes situated throughout the country (website of the ASCR).

Since 1 January 2006, following a reorganisation of the Academy of Sciences, research centres (partly) active in the field of biotechnology / life sciences are the following:
- Institute of Analytical Chemistry,
- Institute of Animal Physiology and Genetics,
- Institute of Biophysics,
- Biological Centre of the ASCR (merger of Hydrobiological Institute, Institute of Entomology, Institute of Parasitology, Institute for Plant Molecular Biology and Institute of Soil Biology),
- Institute of Macromolecular Chemistry,
- Institute of Microbiology,
- Institute of Molecular Genetics,
- Institute of Physiology,
- Institute of Systems Biology and Ecology.

The Research Institute of Food Industry was founded in 1958 by an act of the then Ministry of Food Industry and Purchase. Currently known as the Food Research Institute

of Prague, it deals with fundamental and applied research, developments in food chemistry, biochemistry and engineering, and the construction of special machines and devices for the food industry.

The National Institute of Public Health is a research institute specialised in basic preventive disciplines, including hygiene, epidemiology, microbiology and occupational medicine. Its main tasks are health promotion and protection, disease prevention and follow-up of environmental impacts on the health of the population. The main activities of the institute comprise science and research, reference and methodological advice, provision of expert opinions on health safety issues related to various products (e.g. cosmetics, food supplements, items of daily use), systematic monitoring of environmental impacts on human health in the Czech Republic, and preparation of legislation in the field of health protection, including the harmonization of Czech legislation with European Union norms (website of the National Institute of Public Health).

CezchInvest provides a detailed overview of basic research groups active in biotechnology (website of CzechInvest).

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

2.1 Introduction

This chapter 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 directed by explicit policy decisions about specific instruments, such as 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 specifically set up to stimulate biotechnology. Generic policy instruments are not linked to a specific technology, but in principle stimulate all technologies, including biotechnology. The BioPolis project only considers those generic instruments that make a reference to (the stimulation of) biotechnology activities in the policy of the funding organisation running the programme, or that of the ministry/government department itself.

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

This chapter describes the funding of biotechnology research through policy-directed and non-policy-directed instruments, and of biotechnology commercialisation through policy-directed instruments. Section 2.2 presents non-policy-directed funding, and section 2.3 policy-directed funding of biotechnology/life sciences. Charities also play an important role in the funding of biotechnology research in some countries; these are addressed in section 2.4. The final section provides a short overview of European funding of biotechnology research in the Czech Republic through the 6th Framework Programme.

2.2 Non-policy-directed funding of biotechnology research

The funding of research in the Czech Republic is rather complicated. The recent TrendChart report of the Czech Republic says there are 22 entities (mainly ministries) channelling R&D support from the state budget to public research organisations and companies (European Commission, 2005). Some of these funds fall in the category of non-policy-directed funding.

Most non-policy-directed funding of biotechnology/life sciences research in the Czech Republic is allocated through research council type of organisations, such as the Grant Agency of the Czech Republic (Czech Science Foundation), the Grant Academy of the Academy of Sciences, the Internal Grant Agency of the Ministry of Health and the National Agency for Agricultural Research. Charles University also has a Grant Agency. Unfortunately, data on the funding of biotech-related activities in the period 2002-2005 was only available for two of these agencies (see Table 2.1).

Table 2.1 Non-policy-directed funding of biotechnology research during the period 2002-2005 (M EUR)

Funding organisation	**Public research institutions / Response mode**	**Biotech part of the funds**
Grant Agency of the Czech Republic	Response mode	4.0
Grant Agency of the Academy of Sciences of the Czech Republic	Response mode	NA
Internal Grant Agency of the Ministry of Health	Response mode	NA
National Agency for Agricultural Research	Response mode	20.9
Charles University Grant Agency	Response mode	NA
TOTAL		24.9

NA: Not Available
Source: BioPolis Research

2.3 Policy-directed funding of biotechnology research and commercialisation

The Czech Republic has a large number of programmes that support research, technology transfer, commercialisation, businesses activities, etc. There are no programmes that specifically stimulate biotechnology activities; biotechnology is only funded through policy-directed generic instruments.

The most relevant generic instruments that were identified are the Research Centres Programme of the Ministry of Education, Youth and Sports and a number of programmes run by the Ministry of Industry and Trade. Table 2.2 gives a summary of programmes and funds; these are presented in more detail in the rest of this section.

Table 2.2 National public policy-directed instruments stimulating biotechnology during the period 2002 - 2005

Instrument	Funding organisation	Biotech part of the budget	Use of DF/SF
National			
Generic			
Research Centres Programme	Ministry of Education, Youth and Sports	9.8	NA
Innovation Programme	CzechInvest	4	√
Prosperity Programme	CzechInvest	NA	√
Impulse Programme	Ministry of Industry and Trade	NA	NA
Tandem Programme	Ministry of Industry and Trade	NA	NA
Pokrok Programme	Ministry of Industry and Trade	NA	NA
TOTAL		13.8	

NA: Not Available
Source: BioPolis Research

Research Centres Programme of the Ministry of Education, Youth and Sports
In 2000, the Ministry of Education, Youth and Sports initiated the Research Centres Programme. The main aim of the programme was the establishment of 33 national research centres. In 2001, 23.3M EUR were invested in the centres; approximately the same investment was planned annually until 2004.

Twenty-one centres carry out basic research which involves international collaboration; twelve are committed to applied research that is oriented towards final application in the region through transfer to the private and public sectors. Centre activities include training and career development of young researchers.

Individual centres are based mostly at Czech universities and research institutes of the Czech Academy of Sciences. They cooperate with research organisations (including government labs and private non-profit research institutions) and private for-profit companies in the Czech Republic or abroad. Support to a given centre is arranged by contract for a period of five years.

The goals of the Research Centre Programme were to:
- Concentrate all resources and capacities (financial, human, technical, infrastructural) in specific fields;
- Focus on specific research branches in a limited number of suitable research centres;
- Improve the quality of R&D focused on long-term, relevant, regional needs;
- Support intra- and multidisciplinary cooperation in existing R&D institutions and sectors;
- Keep young scientists in the country and improve their qualifications and education.

The programme included two sub-programmes:
- 'A' for centres doing basic research, with a prerequisite of involvement in international R&D networks.

- ‘B’ for centres doing applied and targeted research, with a prerequisite of R&D result transfer and regional application.

Nine of the 33 research centres operate in the field of biotechnology/life sciences:
- Biomolecular centre,
- Centre of molecular and cellular immunology,
- Structure and dynamics of complex molecular systems and biomolecules,
- Proteome centre for the study of intracellular parasitism of microbes,
- Centre of integrated genomics,
- Signalling pathways in plants,
- Mechanism, ecophysiology and biotechnology of photosynthesis,
- Centre for molecular and gene biotechnologies,
- Centre for cell therapy and tissue repair.

Together, the nine centres received annually 5.5M EUR (approximately 157M CZK) over the five-year period 2000-2004.

After the Research Centres Programme ended in 2004, a new and similar programme started in 2005. It also consisted of two parts: basic research and applied research.

In terms of basic research, five new centres working in the field of biotechnology/life sciences have been set up. Together, they have an annual budget of approximately 1.6M EUR for the period 2005-2009.

These centres are the following:
- Centre for biomolecules and complex molecular systems,
- Functional organisation of the cell,
- Chromosome dynamics and organisation during the cell cycle in normal and pathologic conditions,
- Centre of molecular biology and physiology of yeast communities,
- Neuroscience centre.

An additional six centres in the field of biotechnology/life sciences will be set up in the period 2006-2010.

The applied research part of the programme includes six centres working in the biotech field. In total, they have an annual budget of 4.9M EUR for the period 2005-2008.

These centres are the following:
- Centre of molecular and cellular immunology,
- Centre for cell therapy and tissue repair,
- Centre for applied genomics,
- Centre for bioindication and revitalisation of toxic and anthropogenic substrates and water sources,
- Centre for biomedical informatics,
- Centre for functional genomics and proteomics for crop development.

The first two centres began their activities in 2000 and have been receiving funds for a second period.

Programmes of the Ministry of Industry and Trade
The Ministry of Industry and Trade is responsible for supporting industrial R&D. It spends approximately 12% of the total state budget on R&D. It runs a large number of programmes. Two of these – the Innovation Programme and the Prosperity Programme – are managed by CzechInvest (Ministry of Industry and Trade, 2004). There are three research-related programmes run by the Ministry itself: Impuls, Tandem and Pokrok. Other programmes related to innovations are Clusters, Start, Development, Marketing and Kredit (European Commission, 2005).

The Innovation Programme (INOVACE CZ-29) supports projects that increase the technical and utility values of products and services, increase the effectiveness of production processes and services, introduce advanced management methods, contribute to major changes in the organisational structure or strategic orientation of a business, or contribute to other non-technical innovations. The programme started in 2004 and by mid-2005 140 applications had already been submitted; as a result, the programme came to an end on June 30, 2005 (ibid). Approved biotechnology projects that began in 2004 and 2005 had a total budget of approximately 4M EUR.

The Prosperity Programme (PROSPERITA CZ-25) supports the infrastructure of industrial development, in particular science and technology parks, business incubators and centres for technology transfer. Due to the nature of the programme (large projects involving construction and thus requiring big time investments) and the low level of interest in business incubators and cooperation with industry shown by the Academy of Sciences until mid-2005, only 11 projects were submitted in total; four of these were retained for financing (ibid). No data are available about biotech projects and funds.

The IMPULS programme (CZ-17) was designed for research organisations and companies wishing to perform application-oriented R&D that potentially can lead to commercial success in the medium term. The programme is very popular with enterprises, especially small- and medium-sized enterprises. By mid-2005, 225 projects were already being supported, the first results of which were put into production in 2006 (ibid). No data are available about biotech projects and funds.

The TANDEM programme (CZ-16) supports companies carrying out basic and applied research in collaboration with research organisations. To qualify for this programme, it must be contractually agreed that project results will be used in related projects of industrial research and development leading to new products, technologies and materials. The request for assistance under this programme exceeded funds available in the budget (ibid). No data are available about biotech projects and funds.

The POKROK (Progress) Programme (CZ-15) was launched as part of the first National Research programme. It supported R&D projects in specific areas defined by the NRP.

The programme ended 2005 and was not relaunched (ibid). No data are available about biotech projects and funds.

2.4 Charities

The League Against Cancer in Prague (Liga Proti Rakovině Praha) provides advice and information to cancer patients in the Czech Republic. No information is available about funds for research in the League (www.lpr.cz).

2.5 Participation in the 6th Framework Programme

Research groups in the Czech Republic are only involved as participants in programmes of the Sixth Framework Programme of the European Commission (see Table 2.3). They participate in 113 (of the 8 537) projects of thematic priority 1 on 'Genomics and Life Sciences', in 24 (of the 1 599) projects in thematic priority 5 on 'Food Quality and Safety', and in 3 (of the 106) projects of the Nanobiotechnology component of thematic priority 2 on 'Nanotechnology'.

Table 2.3 Involvement of the Czech Republic in biotechnology/life sciences activities of the 6th Framework Programme

Sixth Framework Programme Thematic priority	Participation as project manager in # of projects	Participation as member of project team
1. Genomics and Life Science for Health	0	113 (1.3%)
5. Food Quality and Safety	0	24 (1.5%)
2. Nanobiotechnology	0	3 (2.8%)

Source: BioPolis Research

3. Performance of the national biotechnology innovation system

3.1 Introduction

This chapter analyses the performance of the Czech Republic's 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. Each time period includes several years to avoid capturing erratic trends. National trends are benchmarked against the performance of EU25 member states and the USA.

The presentation of the performance is structured along the four main areas of the innovation system: the knowledge base, processes of knowledge transmission and application, industrial development, and markets for biotechnology-based products. In each area, data for a number of different indicators are shown for the Czech Republic, USA and EU25. The values of EU25 have been chosen as a reference in each indicator. The absolute figures 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 indicators; Table A.5.1 presents for each indicator the specific years for each period.

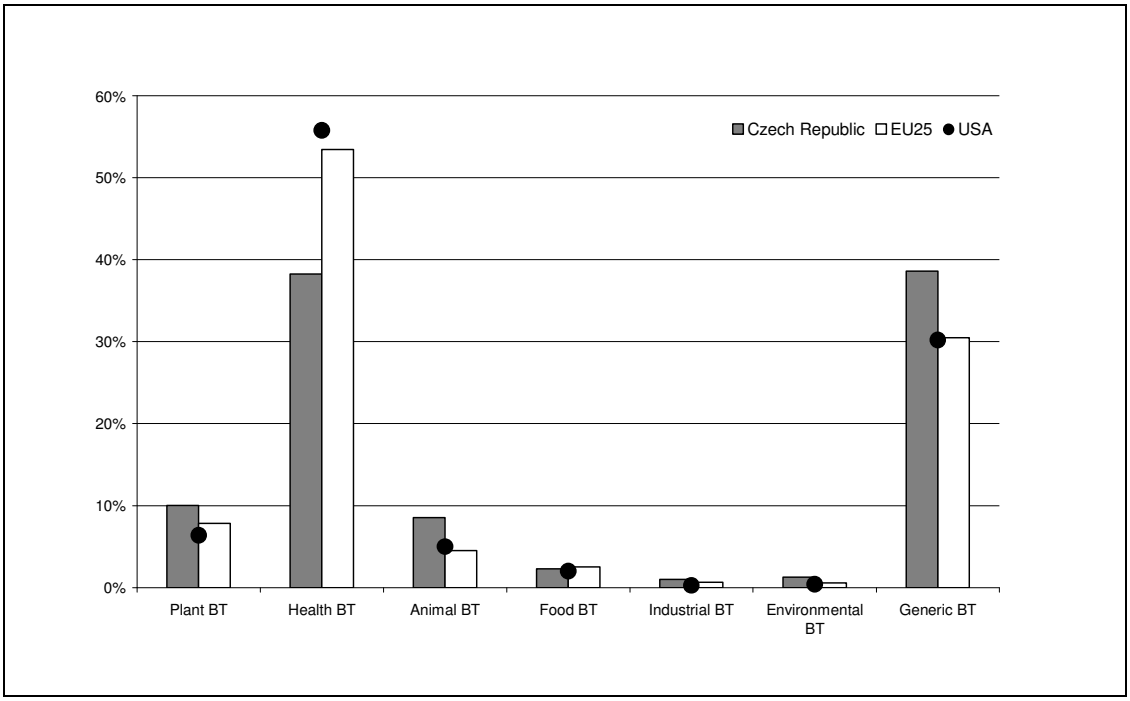
3.2 Performance in creating a knowledge base and supporting the availability of human resources

Over a ten-year period, the Czech Republic increased its output of biotechnology publications per million capita, from index 46 in 1994-1996 to index 52 in 1998-2000 to index 72 in 2002-2004 (see Chart 3.1). It nevertheless remained under the EU25 level (index = 100) and USA level. The share of biotechnology publications in relation to the total number of publications increased from index 86 in 1994-1996 to index 103 in 2002-2004. In the last period, Czech performance exceeded the EU25 average. USA figures were slightly higher.

When considering the number of citations per biotechnology publication in 1994-1996 and 2002-2004, the Czech Republic showed a lower performance than both the USA and EU25, with records of 79 in the first period en 71 in the last period.

With regard to graduates in life sciences, the number of graduates per million capita increased from index 29 in 1998-2000 to index 37 in 2002-2004, but remained far below EU25 and USA levels.

Chart 3.1. Czech biotechnology knowledge base indicators: comparison with EU25 and USA figures in three periods (index value)

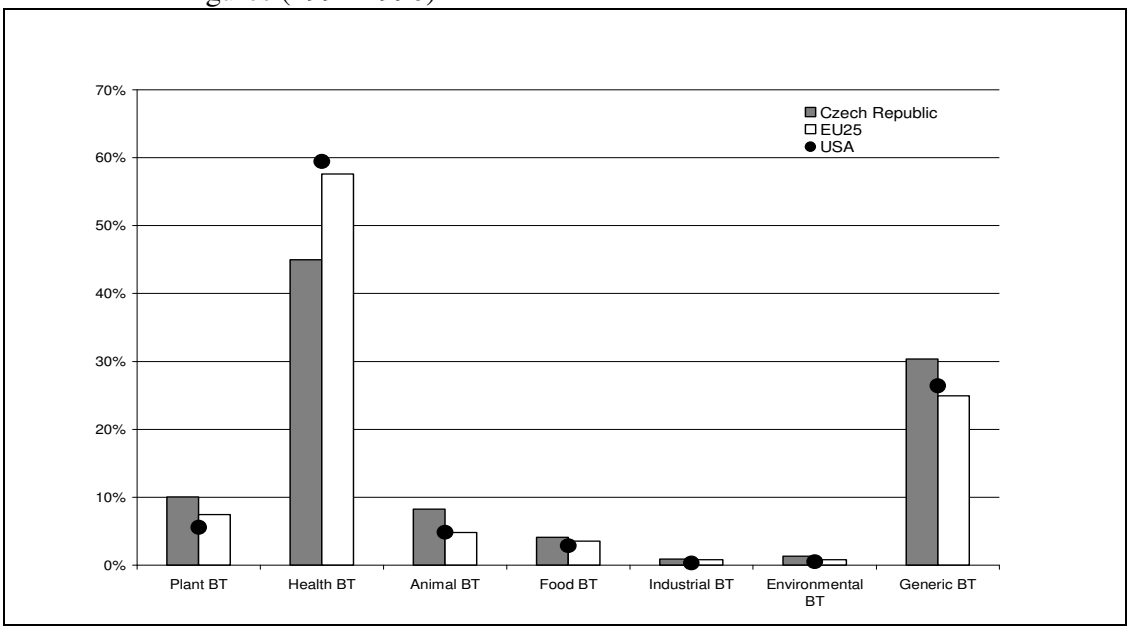


Source: BioPolis Research
Data: Science Citation Index

Charts 3.2.1 and 3.2.2 show biotechnology publications by subfield in the Czech Republic, USA and EU25 during 1994-1996 and 2002-2004.

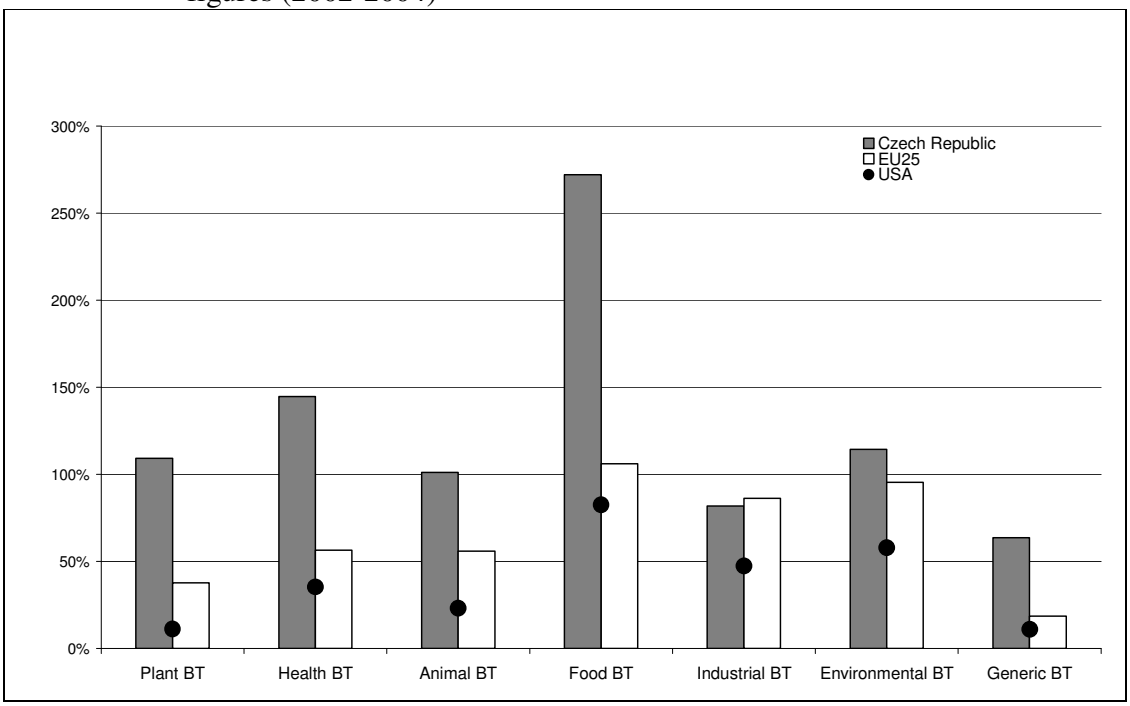
Czech biotechnology publications can be found especially in the field of human health, and, to a lesser extent, generic biotechnology. If we compare figures for the periods 1994-1996 and 2002-2004, the picture does not really change.

Chart 3.2.1. Share of biotechnology subfields, as a percentage of total biotechnology publications, in the Czech Republic: comparison with EU25 and USA figures (1994-1996)



Source: BioPolis Research
Data: Science Citation Index

Chart 3.2.2. Share of biotechnology subfields, as a percentage of total biotechnology publications, in the Czech Republic: comparison with EU 25 and USA figures (2002-2004)

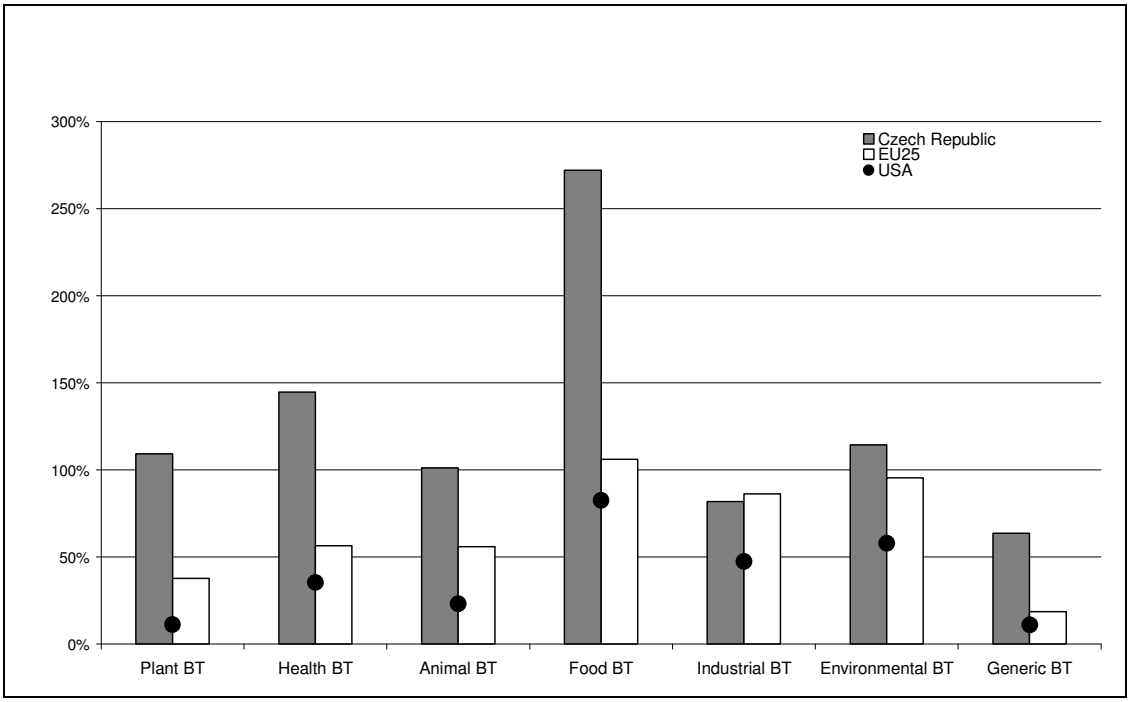


Source: BioPolis Research
Data: Science Citation Index

In the period between 1994-1996 and 2002-2004, the number of food biotechnology publications increased by 272%, with 25 publications appearing in 1994-1996. Human health biotechnology publications grew by 145% (416 publications in the first period), and environmental biotechnology publications by 114% (14 publications in the first period). Plant and animal biotechnology publications grew by approximately 100%. The growth rate for industrial biotechnology and generic biotechnology publications was below 100%.

The growth figures for all fields, except industrial biotechnology, far exceed USA and EU25 levels. This indicator shows that the Czech Republic has been rapidly catching up with the international research community in the field of biotechnology.

Chart 3.3 Growth rates of biotechnology subfield publications in the Czech Republic: comparison with EU25 and USA figures (1994-1996 and 2002-2004)



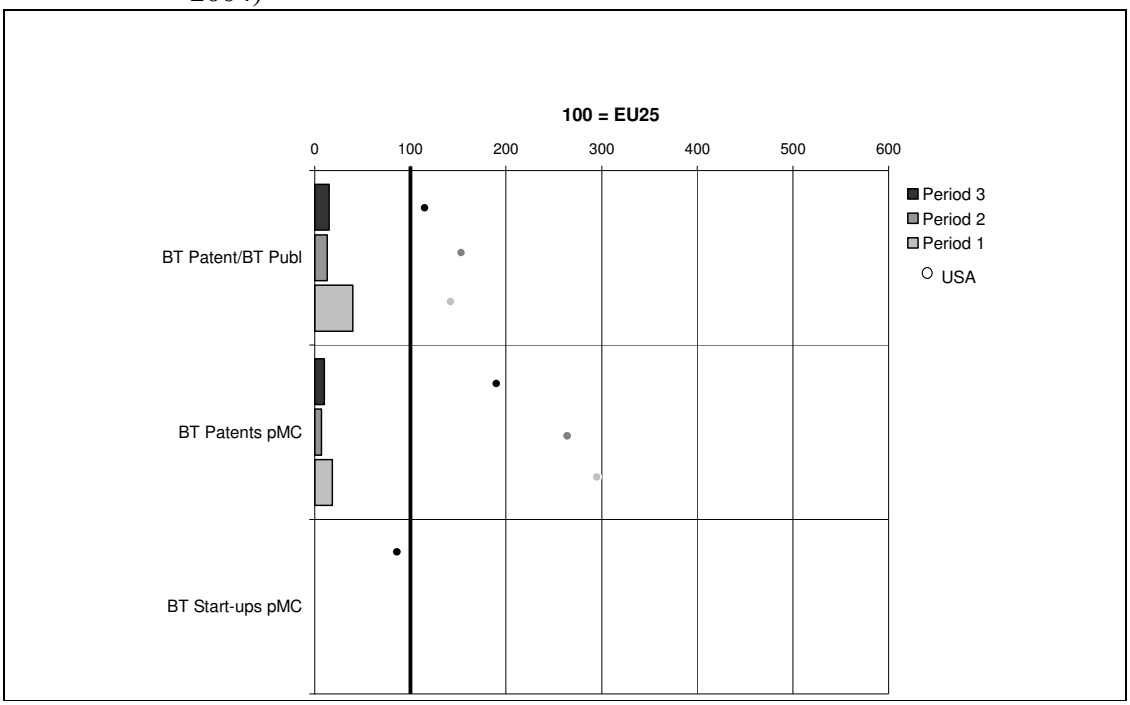
Source: BioPolis Research
Data: Science Citation Index

3.3 Performance in knowledge transmission and application

The Czech Republic's output of biotech patent applications per biotech publications decreased from index 57 in 1994-1996 to index 17 in 2002-2004. Chart 3.4 shows that the Czech Republic lagged behind both the EU and USA. With regard to biotech patent applications per million capita, the output was even lower during this period, having

decreased from index 18 in 1994-1996 to index 10 in 2002-2004. Czech performance in this category was also far outweighed by that of the EU and USA (index 295 and index 190 for the corresponding periods). In the source used to produce this figure, no data were available for the Czech Republic in terms of biotechnology start-ups.

Chart 3.4. Performance indicators for biotechnology knowledge transmission and applications in the Czech Republic (1994-1996, 1998-2000 and 2002-2004)



Source: BioPolis Research
Data: Science Citation Index

3.4 Industrial development

In the BioPolis project, indicators used for performance in industrial development are based on the number of biotechnology companies pMC, the number of biotech Initial Public Offerings (IPOs) pMC, and Venture Capital in EUR pC.

As yet, the Czech Republic has no biotechnology IPOs and also no venture capital invested in Czech biotech firms. Data on the number of Czech biotechnology companies pMC are not available in the source that was used. Other sources give figures of 63 to 120 biotech companies (see Section 1.1).

3.5 Market conditions

In the BioPolis project, two indicators were used to measure market conditions: approved biomedicines (1995-2002) and field trials (1996-2002).

In the period covered, there were no biomedicines developed in the Czech Republic that were approved on the European market. Similarly, field trials were absent in the Czech Republic.

4. Conclusions

4.1 Introduction

This concluding chapter provides an overview of the main characteristics of the group of policy-directed instruments used by the Czech government in the period 2002-2005 to stimulate biotechnology R&D, technology transfer and commercialisation. The overview summarises the funding of biotechnology, in terms of types of policy instruments used, policy goals addressed, biotechnology applications areas funded and biotechnology activities stimulated.

4.2 Public funding of biotechnology through policy instruments

In the period 2002-2005, the Czech government spent at least 38.7M EUR on biotechnology research and commercialisation activities (see Table 4.1). This is an estimate, as data were lacking for both non-policy and policy-directed instruments.

Table 4.1 Public funding of biotechnology through non-directed, generic and specific policy instruments in the period 2002-2005 (in M EUR)

	2002	2003	2004	2005	Total
RESEARCH					
1. *Non-policy-directed*					
Public research institutions	NA*	NA	NA	NA	NA
Response mode	3.6	5.8	8.4	7.1	24.9
Total	3.6	5.8	8.4	7.1	24.9
2a. *Policy-directed, Generic*					
National	1.1	1.1	2.1	7.5	11.8
Regional	-	-	-	-	-
Total	1.1	1.1	2.1	7.5	11.8
2b. *Policy-directed, Biotech-specific*					
National	-	-	-	-	-
Regional	-	-	-	-	-
Total	-	-	-	-	-
COMMERCIALISATION					
1a. *Policy-directed, Generic*					
National	-	-	1	1	2
Regional	-	-	-	-	-
Total	-	-	1	1	2
1b. *Policy-directed, Biotech-specific*					
National	-	-	-	-	-
Regional	-	-	-	-	-
Total	-	-	-	-	-
OTHER					
1a. *Policy-directed, Generic*					
National	-	-	-	-	-
Regional	-	-	-	-	-

	2002	2003	2004	2005	Total
Total	-	-	-	-	-
1b. *Policy-directed, Biotech-specific*					
National	-	-	-	-	-
Regional	-	-	-	-	-
Total					
GRAND TOTAL	4.7	6.9	11.5	15.6	38.7

* NA: Not Available
Source: BioPolis Research

4.3 Specific features of the instruments

Public research organisations are the main recipients of funds from the Research Centres Programme, while companies are the main recipients of funding from programmes of the Ministry of Industry and Trade. In some of these programmes, cooperation with public research organisations is encouraged and funds to these organisations are provided through the companies.

Table 4.2 Participants/recipients and contribution requirements of Czech policy-directed programmes funding 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						
Research Centres Programme	Ministry of Education, Youth and Sports	√			-	-
Innovation Programme	CzechInvest		√	√	46% *	
Prosperity Programme	CzechInvest	√	√	√	25% **	
Impuls Programme	Ministry of Industry and Trade	√	√	√	NA	
Tandem Programme	Ministry of Industry and Trade		√	√	NA	
Pokrok Programme	Ministry of Industry and Trade	NA	NA	NA	NA	

* Subsidy did not exceed 46% of eligible project costs. For specific components (acquisition of long-term intangible assets, such as the purchase of patents, consultancy services, etc.) 25% to 50% of the costs can be paid by the subsidy.
** Support was provided in the form of a subsidy for eligible costs not exceeding 75% of total eligible project costs.
Source: BioPolis Research

4.4 Policy goals

The main policy goal addressed by the Czech programmes is the stimulation of high levels of basic and applied research. The Research Centres Programme also deals with interdisciplinary research and education. Other policy goals include technology transfer, adoption of biotechnology by industry and firm creation.

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

	1*	2	3	4	5	6	7	8	9	10
National										
Generic										
Research Centres Programme	√	√	√	√						
Innovation Programme		√				√				
Prosperity Programme					√		√			
Impuls Programme		√								
Tandem Programme	√	√								
Pokrok Programme		√								
Grand total**	4.0	6.0	0.9	0.9		2				

*

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 = 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

** Funding data for the Research Centres Programme and the Innovation Programme are based on estimates made by the author
Source: BioPolis Research

4.5 Biotech research application areas

The research centres that were funded spend approximately half of their funds on basic research. The rest of the funds are mostly spent on health-related biotechnology (approximately 75%), plant biotechnology and industrial biotechnology.

The Innovation Programme is a general programme. Projects have been funded in the field of health and plant biotechnology, as well as one on incubators. There is no data available on biotech areas covered by other programmes.

Table 4.4 Coverage of biotech research application areas and funding, by policy-directed instruments, in the period 2002-2005 (in M EUR)

	Biotech areas								
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
National									
Generic									
Research Centres Programme	√			√		√	√		
Innovation Programme	√			√					√
Prosperity Programme **									
Impuls Programme **									
Tandem Programme **									
Pokrok Programme **									
Grand total ***	1.29			7.12		0.3	4.9		0.23

*

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 (e.g capacity building, support patenting, *etc.*)

** No data are available on the coverage of biotech areas by individual projects in this programme
*** The grand total figures are based on information that was available (in terms of funding and research areas) and on estimates made by the author.
Source: BioPolis Research

4.6 Stimulation of biotech activities through policy instruments

Table 4.5 shows biotechnology activities funded by each policy-directed instrument. In total, ten different activities are funded. The budgets of both programmes for which funding data are available are mainly allocated to research (activities 1, 2 and 3); activity 6 mainly covers the education of scientists, which also involves research. Industry research is the fifth activity being funded. Other activities include valorisation of research (activities 10-15).

Table 4.5 Coverage and funding of biotech activities, by policy-directed instruments, in the period 2002-2005 (in M EUR)

	Biotech activities									
	1*	**2**	**3**	**6**	**10**	**11**	**12**	**14**	**15**	**17**
National										
Research Centres Programme	√	√	√	√			√			
Innovation Programme		√					√	√		√
Prosperity Programme					√	√			√	
Impuls Programme		√								
Tandem Programme	√	√								

	Biotech activities									
	1*	**2**	**3**	**6**	**10**	**11**	**12**	**14**	**15**	**17**
Pokrok Programme		√								

*

1 Basic research
2 Applied research
3 Centres of excellence
4 Research networks
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 Establishment of research institute/centre of industrial interest
10 Technology transfer office
11 Science and technology park
12 Protection of IPR in public research organisations
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 this field
17 Grants for industrial research
18 Other incentives for business investment
19. Support for public discourse activities

Source: BioPolis Research

5. Future developments

The government of the Czech Republic developed research and innovation policies for the period following 2005. The National Innovation Policy of the Czech Republic 2005-2010 was published (without any reference to biotechnology or life sciences). The new Operational Plan for Industry and Enterprise (OPIE) will run for the period 2007- 2013. Most programmes of the Ministry of Industry and Trade (including those managed by CzechInvest) that have been presented in this report have run beyond 2005. Only the PokRok Programme was not extended.

The Research Centre Programme of the Ministry of Education, Youth and Sports was also extended. In 2005 and 2006, new centres were set up, again for a period of five years.

In November 2006, the Academy of Sciences announced that two of its institutes, the Institute of Experimental Medicine and the Institute of Molecular Genetics, were planning to open a joint biotechnology research centre just outside Prague in a village called Vestec. They planned to combine their research in order to improve the diagnosis and treatment of serious diseases. The 71M EUR campus will be equipped with state-of-the-art labs and will employ 400 specialists. It will be partly funded by the European Commission through its structural and regional development funds. The state budget of the Czech Republic will cover 30-40 per cent of the cost, on the institutional side. The project proposal will be submitted to the European Commission by the end of 2007. The new research centre should open at the end of 2010 or beginning of 2011.

Annex 1 List of tables

Annex 2 List of figures and charts

Annex 3 List of contact persons

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Alena Stikova	Academy of Sciences of the Czech Republic
Vera Jencova	Technology Centre AS CR

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Ministry of Agriculture: http://www.mze.cz (accessed 29/11/2005)

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Cancer Patients Organisation (only in Czech): www.lpr.cz (accessed 02/10/2006)

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

	Indicator	Chart	Comments	Time periods
Ind. 6	Graduates in life sciences pMC	3.1	Index: Reference Region EU17 =100 and US data for comparison	(2) 1998 (3) 2002
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[1]	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for	1995-2002

[1] http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf

	Indicator	Chart	Comments	Time periods
			comparison	
Ind. 17	Field trials	3.6	Source: Biotechnology Innovation Scoreboard 2002 Index: Reference Region EU15 =100 US data for comparison	1996-2001

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 Charts 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
Czech Republic	1044	1519	2337	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
Czech Republic	101	148	229	46	52	72
USA	454	492	529	208	172	166

Source: BioPolis Research
Publications: SCI
Population: 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.		n.a.
Czech Republic	2337				n.a.		n.a.
USA	154402				n.a.		n.a.

Source: BioPolis Research
Publications: SCI
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
Czech Republic	1044	1519	2337	10661	13468	17413
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
Czech Republic	10%	11%	13%	86	90	103
USA	13%	14%	15%	119	115	113

Source: BioPolis Research
Publications: SCI

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
Czech Republic	4.84	5.17	79	71
USA	6.39	8.54	104	117

Source: BioPolis Research
Citations: SCI

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	46859**	81316	552**	431
Czech Republic	256*	716	10*	10
USA	75253*	70950	276*	288
	Graduates pMC		**Index EU17=100**	
	1998 / 1999	**2002**	**1998 / 1999**	**2002**
EU17	85**	189	100	100
Czech Republic	25*	70	29	37
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
OECD Education Database

Population source for US OECD

Raw data for Chart 3.2.1. BT publications in subfields, as share of total 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%
Czech Republic	100%	10%	38%	9%	2%	1%	1%	39%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BioPolis Research
Publications: SCI

Raw data for Chart 3.2.2. BT publications in subfields, as share 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%
Czech Republic	100%	10%	45%	8%	4%	1%	1%	30%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BioPolis Research
Publications: SCI

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
Czech Republic	1088	109	416	93	25	11	14	420
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BioPolis Research
Publications: SCI

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
Czech Republic	2263	228	1018	187	93	20	30	687
USA	141680	7910	84234	6872	4070	436	724	37434

Source: BioPolis Research
Publications: SCI

Raw data for Chart 3.3. Growth rate of BT publications in subfields between 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%
Czech Republic	109%	145%	101%	272%	82%	114%	64%
USA	11%	35%	23%	83%	47%	58%	11%

Source: BioPolis Research
Publications: SCI

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
Czech Republic	21	14	23	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
Czech Republic	2	1	2	18	7	10
USA	33	52	42	295	264	190

Source: BioPolis Research
Publications: SCI
Patents: 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
Czech Republic	1	0	1	35	66	83
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
Czech Republic	0.03	0.00	0.01	57	0	17
USA	0.07	0.11	0.08	142	153	115

Source: BioPolis Research
Publications SCI
Patents Questel Orbit

Raw data for Chart 3.5. Number of BT companies pMC for years 2001 – 2004: absolute and indexed values

	BT companies				Population in T			
	2001	**2002**	**2003**	**2004**	**2001**	**2002**	**2003**	**2004**
Europe	1879	1878	1861	1815	452016	452641	454580	456863
EU Available	1643	1650	1782	1605	319337	319484	408602	322210
Czech Republic	n.a.	n.a.	n.a.	n.a.	10206	10206	10203	10212
USA	1457	1472	1473	1444	285102	287941	290789	291685
	BT companies pMC				**Index**			
	2001	**2002**	**2003**	**2004**	**2001**	**2002**	**2003**	**2004**
Europe								
EU Available	5	5	4	5	100	100	100	100
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	5.11045	5.1122	5.066	4.95	99	99	116	99

Note: EU Available is the result of the sum of available EU member states
n.a.: not available
Source: BioPolis Research
Biotech companies: E&Y Beyond Borders 2002, 2003, 2004, 2005; EuropaBio

Raw data for Chart 3.5. BT start-ups pMC for period 2001-2003 and year 2003: absolute and indexed values

	BT start-ups		Population in T	
	2001-2003	2003	2003	
Europe (EU 15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051	
Czech Republic	n.a.	n.a.	10203	
USA	355	83	290789	
	Biotech start-up/pMC	Index	Biotech start-up/pMC	Index
	2001-2003	2001-2003	2003	2003
Europe (EU 15 - Cyprus - Greece + Norway + Switzerland)	1.4	100	0.36	100
Czech Republic	n.a.	n.a.	n.a.	n.a.
USA	1.2	86	0.29	79

Source: BioPolis Research
Start-ups: EuropaBio

Raw data for Chart 3.5. 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
Czech Republic	0	10206	10203	10212	10221	10211
USA	52	287941	290789	291685		290138

	IPO /pMC	Index
	2002-2005	2002-2005
EU Available	0.00	100
Czech Republic	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 & Young 2002-20045 London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burril & Company

Raw data for Chart 3.5. Venture capital pC: absolute and indexed values

	Venture capital in biotechnology companies M€			Population in T		
	2002	**2002**	**2002**	**2002**	**2003**	**2004**
Europe	1100	920	2800			
EU Availiable	890	883	1111	315584	319663	325131
Czech Republic	n.a.	n.a.	n.a.	10206	10203	10212
USA	2288	2498	2855	287941	290789	291685
	Venture capital in €/pC			**Index**		
	2002	**2003**	**2004**	**2002**	**2003**	**2004**
Europe						
EU Availiable	2.8	2.8	3.4	100	100	100
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	8	9	10	282	311	286

Source: BioPolis Research
VC data: E&Y Beyond Borders 2002, 2003, 2004, 2005

Raw data for Chart 3.6. Number of Biomedicines pMC

	Biomedicines	**Population (Million)**	**Biomedicines / pMC**	**Index**
	1995-2002	**2002**		**1995-2002**
EU15	39	378	0,10	100
Czech Republic	n.a	10	n.a	n.a
USA	115	289	0,40	387

Note: EU 15 is the result of the sum of the 15 old EU member states
Source: BioPolis Research
Number of medicines: Benchmarking of public biotechnology policy 2005

Raw data for Chart 3.6. Number of field trials pMC

	Field Trials	**Population in M**	**Field Trials pMC**	**Index**
	1996-2001	**2001**	**1996-2001**	**1996-2001**
EU15	1334	379	4	100
Czech Republic	n.a	10	n.a	n.a
USA	6745	278	24	688

Note: EU 15 is the result of the sum of the 15 old EU member states
Source: BioPolis Research
Field trials: Biotechnology Innovation Scoreboard 2002

Raw data for biotechnology acceptance. Data are mentioned in the text of Chapter 3.

BT Acceptance Index 2002		
	Index Average	**N (sample size)**
EU - 15*	100.29	16828
Czech Republic	n.a.	n.a.

*Weighted Average according to the weight "W13" of the Eurobarometer 58.2, which considers population differences among countries and corrects for inconsistencies in the national samples
Source: BioPolos Research
BT acceptance index: Benchmarking of public biotechnology policy 2005

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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

ASCR	Academy of Sciences of the Czech Republic
GACR	Grant Agency of the Czech Republic
GERD	General Expenditures on Research and Development
IPO	Initial Public Offering
OPIE	Operational Program Industry and Enterprise
pMC	per Million Capita
pC	per Capita
R&D Council	Research and Development Council