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Nederlandse Organisatie voor
toegepast-natuurwetenschappelijk
onderzoek / Netherlands Organisation
for Applied Scientific Research

Schoemakerstraat 97
P.O. Box 6030
2600 JA Delft
Nederland

www.tno.nl

P +31 (0)15 269 69 00
F +31 (0)15 269 54 60
stb@stb.tno.nl

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Effectiveness of innovation policies: biotechnology in Belgium (1994-2001)

Date	17 January 2003
Author(s)	A. van der Giessen, S. Kern, C. Enzing
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Contents

1 Introduction

The EPOHITE project explores the efficiency of biotechnology innovation policies in the EU Member States. EPOHITE applies an actor-based approach for studying the policy impact on the performance of important components in the innovation system. A selected group of various actor types, which are relevant for a successful innovation system and which are therefor the subjects of innovation policy in most countries, are analysed in detail using a mix of quantitative and qualitative indicators.

In the EPOHITE project, we distinguish between 4 types of actors: large firms, successful small and medium sized enterprises (SMEs), high performing start-ups, and public sector research organisations. Large firms are both national firms and multinationals, which are not dedicated to biotechnology, but have biotechnology research activities in the country. They are present in the biopharmaceutical and/or agro-food sector. Successful SMEs have left the start-ups stage and have the main goal to manage consolidation and growth. They usually have been established before 1996 and have already received a third tranche of investment. High performing start-ups are new biotech firms that are mainly dealing with managing the start-up stage, but are also planning or have already experienced growth. Public sector research organisations include university research groups, academic hospitals, public research institutes and charity research organisation that receive at least 25% of their budget from public funding and that carry out a considerable part of their basic and/or applied research in biotechnology.

In order to assess the performance and success of the four actor groups, national case studies in 14 EU Member States are conducted. Based on the national case studies, clusters of countries performing at the same level will be defined and analysed for their policy effectiveness. The website http://www.epohite.fhg.de gives more information about the methodological aspects of the EPOHITE project.

In this national report, the Belgian case study is presented. First of all, in chapter 2 an overview of the Belgian policies affecting the innovation system in Belgium is provided. In chapter 3, the performance of the Belgian biotechnology innovation system is discussed, based on the results of the assessment using quantitative performance indicators like publications and patents. Based on the interviews with the Belgian respondents, the respondents' perspectives on the policy effectiveness are summarised in chapter 4. Finally, chapter 5 presents the main conclusions on the policy effectiveness in Belgium.

In this case study the notion of the structure of the Federal State of Belgium is taken into account. This means that attention is given to differences and similarities between the various Belgian Regions and Communities. However, for operational reasons, information about the performance of the Belgian biotechnology innovation system has been collected and analysed at an aggregate level. Therefore it has not been possible to link regional policy profiles and regional performances and policy assessments.
The French partners of the EPOHITE project team carried out the interviews with the respondents in Wallonia and the Brussels Capital. The Dutch team is responsible for the information from Flanders and synthesised all the information in the final national report.

2 The Belgian biotechnology policy profile: 1994-2001

2.1 Introduction

In this chapter we present an overview of the policies in the biotechnology innovation system in Belgium in 2001 and its changes since 1994. We distinguish between so-called vertical policies with instruments and programmes, which are directly aimed at influencing the biotechnology system, and horizontal policies with instruments and programmes, which mostly have an indirect influence.

Belgium has a population of a little over 10 million. Belgium has a very open economy and is very dependent on trade, with imports accounting for 85% and exports accounting for 88% of the gross domestic product (GDP)[1]. Especially the food and pharmaceutical industry are important sectors for Belgium. The agriculture sector is not very important for the country, accounting for only 1.3% of the GDP[2].
Belgium used to invest relatively little in R&D with a gross expenditure on R&D (GERD) that accounted for 1.7% of GDP in 1994[3]. This was below the EU as a whole with 1.8% of GDP. However, since 1996 the Belgian investments in R&D have been increasing and in 1999 the GERD accounted for 1.98% of GDP[4]. The business sector finances the most important share of the total R&D expenditures with 67% in 1999. The government accounts for 23% of the total R&D expenditures[5].

Belgium is a Federal State and includes three Communities (French Community, Flemish Community and German-speaking Community) and three Regions (Walloon Region, Brussels-Capital Region and Flemish Region). Communities are based on language and cultural differences and correspond to population groups. Regions are historically inspired by economic activity and based on a territorial concept. In Flanders, the Flemish Region and the Flemish Community are integrated into one government. In Wallonia, the French Community, the German-speaking Community, and the Walloon Region operate as separate entities.

The Communities are responsible for the general support for research carried out in higher education institutions. The Regions provide the general support for industrial and technological research and innovation. The Federal Authority, besides supporting research required for the fulfilment of its own assignments, also finances the federal scientific institutions, space research conducted in an international context, data transfer networks between scientific institutions as well as several other activities requiring uniform implementation at national or international level
(http://www.cordis.lu/belgium; Capron et al., 2000).

At federal level, the primary body responsible for research and development is the Office of Scientific, Technical and Cultural Affairs (OSTC). Main tasks of OSTC are the allocation of S&T resources to support the federal S&T policy, the management of ten federal research centres, and the implementation of research actions and

[1] National Institute for Statistics, http://statbel.fgov.be/home_nl.htm, figures for 2000
[2] National Bank of Belgium, http://www.nbb.be/belgostat/, figures for 2000
[3] Federal Office for Scientific, Technical and Cultural Affairs, http://www.belspo.be/belspo/home/
[4] Federal Office for Scientific, Technical and Cultural Affairs, http://www.belspo.be/belspo/home/
[5] Federal Office for Scientific, Technical and Cultural Affairs, http://www.belspo.be/belspo/home/

programmes on themes of national or international scope. In addition to the OSTC, several federal ministries have budgets for specific research institutes and research projects (Benedictus and Enzing, 1999; Capron et al., 2000).
In Flanders, the Ministry of the Flemish Community funds the public support for science and technology. The Department of Education provides basic funding for the universities. The S&T policy is prepared, co-ordinated and implemented by the Science and Innovation Administration (AWI). Funding is channelled through the Fund for Scientific Research-Flanders (FWO-Flanders) for fundamental research and the Flanders Institute for the Promotion of Innovation by Science and Technology (IWT) for R&D at companies and industry-related research at universities and institutes.
For the French Community Government, the General Directorate for the Non-Compulsory Education and Scientific Research (DGENORS) provides funding for fundamental research at universities and sets up funds for general scientific research (FNRS-National Scientific Research Fund and associated funds). The General Directorate for Technology, Research and Energy (DGTRE) of the Ministry of the Walloon Region supports applied and strategic research, through various schemes.
In Brussels Capital Region, support for science and technology is co-ordinated by the Research and Innovation Department at the Administration of Economic Affairs.

Biotechnology research in Belgium is carried out by universities, research institutes and in industry. In Flanders important players are those departments united in VIB and other departments at universities in Leuven, Gent, Antwerp, and Brussels. Other relevant university centres in Belgium are the Université Catholique de Louvain, the Centre for Research in Biotechnologies at the Université Libre de Bruxelles, the biotechnology centre at the Université de Liège, the Faculté des Sciences Agronomiques à Gembloux, the Facultés Universitaires Notre-Dame de la Paix à Namur, the Limburgs Universitair Centrum, the Université de Mons-Hainaut, and the Faculté Polytechnique de Mons. In addition, there are several research institutes that also perform biotechnology research like the federal Belgium Co-ordinated Collections of Micro-Organisms, the federal Veterinary and Agrochemical Research Centre (VAR), and the Flemish Institute for Technological Research (VITO).
The Belgian biotechnology industry consists mainly of young and small firms (80%) and national bases of multinationals. The focus of the Belgian biotechnology industry is mainly on health related applications (Benedictus and Enzing, 1999).

In this chapter we present the instruments according to various policy types. Policy types are:

a) vertical policies that support the knowledge base
b) vertical policies that support commercialisation
c) vertical policies with a socio-economic and ethical dimensions
d) horizontal policies that support science and technology
e) horizontal regulation matters for the biotechnology industry
f) horizontal legislation on intellectual property rights
g) horizontal measures to assure the availability of financial capital in high-growth sectors.

Instruments can be found under several policy types as they often combine a broad mixture of policy goals. Annex 1 shows how the instruments match with the various policy types.

2.2 Vertical policies in the Belgium biotechnology innovation system in 2001

2.2.1 Policies for knowledge base support

2.2.1.1 Instruments to encourage basic research

Only Flanders has specific biotechnology instruments for the support of basic biotechnology research. Flanders Inter-University Institute for Biotechnology (VIB) was installed in 1995 and acts as a virtual biotechnology institute in which several academic research departments at the universities of Leuven, Gent, Brussels and Antwerp participate. In addition to the support to its different departments, VIB also supports other research groups through open calls or specific research projects. VIB has an annual research budget of Euro 50 million of which 56% (Euro 28 million) is donated by the Flemish Government. VIB started in 1996 and in 2001 a new 5-year contract was concluded (VIB annual report 2001).

2.2.1.2 Instruments to encourage industry oriented (and applied) research

In Flanders, VIB aims to stimulate technology transfer of new findings and technologies originating from its strategic basic research. VIB's Technology Transfer Office protects inventions via patent applications and forms the central communication point for companies and investors who want to bring new applications – based on VIB's biotech know-how and proprietary technology – onto the market (http://www.vib.be; VIB Annual Report 2001).

In Wallonia, the Mobilising Programmes aim at fostering research in strategic areas. One of these Mobilising Programmes is the BIOVAL programme on valorisation of cellular biological assets. It aims at reinforcing R&D in universities and enterprises and promotes co-operation between them. It supports the development of innovative products and technologies in order to create new markets and employment in Wallonia. The programme was launched in 1998 and lasts for 3 years. The total budget is Euro 18.5 million. The programme is managed by DGRTE of the Ministry of the Walloon Region (http://trendchart.cordis.lu).

2.2.1.3 Instruments strengthening academic co-operation

VIB is first of all a virtual centre of excellence: it combines nine university departments and five associated laboratories. One of the most important purposes of VIB is to strengthen academic interaction between public research institutes and among disciplines.

In Wallonia two centres of excellence have been created, one is in the field of biotechnology research: the Biotechnology Research Centre (CRB) of the Université Libre de Bruxelles at Charleroi (European Commission, 2001).

2.2.2 Policies for commercialisation support

2.2.2.1 Instruments to build up technological capabilities for the industry

An important objective of VIB is, in addition to performing high-quality scientific research, to serve as a centre of excellence for the industry and to transfer research results to biotechnology companies (http://www.vib.be; VIB Annual Report 2001).

In Wallonia, the CRB of the Université Libre de Bruxelles at Charleroi has been created as a centre of excellence in which industry relevant research is performed and services are provided to the industry (European Commission, 2001).

2.2.2.2 Instruments to encourage the commercialisation of scientific results from public research organisations

One of the purposes of VIB is valorising the results of the biotechnology research in the VIB departments. The Technology Transfer Office has been set up to transfer technologies and research results to existing companies by establishing alliances and concluding contracts and to create new companies. It prepares business plans and searches for investors who want to invest in spin-offs. VIB also aims to improve the biotechnology infrastructure and to set up bio-incubators (http://www.vib.be; VIB Annual Report 2001). Together with the Investment Company for Flanders (GIMV), VIB has set up the Biotech Fund Flanders in 1994. This fund invests in biotechnology start-ups (http://www.gimv.be).

2.2.2.3 Instruments to encourage public-private collaboration

VIB aims to stimulate the co-operation between public research organisations and industry by means of research programmes, in which industry involvement is obligatory. The Technology Transfer Office acts as a mediator between research departments and biotechnology companies (http://www.vib.be; VIB Annual Report 2001).

2.2.3 Policies with a socio-economic and/or ethical dimension

In 1996, the Federal Government installed the Belgian Committee for Bio-ethics. This Committee aims to inform the public about bio-ethics and to advice federal and local government and research institute (http://www.health.fgov.be/bioeth/).

Another purpose of VIB is to stimulate a well-structured social dialogue on biotechnology. VIB provides education and information concerning biotechnology and performs social research studies. A special Technology Assessment Office has been set up in order to co-ordinate these tasks and performs specifically technology assessment projects on various biotechnology-related social issues. In addition, a special platform committee has been set up, in which various experts in socio-economic and ethical areas provide advice on several biotechnology issues (http://www.vib.be; VIB Annual Report 2001).

2.3 Horizontal policies in the Belgium biotechnology innovation system in 2001

2.3.1 Science and technology policies

2.3.1.1 Instrument to support the knowledge base, including mobility of researchers

At the federal level, OSCT manages the federal research centres, allocates scientific and technical resources and implements research actions and programmes on themes of national or international scope. OSCT funds the Belgium Co-ordinated Collections of Micro-Organisms (Euro 11.1 million) and provides support by means of a network programme, the Inter-University Poles of Attraction (IUAP/PAI) in which collaborative academic research projects are funded. The IUAP/PAI was established in 1987 and the fourth phase of this programme ended in 2001. The total budget for five years was Euro

111.55 million. The fifth phase starts in 2002 and the total budget for the next five years will be Euro 111.64 million (http://www.dwtc.be/).
Other federal ministries like the Ministries of Small Enterprises, Traders and Agriculture, Public Health and Environment, and Economic Affairs have budgets for specific research institutes and research projects (Benedictus and Enzing, 1999; Capron et al., 2000) [6].

In Flanders, FWO-Flanders provides support for fundamental research in strategic areas by means of fellowships and funding of research projects (annual budget Euro 110 million) (http://sun.fwo.be). Also IWT provides funding for scholarships and research fellowships (continuous annual budget "Onderzoeksmandaten": Euro 0.8 million, "Specialisatie Beurzen": Euro 18.25 million). In addition, in 2001 the Generic Basic Research at Universities (GBOU) programme of IWT is introduced and this programme aims to stimulate strategic technological research at universities, which is also relevant for the economy and society in the long term (Euro 20.2 million in 2001). All programmes are open to all research areas (http://www.iwt.be; IWT Annual Report 2001). Funding is also provided for VITO, the Flemish Institute for Technological Research. VITO supplies both industry and government with strategic research in environmental, materials and energy issues, including biotechnology (Euro 25.46 million annually) (http://www.vito.be).

DGRTE of the Ministry of the Walloon Region provides support for the knowledge base by the programme 'Les Recherches d'Initiative". By means of an open call system, individual research projects at universities and research centres are funded. The programme started in 1991 and the fifth call was announced in 2002. The total budget in 2000 was Euro 41.68 million. The programme is open to all research areas (http://mrw.wallonie.be/dgtre/).
DGENORS of the Ministry of the French Community funds university institutions and sets up funds for general scientific research (FNRS -National Scientific Research Fund and associated funds), organises concerted research activities and is responsible for the special fund for research in university institutions. FNRS supports researchers by providing them with temporary or permanent funding (http://www.fnrs.be). Another programme is the "Actions de Recherche Concertées" (Concerted Research Actions - ARC). The ARC programme is aimed at developing centres of excellence specialised in areas that are essential to scientific progress. The ARC programme started in 2000. The "Fonds Spécial pour la Recherche" (Special Research Fund) also started in 2000 and is a research grant provided to university institutions. These programmes are all open to all research areas (http://www.cordis.lu/belgium; http://www.cfwb.be/infosup/).

The Brussels-Capital Region initiated two instruments to support young promising researchers in universities and research institutes. "Research in Brussels" aims to attract foreign researchers to university research centres in Brussels and "Prospective Research for Brussels" supports promising young researchers with scholarships in order to stimulate research in sectors crucial to the Brussels Capital Region. In 2000, approximately Euro 2.97 million was available for the 'Prospective Research for Brussels" programme. The programmes are open to all research areas (http://www.cordis.lu/belgium; http://www.bruxelles.irisnet.be).

[6] Due to institutional reforms several tasks and responsibilities are transferred from federal ministries to regional authorities and remaining federal tasks and responsibilities are re-structured. This also implies that the ministries mentioned here can have different tasks, responsibilities and names in the near future.

2.3.1.2 Instruments to support the commercialisation of technologies

The Ministry of Finance of the Federal Central Government initiated an "Increased tax deduction rate for R&D investments and patents acquisition" for small and large companies in order to stimulate R&D and commercialisation of research results. In addition there is a "Tax deduction for increase in R&D personnel" available for all companies that hire R&D personnel (http://www.cordis.lu/belgium).

In Flanders, IWT provides companies with grants for industrial research (Euro 38.2 million in 2001). In addition, there are also several specific programmes (IWT Annual Report 2001, http://www.iwt.be; http://trendchart.cordis.lu/)

- The "Flemish Innovation Collaborations" (VIS) programme aims to stimulate networks of companies and research institutes. The programme started in 2001 and has an annual budget of Euro 14 million.
- The "Non-university Higher Education Fund" (HOBU) fund aims to support research projects, which are carried out by a higher education institute in collaboration with companies and a science-based partner. This fund started in 1997 and the total budget in 2001 was Euro 6 million.
- The "Programme for the Stimulation of Innovation in SMEs" (KMO) aims to stimulate technological innovation at small and medium enterprises (SMEs). The KMO programme supports technological advices by research institutes and projects aimed at the realisation of innovations. This programme replaces former programmes and started in 2001. The budget for 2 years is Euro 19.83 million.
- The "Generic Basic Research at Universities" (GBOU) programme also aims to support research projects which especially involve the industry (users of technology) and which are focused at utilisation within the industry. The programme started in 2001 and is the result of the reform of previous programmes. Its budget in 2001 was Euro 20.2 million.
- The "University Interfaces" programme supports university-industry co-operation, creation of spin-offs, valorisation of research results and intellectual property rights (IPR) to universities. This programme started in 1998 and has an annual budget of Euro 1.31 million.

The programmes are open to all research areas.

The PLATO programme resulted from the "Strategic Plan Kempen" and aims to connect small and medium enterprises to large companies for parentinghood in order to establish technology transfer and stimulate networking. The PLATO programme started in 1998 (http://www.innet.spk.be/spk/Plato; http://trendchart.cordis.lu).

Each province in Flanders has a Regional Development Agency (GOM) to support new investments and innovation projects and start-ups. They especially take care of technology diffusion towards SMEs. Other organisations that support companies in technological development and take care of technology diffusion are the Regional Technology Advisory Centres (RTAC) (Capron et al., 2000).

DGRTE of the Ministry of the Walloon Region manages several programmes to support the commercialisation of technologies (http://trendchart.cordis.lu; http://mrw.wallonie.be/dgtre/)

- The "Enterprise Subsidy" programme supports basic industrial research projects of enterprises. The programme started in 1994 and its annual budget is Euro 6.2 million.

- The “Interest Free Loans” programme supports companies with realisation of research results by providing interest-free loans. The programme was launched in 1990 and approximately Euro 24,800 is spent per year.
- The “Responsible Innovation Technologique (RIT)” programme supports the hiring of a technological innovation manager in small and medium enterprises for undertaking research projects and the realisation of research results. The programme started in 1981 and has annual budget of Euro 1.24 to 1.48 million. Since 1989, this programme has also been providing specific extra support to SMEs in collaboration with a European partners (approximately Euro 248,000 annually).
- The “Technico-Economic Studies” programme supports SMEs in evaluating chances of success of new products, processes or services. The programme was launched in 1981 and approximately Euro 1.24 million is spent per year.
- The “FIRST doctorate enterprise” programme supports research of PhD students performed in collaboration between university and industry. The programme started in 1991 and in 1999 the budget was Euro 1.09 million.
- The “FIRST Europe” programme also started in 1999 and supports researchers and research projects performed in collaboration between a company in Wallonia and a EU research institute. In 1999, the budget was Euro 2.84 million.
- The “Feasibility Studies for Technical Support” programme supports SMEs by financing feasibility studies carried out by a research institute. The programme started in 1990 and in 1996 the budget was approximately Euro 700,000.
- The “Technology Transfer” programme supports SMEs by financing feasibility studies for technology transfer.
- The “Horizon Europe” programme supports companies and research centres in preparing co-operative research projects in the 5th Frameworks of the EU. The programme started in 1991 and in 2000 the budget was Euro 94,200.
- The “Fund for the Industrialisation and Commercialisation of the Results of Research Financed by the Region” provides equity and loans to companies in order to exploit the research results of research projects co-financed by the Walloon government. The fund was installed in 1999 and its total budget is Euro 46.5 million.
- The “University Interfaces” programme stimulates industry-university relationships by financing specialised personnel in charge of fostering the valorisation. The programme started in 1998 and was completed in 2001. The total budget available was Euro 2,900.
- Since 1971, the “Support for Immaterial Investment” programme has been supporting companies in acquiring immaterials like patents and licences.
- The “Arrêté Royal 123” supports hiring unemployed persons in SMEs for development projects. This measure started in 1994 and in 2001 its budget was Euro 10.41 million.

The programmes are open to all research areas.

Since 1985, the Research and Innovation Department at the Administration of Economic Affairs of the Brussels Capital Region has been granting subsidies for basic industrial research. In 2000, the programme “Support for the development of prototypes, new products and processes” started with an annual budget of Euro 1 million. Since 1982, there have been subsidies for hiring unemployed personnel (Arrêté Royal 123) for development projects and for immaterial investments like acquisition of patents and licenses (http://trendchart.cordis.lu).
In addition, a service-centre for innovation management has been set up. This centre is the Brussels Technopol. Technopol aims to build synergies between public and private

economic and scientific organisations and offers a complete set of services of various organisations to small and medium enterprises (European Commission, 2001).

2.3.1.3 Instruments to support firm creation

There are several instruments in Flanders to stimulate firm creation. The Flemish government supports the establishment of incubators and innovation centres in science parks or at universities by means of the "Incubators and Innovation Centres" programme. Already three of these centres have been created, each supported by Euro 250,000 (http://trendchart.codis.lu). The Flemish government also supported the establishment of the "Vlerick Business Angels Networks" (Vlerick BAN) in 1998. The Vlerick BAN is a matching service between business angels and entrepreneurs and mediates for risk capital and advice to start-ups (http://trendchart.cordis.lu). The Investment Company for Flanders (GIMV) has been set up as a public investment organisation to provide financial capital and advice mainly to start-ups. In 1997 GIMV did an Initial Public Offering (IPO) and the Flemish government decreased its shares in GIMV. Nevertheless, GIMV continues to fulfil its advisory task to the Flemish government and a special participation group represents the shares of the Flemish government. GIMV invested Euro 210 million in 2001 (http://www.gimv.be).

DGRTE of the Ministry of the Walloon Region manages two programmes to support firm creation (http://trendchart.cordis.lu; http://mrw.wallonie.be/dgtre/):

- The "FIRST Spin-off" programme supports university researchers to set up a spin-off. This programme started in 1999 and its annual budget is approximately Euro 1.09 million.
- The "Pre-activity grant" is provided to individuals who propose a project for the creation of a new firm based on a good idea. This scheme started in 2001 and the annual budget is approximately Euro 150,000)

In addition, the Walloon government has set up various "Business Innovation Services" that provide a wide range of services for the creation and development of companies. Like in Flanders, a Business Angels Network has been set up, which serves as a mediator between demand and supply of risk capital. It provides both risk capital and advice to start-ups. Like GIMV in Flanders, the Société Régionale d'Investissement de Wallonie (S.R.I.W.) is an investment company that invests seed and risk capital in Belgium and abroad (European Commission, 2001).

Like in Wallonia and Flanders, the Brussels Capital Region has set up a business angels network (Business Angels Connect), that acts as a mediator between supply and demand of risk capital. The Business Angels Connect is managed by the Erasmus European Business and Innovation Centre. This centre also supports start-ups by providing various business services. The Brussels Regional Development Centre (SRIB/GIMB) aims to provide support for start-ups by taking participations in these start-ups (http://trendchart.cordis.lu; European Commission, 2001; http://www.eebic.be).

2.3.2 Regulation matters for the biotechnology industry

Belgium implemented the various European directives, regulations, rules and decision on biotechnology in both federal and regional regulation. Various authorities are responsible for this regulation: the Federal Ministry of Employment, the Brussels Institute for Management of the Environment, the Flanders Ministry of Environment,

the Flanders ANIMAL[7], the Walloon Ministry of Environment, the Federal Ministry of Small enterprises, Traders and Agriculture, and the Federal Ministry of Social Affairs, Public Health and Environment. Although several authorities are responsible for the regulation, Belgium has one single scientific evaluation system for biosafety issues. This system has two entities: the Biosafety Council and the Service of Biosafety and Biotechnology (SBB). The Council advises the various authorities about biosafety issues (deliberate release). SBB supports the Council by performing risk assessments and evaluations of both contained use and deliberate releases (http://biosafety.ihe.be/). The integrated evaluation system follows from the recent emphasis on efficient administration (e.g. the Ministry of Small Enterprises, Traders and Agriculture will be closed in 2002). In Flanders, VIB also has the social mission to help governmental authorities by developing and scientifically supporting a regulating framework for biotechnology. VIB provides a platform for discussions and advice concerning regulation matters (http://www.vib.be; VIB Annual Report 2001).

2.3.3 Legislation on Intellectual Property Rights (IPR)

The Federal Government is responsible for the Belgian patent system. In addition to the traditional role of administration, the Federal Office for Intellectual Property Rights develops a pro-active awareness-raising campaign about the economic importance of patents. The Federal Government wants to improve the protection and exploitation of IPR in Belgium. The following proposals for new measures have been developed:

- introducing a grace period allowing the author of a paper to request a patent;
- allowing a legal entity to request a patent on behalf of an employee;
- measures to reduce the cost of patenting; on-line filing of patents;
- providing additional personnel for federal-funded PSROs to carry out prospective analysis.

In addition the Federal Ministry of Finance supports the acquisition of patents by an increased rate of tax deduction for R&D investments (European Commission, 2001; http://trendchart.cordis.lu).

One of the purposes of VIB is to transfer research results to companies by patenting the discoveries of the research departments. These patents are then converted to companies in various agreements (http://www.vib.be; VIB Annual Report 2001).

In 1998, the Walloon Government initiated the “IPR to Universities” programme in which patent rights on research results of projects financed by the government are granted to the universities. The budget available for 2 years is Euro 1.39 million. In addition, the government reimburses the costs of patenting of universities, for projects financed by the government. In the previously described “University Interfaces” programme, special personnel can be hired by universities in order to support them in IPR issues (Euro 2,900 annually) (http://trendchart.cordis.lu).

2.3.4 Availability of financial capital in high growth sectors

Like described in section 2.3.1.3, there are several investment companies and public instruments to provide risk capital to biotechnology companies. In addition, the Flemish Guarantee Fund (FGF) gives guarantees for loss-coverage of risk capital, provided by investment companies investing in spin-offs of SMEs. It is an incentive for investment companies to take more risk (capital) in investments in SMEs. The fund includes Euro 74 million (European Commission, 2001).

[7] Administration Management of Environment, Nature, Land and Water

The Brussels Capital Region has set up another initiative: the web-site www.investinbrussels.be. This web-site aims to attract new investors by providing an on-stop-shop channel to investment information in Brussels.

2.4 Changes since 1994

Since 1994, the Belgian profile of policies aimed at science, technology and innovation certainly has been changed. Table 2.1 gives an overview of the changes in the relative importance of the various policy types in the period 1994–2001.

During the period 1993-2000, government funding of R&D at least doubled in Flanders and Wallonia. The Flemish Government is the most important player in financing R&D; it is responsible for over 40% of the total public budget for R&D in Belgium. The Federal Government accounts for 33% of total public R&D funding (European Commission, 2001).
Just as in 1994, the Federal Government mainly provides funding for federal research institutes and research at universities. The Federal Government has no specific instruments to support biotechnology R&D and no direct subsidy schemes for firms. However, the federal Ministry of Finance introduced two important tax measures in order to stimulate the creation of new enterprises and innovation in enterprises. In addition, the Federal Government developed proposals for new measures in order to improve the protection and exploitation of Intellectual Property Rights in Belgium. In 1996, the Federal Government also installed the Belgian Committee for Bio-ethics. This committee aims to inform the public about bio-ethics and advises the government, research institutes and others about bio-ethical issues.

In Flanders, one of the main important developments during the period 1994-2001 in supporting biotechnology R&D has been the establishment of VIB in 1995. In 2000, VIB was continued after a positive evaluation. VIB is the most important initiative in Flanders and covers various policy fields we distinguished. Concerning horizontal policies, the new focus since 1994 has mainly been on support for collaborative innovation networks, university-industry interfaces and subsidies for R&D in companies. A new programme “Flemish Innovation Collaborations (VIS)” addresses these objectives and aims to support collaborative actions for industrial research, the provision of technological advice and the stimulation of innovation. Another relevant development is the trend towards a reduction in the number of schemes in order to increase the visibility and take-up by small and medium enterprises. In 2001, the new KMO scheme was introduced. It supports SMEs in doing feasibility studies and innovation projects and aims to increase transparency of the support system and to pay attention to non-technological issues in innovation. In addition, there are several initiatives to support start-ups, also by assuring the availability of financial capital to start-ups.

In Wallonia (including the French Community and Walloon Region) there used to be no biotechnology specific instruments. However, in 1998 the BIOVAL programme was initiated in order to stimulate collaboration between university and industry and valorisation of research results. In addition, a centre of excellence, the Biotechnology Research Centre (BRC), has been established.
Emphasis is put on the stimulation of commercialisation and firm creation and supporting start-ups. Several new instruments have been created in order to stimulate

new enterprises and to simplify the process of delivering support to companies (e.g. FIRST-programme).

In the Brussels-Capital Region, there are no biotechnology specific instruments. In order to support the general knowledge base, two programmes to attract young researchers have been installed. In addition, the government is giving increased attention to industrial research, commercialisation and creation of new enterprises. Several new schemes have been created to support start-ups and the creation of new enterprises (e.g. Business Angels Connect and business support centres).

No specific biotechnology policy or research and development strategy of the Government for the German Community was found.

Table 2-1 Biotechnology policy profile in Belgium

Policy types	Importance	
	2001	**Trend 1994-2001**
Vertical Policies in the biotechnology innovation system		
A. Policies for knowledge base support		
1. Instruments to encourage basic research	Fl: 5, other: 1	Fl: +, other: 0
2. Instruments to encourage industry oriented (and applied) research	Fl: 5, Wal: 3, other: 1	Fl: 0, Wal: +, other 0
3. Instruments for strengthening academic co-operation among PSROs and disciplines	Fl: 5, Wal: 2, other: 1	Fl: 0, Wal: +, other: 0
B. Policies for commercialisation support		
1. Instruments to build up technological capabilities for the industry	Fl.: 5, Wal: 2, other: 1	Fl: +, other: 0
2. Instruments to encourage the commercialisation of scientific results from PSROs	Fl.: 5, other: 1	Fl: +, other: 0
3. Instruments to encourage the collaboration between public and industrial research	Fl: 5, other: 1	Fl: 0, other: 0
C. Policies with a socio-economic and ethical dimension	Fed: 3, Fl: 5, other: 1	Fed: +, Fl: +, other: 0
Horizontal Policies in the biotechnology innovation system		
D. Science and technology policies		
1. Instruments to support the knowledge base, including mobility of researchers	Fed: 5, Fl: 5, Wal: 4, Brus: 2	All: 0, except Brus: +
2. Instruments to support the commercialisation of technologies	Fed: 3, Fl: 5, Wal: 5, Brus: 4	All: 0, except Fed: +
3. Instruments to support firm creation	Fed: 1, Fl: 5, Wal: 5, Brus: 4	Fed: 0, Fl: +, Wal: +, Brus: +
E. Regulation matters for the biotechnology industry	Fed: 3, Fl: 3, Wal: 1; Brus: 1	Fed: +, Fl: +, Wal: 0; Brus: 0
F. Legislation on intellectual property rights (IPR)	Fed: 4, Fl: 3, Wal: 2, Brus: 1	Fed: +, Fl: +, Wal: +, Brus: 0
G. Measures to assure the availability of financial capital in high-growth sectors	Fed: 4, Fl: 5, Wal: 4, Brus, 4	All: +

Source: EPOHITE Research

Fed: Federal Government, Fl: Flanders, Wal: Wallonia, Brus: Brussels Capital.

The policy measures are evaluated with an ascending scale from 1 to 5 based on an analysis of the emphasis given by the policy system to the specific instruments. To evaluate the change since 1994 a "0" is awarded to those instruments that have not experienced significant change in the emphasis received from the policy system since 1994, "+" and "-" indicate increasing or decreasing significance of the instruments.

3 The performance of the Belgian biotechnology innovation system

In this chapter we discuss the performance of the Belgian biotechnology system, in specific the Belgian biotechnology knowledge base and the commercialisation of biotechnology In Belgium. We do this by using data concerning scientific publications, patents, venture capital, Initial Public Offerings (IPOs) and firm creation. Moreover, a comparison is made between these indicators for Belgium and the EU average. No distinction is made between the various Belgian Regions and Communities, as data are only collected at a national level[8]. Annex 2 includes an overview of the indicators in absolute terms and the growth rates for Belgium and the EU. Annex 3 shows the indicators in absolute terms and growth rate for all EU members.

3.1 The performance of the Belgian knowledge base in biotechnology

The total number of Belgian scientific biotechnology publications has increased with 57% from 1176 in the period 1995/1996 to 1848 in the period 1999/2000 (figure 3-1). This is above the growth rate of the total number of EU biotechnology publications (+45.4%; annex 2). Belgium holds in the periods 1995/1996 and 1999/2000 the eighth position in the EU biotechnology publication activities, behind larger countries like the UK, Germany, France, Italy and Spain, but before other small European countries (annex 3). The share of Belgian biotechnology publications in the total number of EU biotechnology publications increased slightly from 3.5% in the period 1995/1996 to 3.7% in the period 1999/2000 (figure 3-2). When considering the biotechnology publications in per capita units, Belgium has a more attractive ranking with the sixth position in 1995/1996 (115.65 publications per million inhabitants) to the fifth position in 1999/2000 (180.46) leaving the UK, Germany and France behind (annex 3).

In 1995/1996, the Belgian biotechnology publications were cited 5,291 times. This increased with 59% to 8,402 citations in the period 1999/2000 (figure 3-1). The increase in citations is below the growth rate for the EU total number of citations to biotechnology publications (+68%; annex 2). In both periods Belgium ranks in the European middle field, when taking into account the share of citations to biotechnology publications in the total number of EU citations to biotechnology publications (3.9% in 1995/1996 and 3.7% in 1999/2000) (annex 3). However, if we correct the number of citations to biotechnology publications for the publication output in biotechnology in 1995/1996 Belgium held the second position in Europe, just behind the UK. Nevertheless, in 1999/2000 Belgium lost its high ranking and moved to the seventh position (annex 3).

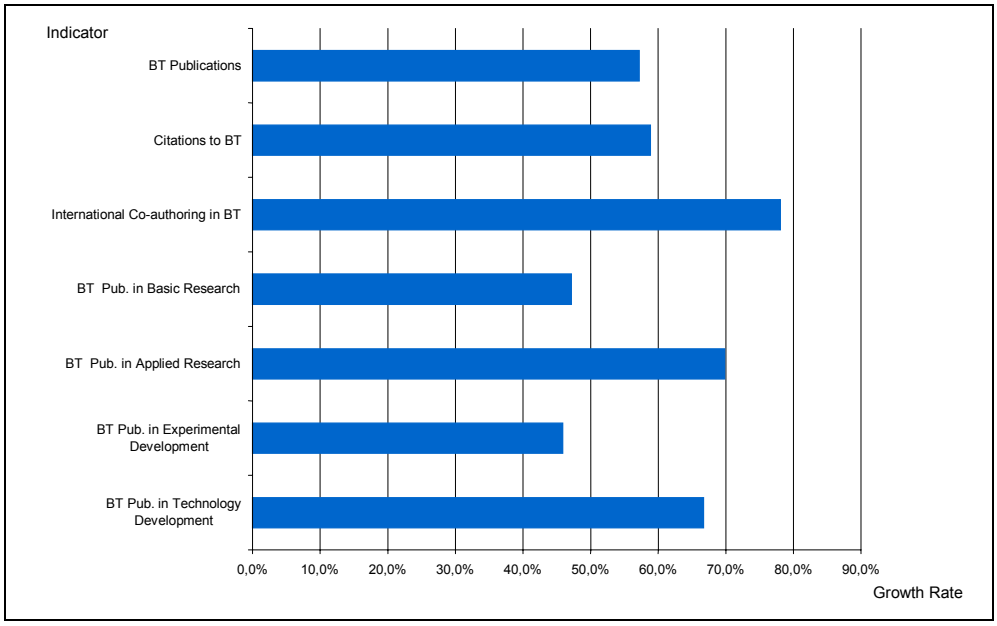
In 1995/1996, 546 international co-publications with at least one Belgian author were published. Figure 3-1 shows that the number of international co-publications with at least one Belgian author increased with 78% to 972 in the period 1999/2000. This growth rate is one of the highest in the EU (EU growth rate is +66.6%; annex 2). Nevertheless, Belgium holds a middle position in the EU ranking, behind the larger

[8] In this case study the notion of the structure of the Federal State of Belgium is taken into account. This means that attention is given to differences and similarities between the various Belgian Regions and Communities. However, for operational reasons, information about the performance of the Belgian biotechnology innovation system has been collected and analysed at an aggregate level.

countries like the UK, Germany and France, but also the Netherlands, Sweden and Spain (annex 3). The share of the number of the co-publications with at least one Belgian author in the total number of co-publications in the EU increased from 4.5% in 1995/1996 to 4.8% in 1999/2000 (figure 3-2). Belgium has a much better ranking in the EU if we relate the number of international co-publications to the total number of biotechnology publications. In 1999/2000 Belgium ranks together with Portugal and Austria at the EU top with 53% of all Belgian biotechnology publications realised in international collaboration. The situation in 1995/1996 was almost similar (annex 3).

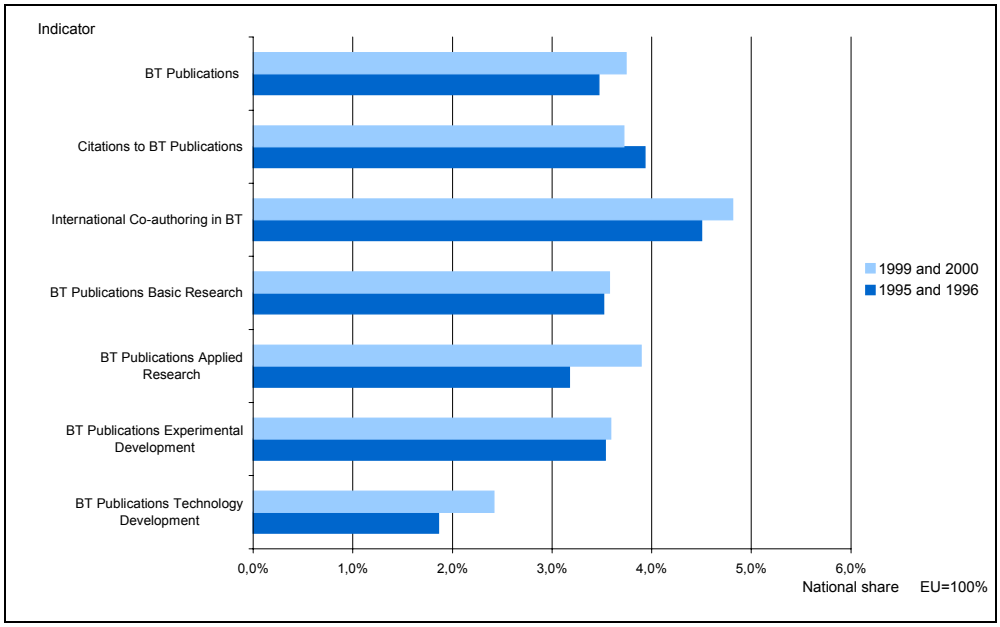
Most Belgian biotechnology publications concern the first two stages of the innovation process: basic research and applied research. Figure 3-1 shows that in the period from 1995/1996 to 1999/2000, the strongest increase can be found in publications in the field of applied research (almost +70%). This increase is far above the EU growth rate of +38.47% (annex 2). This could also explain the rather strong increase in the share of Belgian biotechnology publications concerning applied research in the total EU number (from 3.2% in 1995/1996 to 3.9% in 1999/2000) (figure 3-2). However, Belgium still holds a middle (eighth) position in the EU ranking (annex 3). A strong increase in the number of biotechnology publications is also shown in publications in the field of technology development (+66%). However, this area is the smallest area in biotechnology publications not just in Belgium, but also in rest of the EU (figure 3-2, annex 2).

Figure 3-1 Biotechnology (BT) knowledge base indicators for Belgium. Growths rates between '1995/1996' and '1999/2000'.



Source: EPOHITE Research
Data: Science Citation Index

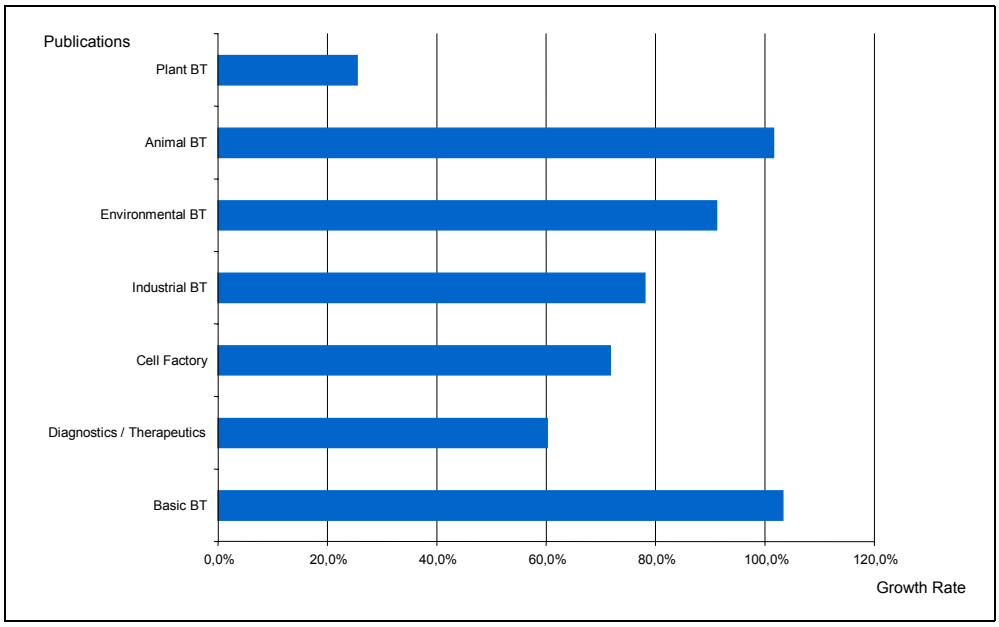
Figure 3-2 Biotechnology (BT) knowledge base indicators for Belgium National share in the European Union (EU), a two period comparison.



Source: EPOHITE Research
Data: Science Citation Index

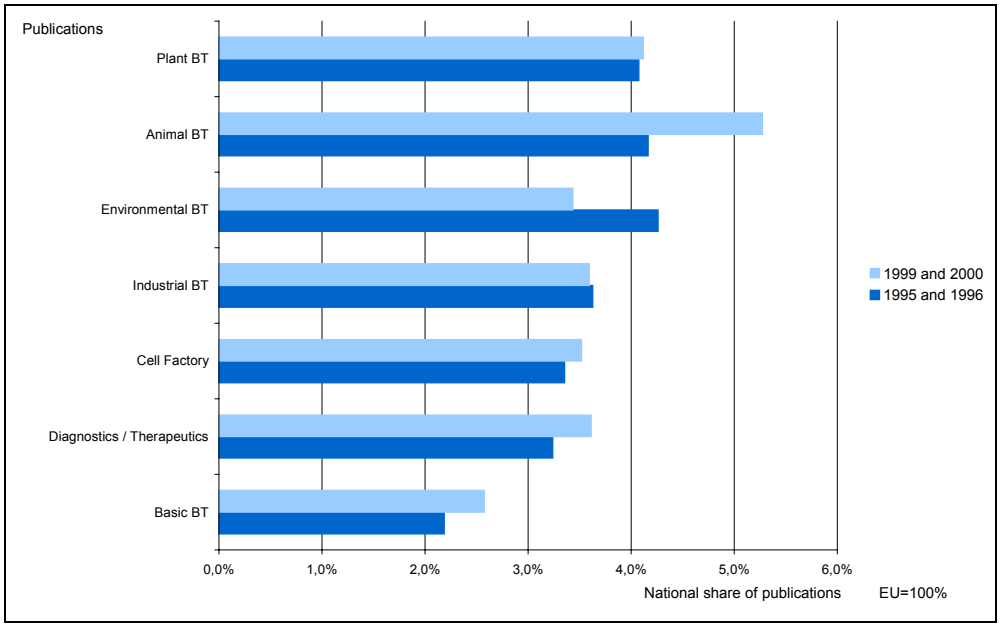
Belgian biotechnology publications can especially be found in the fields of diagnostics/therapeutics, cell biotechnology, plant biotechnology and animal biotechnology. In the period 1995/1996-1999/2000, strong increase is especially shown in animal biotechnology (+101.5%), basic biotechnology (+103.2%) and environmental biotechnology (+91.1%) (figure 3-3). The share of the basic and environmental biotechnology publications in the total number of Belgian biotechnology publications is the smallest. The increase in publications concerning animal biotechnology and basic biotechnology is largely above the EU growth rate (respectively +55% and +72%; annex 2). This could explain the increase in the share of Belgian animal and basic biotechnology publications in the total EU biotechnology publications concerning these areas (figure 3-4). Considering all Belgian biotechnology publications, its share in the EU animal biotechnology publications is the largest (5.3%). However, in all fields Belgium holds a middle position in the EU ranking. Even though the publication growth rate in environmental biotechnology publications is rather strong, the Belgian share in the total EU environmental biotechnology publications decreased considerably as this growth rate is far below the EU growth rate (+137%) (figure 3-4; annex 2).

Figure 3-3 Biotechnology (BT) sub-fields
Growth rates of Belgium publications between '1995/1996' and '1999/2000'.



Source: EPOHITE Research
Data: Science Citation Index

Figure 3-4 Biotechnology (BT) sub-fields
Belgian share of scientific publications in the European Union (EU), a two period comparison.



Source: EPOHITE Research
Data: Science Citation Index

3.2 The commercialisation of biotechnology in Belgium

Belgium holds a middle position in the EU ranking when taking into account the share of the Belgian number of biotechnology firms in the EU total of biotechnology firms. Even though the number of firms shows a large increase of 86% from 35 biotechnology firms in 1996 to 65 biotechnology firms in 2000 (figure 3-5), the share of the Belgian biotechnology firms in the total EU number decreased from 5.26% in 1996 to 4.83% in 2000 (figure 3-6), since this growth is below the EU growth rate (+102%; annex 2). However, if we take the size of the country into account and relate the number of companies to the number of inhabitants Belgium holds in both periods the fifth position in the EU ranking, leaving large countries like the UK, Germany and France behind (annex 3).

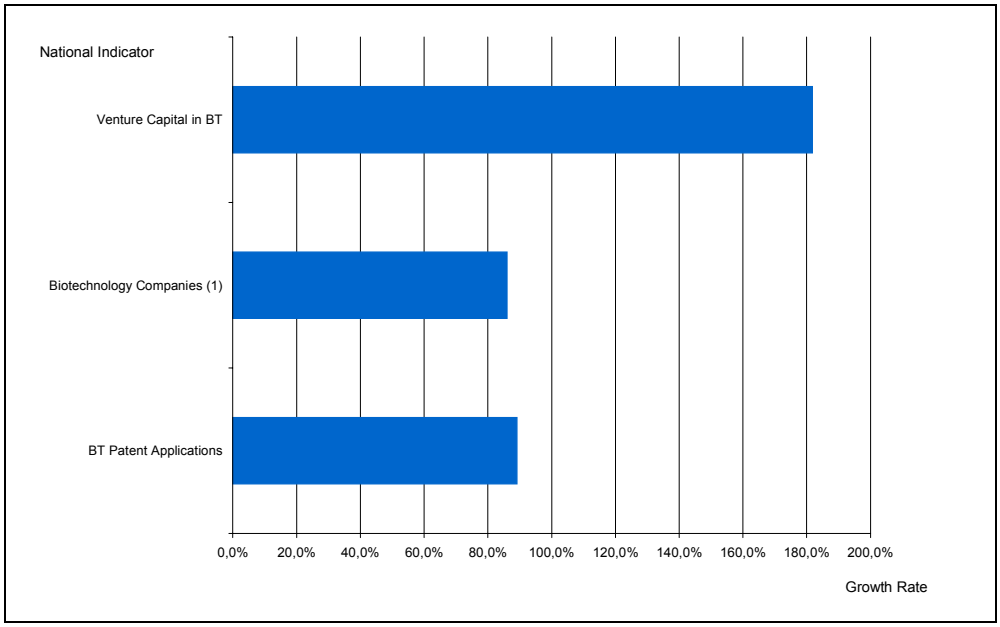
Considering the amount of venture capital invested in biotechnology, Belgium belongs together with the UK, Germany and France to the EU top (annex 3). Figure 3-5 shows that the amount of venture capital invested in biotechnology increased with 181.7 % from 21.45 million PPP[9] in 1995/1996 to 60.44 million PPP in 1999/2000. Nevertheless, the Belgian growth rate in venture capital invested is below the EU growth rate (+337.7%, annex 2). This explains the rather strong decline in the share of the venture capital invested in Belgian biotechnology firms in the total EU amount of venture capital invested in biotechnology (from 8.03% in 1995/1996 to 5.2% in 1999/2000) (figure 3-6). Belgium can still keep its top position in the EU ranking, however the gap with other countries is getting closer (annex 3).

Belgium's position in the number of IPOs is staying behind in relation to other EU countries. The latest IPO of a biotechnology firm in Belgium was in 1996, while at EU level the total number of IPOs increased with 48.4% from 31 IPOs in 1995/1997 to 46 IPOs in 1998/2000 (annex 2).

The Belgian biotechnology patent applications at the European Patent Office strongly increased with 89.3% from 140 applications in 1995/1996 to 265 applications in 1999/2000 (figure 3-5). This increase in patent applications is above the EU growth rate (+69.3%; annex 2). This also explains the slight increase in the share of the Belgian patent applications in the total EU number of patent applications (from 5.14% in 1995/1996 to 5.74% in 1999/2000) (figure 3-6). With this share Belgium has a middle position in the EU ranking (annex 3). However, Belgium has a much stronger position in biotechnology patent activities when taking the size of the country into account: in 1999/2000 Belgium holds a second position in the EU ranking with 25.9 patent applications per million inhabitants, leaving all the large EU countries behind. In 1995/1996 Belgium had a third position (annex 3).

[9] Purchasing Power Parity

Figure 3-5 Indicators for the commercialisation of biotechnology (BT) in Belgium
Growth rates between '1995/1996' and '1999/2000'.

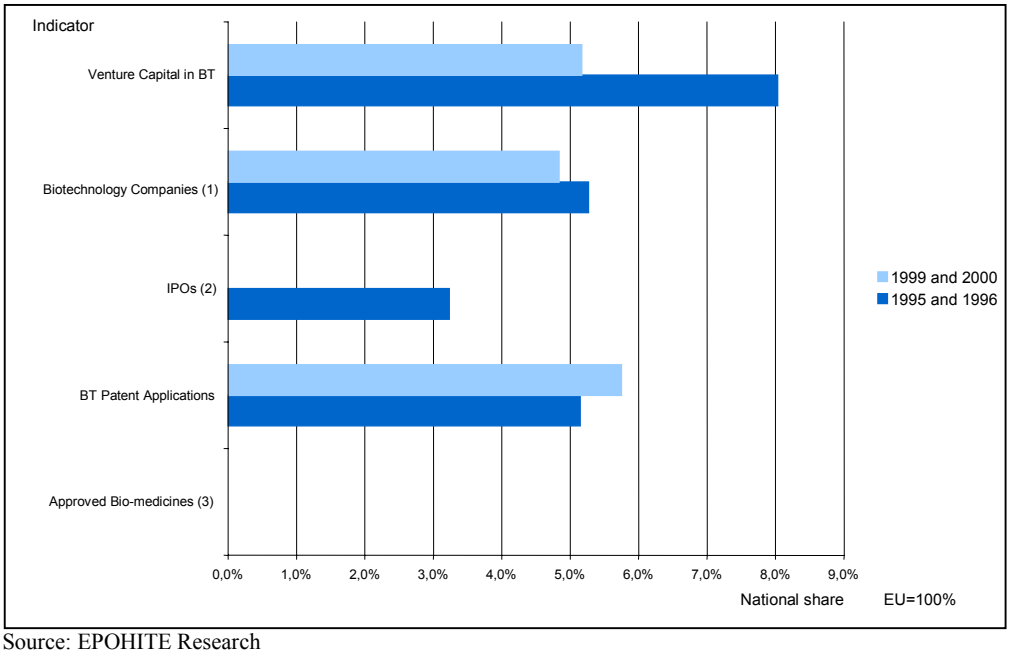


Source: EPOHITE Research

Data: European Venture Capital Association (EVCA), Ernst & Young Annual European Life Sciences Reports, Nasdaq, Neuer Markt, London Stock Exchange and Euronext's Websites, European Agency for the Evaluation of Medicinal Products (EMEA), Database of International Patent Applications (PCTPAT), Database of European Patents (EPAT)

Note: (1) The growth rate refers to the years 1996 and 2000

Figure 3-6 Indicators for the commercialisation of biotechnology (BT) in Belgium National share in the European Union (EU), a two period comparison.



Source: EPOHITE Research

Data: European Venture Capital Association (EVCA), Ernst & Young Annual European Life Sciences Reports, Nasdaq, Neuer Markt, London Stock Exchange and Euronext's Websites, European Agency for the Evaluation of Medicinal Products (EMEA), Database of International Patent Applications (PCTPAT), Database of European Patents (EPAT)

Notes: The figures for each period result from adding up the figures of the given years.

(1) The two periods correspond to 1996 and 2000

(2) Due to low absolute numbers the two periods correspond to 1995-1997 and 1998-2000

(3) Due to low absolute numbers the two periods correspond to 1995-1997 and 1998-2001

3.3 Conclusions

The overall results show that Belgium has improved its performance between 1995 and 2000. The number of publications, citations, international co-publications, biotechnology companies, patents and the amount of venture capital invested has increased seriously and some times even more than the EU growth rate. In absolute terms, Belgium holds a middle position in the EU ranking, behind the larger countries, but before other small countries in the EU. However, Belgium's position concerning the knowledge base and the commercialisation of biotechnology is much more attractive when taking into account the relative figures. Especially in international biotechnology co-publications, biotechnology patent applications, biotechnology companies and venture capital invested in biotechnology Belgium has a top position in the EU ranking, leaving larger EU countries behind. This implies that Belgium, as a small country, has a good position in the European biotechnology innovation system. However, the relevancy of the Belgian biotechnology knowledge base as perceived by others could be declining as Belgium has lost its strong position in the share of citations to the Belgian biotechnology publications. In addition, other (small) countries are coming closer and are nibbling at the position of the Belgian biotechnology industry. Although the number of biotechnology firms increased seriously, the growth rate is below the EU growth rate and the share of Belgian biotechnology companies in the total EU number of biotechnology firms is decreasing. The same is true for the amount of venture capital invested in biotechnology. Even though the amount of venture capital invested in Belgian biotechnology firms has increased heavily, the share in the total EU amount of venture capital invested in biotechnology has declined rather drastically. This could imply that the position of the Belgian biotechnology industry is slowly loosing ground.

4 Policy effectiveness: An assessment from the respondents' perspectives

In this chapter, we present the main findings from the interviews with a number of actors in the Belgium biotechnology system. Most important purpose of the interviews was to have more insight in the use of the instruments by the various actors and their experiences with these instruments in specific and the public S&T policies in general.

The interviews are with actors from Flanders, the Brussels Capital Region and Wallonia. Of the 13 interviews, 8 concern actors in Flanders, 4 actors from Wallonia and 1 actor from the Brussels Capital Region. Most interviews are with public research organisations (5) and start-ups (4). Only one interview is with a representative of a large firm[10] and 3 are with representatives of small and medium enterprises. An overview of the interviewees is given in annex 4. The main findings are presented according to the different policy types.

4.1 Policies to support the knowledge base in biotechnology

Funding of research
The three Flemish researchers we interviewed all work at departments of Flanders Inter-University Institute for Biotechnology (VIB). In addition, they all use funding for fellowships from the Fund for Scientific Research-Flanders (FWO-Flanders). They are also financed by their own universities and fellowships or competitive funding (GBOU) of the Flanders Institute for the Stimulation of the Scientific-Technological Research in the Industry (IWT). The two Walloon research organisations are funded by the regional National Scientific Research Fund (FNRS) and the federal Inter-University Poles of Attraction (IUAP/PAI) programme of the Federal Office for Scientific, Technical and Cultural Affairs (OSTC). The latter programme is also used by the Flemish researchers. All five interviewed research organisations also use funding from the European Union. Applied research in Flanders as well as in Wallonia is also funded by the industry.

In general, funding of basic research is considered as rather supportive for research activities. Only one (Walloon) researcher considers funding for industry oriented research as irrelevant for its research activities. The five interviewed researchers are not very positive about the federal funding. Especially the three Flemish researchers indicate that the influence of politics is too large. In a small country like Belgium, everyone knows everyone. They argue that decisions about budgets are not based on objective criteria and mechanisms, but on politics. In addition, all researchers say that the budgets of the federal programmes are too small.

The small budgets are also mentioned by the two Walloon researchers. Although it is easy to get the funding, the budgets of the regional programmes are just too small. In addition, the Walloon researchers consider the Wallonian programmes as bureaucratic and funding is too much dispersed over many organisations.

In general, the three interviewed Flemish researchers are far more positive about the programmes they use. Especially VIB and IWT are evaluated as very positive. VIB

[10] Unlike the definition of large firms in chapter 1, the large firm in our sample is dedicated to biotechnology

support is considered as very important for the development of the biotechnology knowledge base in Flanders. The services VIB is providing, especially the valorisation service, are praised. According to the interviewed researchers, a beneficial aspect of the VIB support is that the departments can decide for themselves how to spend the budget. Although the general judgement of VIB is very positive, there are also recommendations for improvement. VIB is a virtual institute and the Flemish researchers all have the feeling that a real institute, physically at one location, and with an overall research agenda could improve the synergy between the various departments and create a critical mass in the international world of biotechnology research.

The programmes of IWT are also judged as very positive. Researchers indicate that people at IWT have a good knowledge of what is going on in biotechnology and know very well what researchers need for doing research. The only recommendation is that IWT should finance the full research costs of PhD students. Now, research institutes always have to search for additional funding for PhD students.

The interviewed Flemish researchers are less positive about the funding from FWO-Flanders. The budgets are simply too limited and, again, it would be better to finance the full research costs of researchers.

Recruiting of researchers
In general, both interviewed Flemish and Walloon researchers have no specific problems in recruiting high-skilled researchers, although it is rather difficult to hire (post-doc) researchers from abroad. Junior researchers are easier to be found than senior researchers. One of the reasons for this could be that Belgium is not very attractive to foreign researchers. It is considered as a very small country with limited biotechnology activities.
Only one (Walloon) researcher sees policies aimed at the availability of skilled labour as irrelevant for its research activities. The other four Belgian researchers consider these types of policies as very relevant for their research activities, as they need high-skilled researchers for their research activities.

Interdisciplinary biotechnology research
Interdisciplinary research is not supported by special programmes in Belgium. Both interviewed Flemish and Walloon researchers consider biotechnology research as interdisciplinary, as this is one of the main characteristics of biotechnology research. They also point out that breakthroughs in biotechnology are mainly the result of interdisciplinary efforts, although in science the real breakthroughs are also the results of the creativity and genius of the individual researcher. One of the main barriers for interdisciplinary research is the difference in ‘language’ between the various disciplines. In order to promote collaboration, researchers advice that the various disciplines should be aware of each other’s activities and ideas, and should be able to use the same ‘language’ in collaborative research projects.
When asked whether specific instruments to support interdisciplinary research could be supportive, the two Walloon researchers confirmed this. The three Flemish researchers are less positive about this type of support.

Collaboration in research
All interviewed researchers in public research organisations consider collaboration as rather important. Three of the five researchers indicate that they do all the research projects in collaboration with others. They mainly collaborate with other public

research organisations. For the Flemish research organisations, most of their partners come from abroad. The Walloon research organisations mainly work together with other Belgian research organisations. Reasons for collaboration with other research organisations are mainly: sharing of expertise, infrastructure and materials, and access to complementary knowledge. In addition, it is mentioned that especially in genomics it is impossible to do good research on your own. Collaborations of public research organisations with biotechnology companies are mainly because of access to production methods and diffusion activities. For the VIB departments, another reason is that it is in the mission of VIB to support the creation of new business. A reason to do collaborative projects with large firms is to have access to extra funding (from contract research and EU programmes). Three of the five interviewed researchers work together with companies, which are only Belgian firms. For the large firm, reasons to collaborate with other companies are technology transfer (e.g. licensing agreements), further development of technologies, and access to distribution and sales activities. These collaborations are mainly with international partners.

The Inter-University Poles of Attraction (IUAP/PAI) of the federal Office of Scientific, Technical and Cultural Affairs (OSTC) is a special federal programme, but provides only limited support. The IUAP/PAI programme is considered as an artificial way of enhancing collaborations between Walloon and Flemish research organisations. It does not really stimulate strong, lasting collaborations, because collaborations are only set up for the money, not because of interesting research partners. Collaboration is the mission of VIB and an important benefit is that VIB departments have no specific restrictions considering the partners chosen. Collaborations between Flemish research organisations and companies are supported by IWT. The three Flemish researchers consider IWT as very service oriented and co-operative without being bureaucratic. In general, research partners are not very difficult to find, especially when they are academic partners. Industrial partners are a bit more difficult to find because of the economic situation. None of respondents use public services for finding partners, because it is better and easier to use their own network.

4.2 Policies to support the commercialisation of biotechnology

Commercialisation by public research organisations
The majority of the five interviewed researchers in public research organisations commercialise the results of their research by applying for patents. Most of the patents are not granted yet, but are still in their application phase. Three of the five research organisations have sold patents to companies. The main reason to do this is that patenting for the act of patenting is regarded as useless; patenting is only useful if you can make money with it. Most research organisations have formal incentive schemes and VIB uses patenting activities as an evaluation criterion. In addition, research results are checked for patenting opportunities and researchers are informed about valorisation activities. Only two of the five research organisations (a Walloon and a Flemish) created spin-offs. The Flemish researchers use the technology transfer office of VIB for advice and support on commercialisation issues. They consider this VIB service as very positive and supportive. Especially the availability of seed-money for spin-offs, based upon commercial benchmarks is considered as beneficial. The two Walloon researchers do not use any public support for their commercialisation activities, although one researcher thinks that the new technology transfer office at the university could be useful in the future. The researchers that are active in commercialisation of research results consider policies for the creation of high technology firms as supportive for their

own activities. Researchers are less positive about other instruments that aim at the stimulation of technology transfer, like grants for industrial research, the presence of science and technology parks, and collaboration between public and industrial research.

Most of the five researchers in public research organisations consider the quality of research results as a very relevant factor for the commercialisation of research results. According to the respondents, larger research units are not necessarily better in their research than smaller research groups. It is remarkable that most researchers consider multidisciplinarity of the research as not important for the commercialisation of their research. Especially the two Walloon researchers consider the publication intensity in major scientific journals as relevant. Other important factors for the commercialisation of the research results are the personal contacts with industry partners and the willingness of the researchers to patent and to create spin-offs. Personal contacts with other research organisations are not considered as relevant for the commercialisation of research results.

Commercialisation by companies
All eight interviewed companies have a background in public research organisations. Some are directly a spin-off of the university; others established the company on specific scientific findings by means of licenses of the university. Most companies have one or more patents granted and several patent applications. Almost all eight companies sold or bought patents. Main reasons to buy patents are to acquire necessary technologies and to form clusters of patents. An important reason to sell patents is that some patented technologies do not fit in the company patent portfolio. Another reason is to enhance the further development of technologies and products. Most of the companies have no official incentives scheme. Everyone is convinced of the necessity to patent and there is a constant 'pressure' to patent. The ownership of patents is considered as very relevant for the creation and development of the company.

Future plans of interviewed biotechnology companies mainly include searching for new partnerships for the further development of the products or services. Partners could be other biotechnology firms, but several companies indicate that they also aim at establishing co-operations with large firms. This is because large firms have manufacturing and marketing capabilities.

The eight interviewed companies are not very positive about the support available for start-ups and small companies: professional special services for small companies, like advice on regulations and IPR in biotechnology are lacking. There are services available, but the public organisations that provide these services have no knowledge of biotechnology and are not able to advise on biotechnology specific issues. According to the interviewed companies, professional public services are really necessary for start-ups and small companies, as they have no money for commercial bureaus.

Collaboration by biotechnology companies
All interviewed small and medium enterprises and start-ups in our sample work together with public research organisations. For start-ups, more than 50% of their collaborations include public research organisations and there are almost no collaborations with large firms. Although the four interviewed start-ups do their research for just a minor part in collaboration, they all work together with both Belgian and foreign public research organisations, and both national and international biotechnology companies. The three interviewed SMEs have collaborations with other

biotechnology companies and also with large firms, both national and international (mainly the USA and the European countries). Collaborations are very important for the SMEs as almost all research activities are done in collaboration with others.

The most important reason for the interviewed companies to collaborate with public research organisations is to have access to specific (fundamental) knowledge, expertise and methods and to the related patents and licenses. Research collaborations include both fundamental and applied research. This is because the activities of these companies are mainly related to the early stages in the R&D process. Some public research organisations, that have referred labs, are also used to validate developed applications. This is not different for start-ups or small and medium enterprises. Most of the SMEs and start-ups are satisfied with the quality of the expertise they have access to, although they also say that there are no exclusive agreements and that the quality of the collaboration also depends on individuals within the public research organisations. In general, collaborations with centres of excellence and other research organisations and access to high quality research results are valued as rather relevant for the creation and development of the company.

An important reason for the interviewed companies to work together with other biotechnology companies is to have access to complementary activities and services, including manufacturing methods. However, start-ups also collaborate because of exchange of technologies and using each other's technology platform. Collaborations with other biotechnology companies are considered as relevant for the development of the companies. Reasons to work together with large firms mainly include access to further stages in the product development and possibilities to sell the technology platforms and related services. Collaborations with large firms are mainly considered as very relevant for the further development of technologies and applications. For none of the biotechnology companies, the collaborations have led to mergers.

The four interviewed Flemish biotechnology companies have good experiences with the programmes of IWT that support co-operative research projects. IWT has good knowledge of biotechnology and the needs of companies and provides considerable amounts of funding. Other positive remarks are the relatively large freedom IWT gives researchers to do their research and the good evaluation procedures. One specific comment is that in order to improve the flexibility, IWT should better catch up with the fast changing world of biotechnology.
The four interviewed Walloon biotechnology companies use mainly EU support and less national or regional support for their collaborations. Although they use less regional support, they are positive about it. They are negative about the EU support, mainly because of the bureaucracy. One of the four Walloon companies has a specific reason not to use public support for its collaborations, as it does not want to share results and processes with a wider public. All the five interviewed researchers of public research organisations are rather positive about the creation of Science & Technology Parks in order to stimulate research collaborations.

None of the interviewed Belgian biotechnology companies has problems with finding partners, however it is easier to find academic partners than business partners. Academics are more willing to collaborate than firms, also due to the economic situation. None of the companies uses public support for finding partners. The main reason is that it is easier and better to use your own contacts and networks. This is also the reason that the interviewed companies use almost no public technology transfer

offices, unless the Flemish companies that work together with or are spin-offs from VIB.

Recruitment by biotechnology companies
Most biotechnology companies we interviewed are able to recruit the researchers with the biotechnology skills they need. Two Walloon companies experience this as very difficult. A reason is that Belgian companies are not attractive enough to foreign researchers, because of low salaries. All interviewed companies argue that although it is possible to recruit researchers, it is getting increasingly difficult to find people with both technological and managerial qualities. These people are especially needed for the further development and growth of biotechnology companies. The availability of skilled labour is for all companies a rather relevant reason to locate the company in Belgium. However, the costs of the labour are not relevant in this decision. Nevertheless, respondents argue that the availability and quality of skilled labour could decrease in the future and that public programmes should pay more attention to the training of multidisciplinary researchers. One company points out that European harmonised regulation on the availability of skilled labour is necessary. The quality of skilled biotechnology researchers differs in the various countries and procedures to hire people from outside the EU are extremely complicated.

4.3 Policies with a socio-economic and ethical dimension

Almost all respondents mention that they take socio-economic and ethical considerations into account when designing and performing biotechnology research. Some respondents do not explicitly take these considerations into account, as they are not active in potential controversial research areas. There is no difference in approaching these socio-economic and ethical considerations between the various types of actors. The respondents that do consider socio-economic and ethical issues, do this first of all because of guidelines and regulations concerning medical research, experimenting with animals, using test persons, using GMOs or embryonic stem cells. Secondly, the respondents take these issues into account because of their own personally felt responsibility, their reputation and because of strategic reasons. No respondents perform specific research on these issues, mainly because it is not their purpose to do this kind of research. Some respondents use external sources and only one researcher published about socio-economic and ethical issues in the past.

Most respondents participate in activities that address the socio-economic and ethical aspects of biotechnology like committees, working groups, biotechnology industry associations or public debates. Only one research organisation organises public information days. Most of the time, respondents participate personally and not formally as a representative of the organisation in these activities. Only two of the eight companies we interviewed point out that they participate in these kinds of activities because of strategic or public relations reasons. One research organisation does not stimulate its researchers to take part in these public activities because of somewhat negative experiences in the past. One start-up does not participate because it wants to keep a low profile, due to its activities in a highly discussed research field. The less presence in public discussions, the better it is for getting environmental allowances.
Respondents do not involve non-governmental organisations in their activities, although some respondents communicate with patients and patient groups. None of the respondents use special programmes to support these actions and considerations. Some respondents point out that for most programmes it is necessary to consider socio-

economic and ethical issues in the proposals. Most of the other respondents, both research organisations and companies, consider the public policies concerning the social acceptance of biotechnology as not relevant or not supportive for their work.
Respondents see no influence of their activities on their biotechnology research in the future. Only one respondent argues that due to public discussions some research has moved to other countries (e.g. research with primates) and costs of research are increasing because of the strict regulations.

4.4 Regulation matters for the biotechnology industry

The research activities of most respondents are affected by regulations. Important regulations concern working conditions, environmental conditions, using animals, using dangerous substances, GMOs, and the registration of medicines. Some respondents point out that they do not have to deal with specific biotechnology regulations because their activities do not concern possible risky activities. The opinions about the positive and negative impacts of these regulations differ. Almost all respondents agree that it is important to have good regulations to increase the safety. Nevertheless, some researchers we interviewed argue that some rules are not strict or clear enough and that in many cases increased safety also depends on their own initiatives and ideas. On the other hand, many companies in our sample argue that the Belgian regulations lack vision, are too strict, inconsistent or in contradiction with each other. This causes a lot of uncertainty, which makes it very difficult to deal with and to define strategies. In addition, regulations are getting increasingly complex (e.g. regulation on medicines) and this causes an increase in research costs, which makes it very difficult for small companies to survive.
Almost all companies in our sample use external advice on regulation matters, but this advice is never provided by public organisations. The Flemish researchers we interviewed use the services provided by VIB and they are satisfied with it. VIB has qualified officers that give useful advice on regulation matters.
According to the five researchers in the public research organisations the lack of European harmonisation in regulations is not really a problem. The companies we interviewed see more problems; lacking harmonisation causes uncertainty and hinders international activities like for example large medicine tests.

4.5 Legislation on Intellectual Property Rights (IPR)

There is a large difference between the researchers and the companies in our sample concerning the problems they face with patenting. Most researchers face no specific problems. However, all companies we interviewed have large difficulties with patenting their research results. The main problems are the huge expenses of the patenting process, the increasing complexity of patenting and the very long time and uncertainty before a patent is granted. In addition, some companies argue that it is very difficult to find people with good knowledge of patenting in biotechnology, than can assist them in patenting. The complexity and uncertainty are mainly due to the large differences between the US and EU patent systems and the discussions about what could be or could not be patented in biotechnology. This makes it very difficult to define an IPR strategy. In order to deal with the difficulties, all companies we interviewed make use of advice on IPR by commercial patent bureaus. The public research organisations in Flanders use advice from university bureaus or the IPR services of VIB.

Most interviewed researchers do not expect any effects from the European harmonisation on IPR related to biotechnology. However, most companies think that this harmonisation will lead to simplification and therefore less bureaucracy and costs. They also argue that the European patent is already harmonised, but that the main problems are related to the differences between the US patent system and the EU patent system. Harmonisation of these two systems is really necessary.

4.6 Measures to assure the availability of financial capital in high growth sectors

Most biotechnology companies in our sample use a combination of venture capital, public programmes and sometimes also private investments, participations and buyouts to finance the creation and development of the company. The main reason to use these combinations is because it is that they need all possible funds to start a biotechnology company and to finance the huge research costs. Without venture capital it is almost impossible to start and to survive. Nevertheless, it is also mentioned that nowadays companies think twice before they start with venture capital as the venture capitalists have a large influence on daily business.

The public funding used by the companies in our sample mainly includes the programmes described in the previous sections. In addition, fiscal measures and specific subsidies for the creation of employment are also used. This funding is rather easy to get and although the funding is small it helps to reduce costs. In general, the companies in our sample consider the public policies concerning private investments in companies and tax reduction schemes as more or less supportive, although its relevancy is rather limited. Two of the three interviewed start-ups in Flanders make use of some support of VIB (e.g. VIB is shareholder and facilitates an incubator building). In general, the experience with VIB support is positive, although it is suggested that VIB could promote better the companies it supports instead of promoting itself and should invest more in facilities for start-ups. One researcher is rather negative about the support of the Investment Company for Flanders (GIMV). The main criticism is that this investment company is increasingly managed as a real venture capitalist and has no longer a public support function. The large firm in our sample also uses public funding from IWT. This support is considered as rather positive, as IWT is very service oriented and co-operative without being too bureaucratic.

5 Policy effectiveness: conclusions

Support for science and technology (S&T) in Belgium is mainly the task of the regions. There is federal support, but the main programmes come from the Flemish and Walloon governments. This is also the perspective of the respondents: for them the regional programmes are far more relevant than the federal programmes. In addition, the regional programmes are also considered as much more supportive than the federal programmes.

Especially in Flanders, biotechnology has certainly been a priority in public policies over the period 1994-2001. The start of VIB in 1995 marked the increased attention for biotechnology in Flanders. All Flemish respondents, both researchers and companies, consider the start of VIB as very relevant for their biotechnology activities. In Wallonia there is less policy attention for biotechnology, although two initiatives have been installed since 1998. In addition, there are several Walloon and Flemish horizontal instruments that support S&T. The main focus of the Flemish and the Walloon S&T policies is on collaborative networks, university-industry interfaces, subsidies for R&D in companies and simplified procedures especially for SMEs and start-ups.

According to the respondents, this increased attention for biotechnology certainly results in, first of all, a more positive attitude of the government and investors towards biotechnology, and more specifically, in more biotechnology companies, increased front-line research results, more valorisation efforts and a better entrepreneurial climate. At first sight, this rather strong focus on biotechnology, in especially Flanders, shows its effect in the performance of the Belgian biotechnology innovation system[11]. The number of biotechnology publications, citations, patent applications and firms, and the amount of venture capital invested increased strongly in the period from 1995/1996 to 1999/2000. More than 50% of the biotechnology publications are with international partners.

However, how long will this good performance last and have the S&T instruments contributed to this performance?

In general the biotechnology knowledge base of Belgium is rather strong. The number of biotechnology publications has increased heavily and Belgium has a relative strong position in the EU. Most of this increase can be found in applied research and technology development and this seems to match the strong focus in the S&T policies on applied and industry relevant research. Nevertheless, many Flemish and Walloon respondents point out that the support is too much dispersed and lacks any vision. The clustering around Gent and Leuven for example is considered as very positive, however this should not be extended to other universities, in order to prevent dispersion of budgets and efforts. Secondly, the quality and availability of skilled researchers is still very good, but many respondents foresee that this will be more difficult in the future. Programmes should increasingly focus on the training of a new generation of multidisciplinary researchers. Multidisciplinary not only in the sense of having

[11] In this case study the notion of the structure of the Federal State of Belgium is taken into account. This means that attention is given to differences and similarities between the various Belgian Regions and Communities. However, for operational reasons, information about the performance of the Belgian biotechnology innovation system has been collected and analysed at an aggregate level. Therefor it has not been possible to link regional policy profiles and regional performances and policy assessments.

knowledge of various scientific disciplines, but also in the sense of having both scientific and managerial capabilities. Thirdly, several respondents argue that the role of politics in public S&T policy is too strong. Belgium is a small country and everyone knows everyone, therefore real objective evaluations of research projects are limited. In addition, the complex set of authorities in Belgium and the frail relations between the various communities and regions make things increasingly difficult. Fourthly, Belgium has lost its strong position in the share of citations to the biotechnology publications and this indicates that the relevance of the publications as perceived by others is declining. Finally, although collaboration in research seems to be very important in Belgium (considering the strong position in international co-publications), the respondents say that reasons to collaborate have nothing to do with the availability of funding for collaborative projects. Collaborations are a necessary condition in biotechnology research. In addition, none of the respondents use public support to find partners: they all have and use their own networks. One conclusion could be that S&T policies aiming at collaborations and interfaces are not really necessary incentives to enhance collaboration and networking.

Another important goal of the S&T policies is the stimulation of commercialisation and the creation of new firms. The number of biotechnology firms has certainly increased, but less strong than elsewhere in the EU. The same is true for the venture capital invested. Belgium still has its position in the middle of the EU ranking, but other countries are closing the gap, or even take over the position of Belgium. On the one hand Flemish companies are rather positive about the S&T support they can apply for, on the other hand Walloon and Flemish respondents argue that professional special services for small companies, like good advice on regulations and IPR in biotechnology, are lacking. The services available are less useful as the service organisations lack knowledge of biotechnology and are not able to take into account the varying needs related to the various development stages of the biotechnology firms. All companies use commercial services, but these are extremely expensive, especially for start-ups. One conclusion could be that, despite the strong focus on commercialisation and firm creation, the various instruments are not able to support SMEs and start-ups sufficiently. It could be interesting to know why these public organisations fail in providing information and assistance and in what way this type of support, especially for start-ups, can be improved.

Although the Belgium biotechnology industry is slowly loosing ground, the patent position is still rather strong, also when taking into account the size of the country. Patenting activities are considered as a necessary condition to survive, especially by the Flemish respondents. Although they consider patenting as important, the respondents also plead for further harmonisation and simplification of the legislation on intellectual property rights. One conclusion could be, despite the strong focus on commercialisation activities by both companies and public research organisations, that on the one hand there are still many barriers in patenting, but on the other hand patenting is taken very seriously. Therefore one could question to what extent all these instruments to support commercialisation and technology transfer actually contribute to the strong Belgian position in patents.

In general it seems that the Flemish respondents are more positive about the S&T policies than their Walloon colleagues. This could relate to the less strong attention for biotechnology in Wallonia. However, Walloon respondents are also not very positive about the existing support for their biotechnology activities. Although it is rather easy to

get the funding, the budgets are too small and too much dispersed and one has to deal with a lot of bureaucracy. Nevertheless, the Walloon programmes are still better than the EU programmes, which are considered as really "...monstrous...".

We can conclude that there are certainly differences between Flanders and Wallonia concerning the priority for biotechnology programmes and the assessment of the respondents of the effectiveness of the various programmes. When taking into account these differences between Flanders and Wallonia, it would be interesting to know what the contribution of each Region is to the overall performances of the Belgian biotechnology innovation system. Information on performances is now collected at a national level, but aggregation of this information at a regional level could tell us more about the contribution of the various regions to overall performance of the Belgian biotechnology innovation system. This type of information could also help us to link regional policy profiles to regional performances and policy assessments.

6 Bibliography

Belgian Biosafety Server: http://biosafety.ihe.be/

BelgoBiotech: http://belgobiotech.be

Belgian Federal Government on line: http://belgium.fgov.be/

Benedictus, J.N., Enzing, C.M. (1999) 'National Report of Belgium', in: Enzing, C.M., Benedictus, J.N., Engelen-Smeets, E., Senker, J.M., Martin, P.A., Reiss, T., Schmidt, H., Assouline, G., Joly, P.B., Nesta, L., *Inventory of public biotechnology R&D programmes in Europe*, Volume 2: National Reports, Luxembourg: Office for Official Publications of the European Communities.

Capron, H., Cincera, M., Dumont, M. (2000) 'The Institutional Profile' in: Capron, H.and Meeusen, W. (eds) *The National Innovation System of Belgium*, Heidelberg – New York: Physica-Verlag

CORDIS Belgium R&D Information Service: http://www.cordis.lu/belgium/

CORDIS Trend Chart Policy Measures: http://trendchart.cordis.lu/Datasheets/index.cfm?fuseaction=DatasheetMatrixList&srcCountry=2&srcAction=-1&srcTarget=-1&srcStartDate=-1&srcEndDate=-1

EEBIC - Erasmus European Business and Innovation Center: http://www.eebic.be

European Commission (2001) *European Trend Chart on Innovation - Country Report: Belgium*, January 2001-June 2001

Federal Office for Scientific Technical and Cultural Affairs (OSCT): http://www.dwtc.be/

Flanders Inter-University Institute for Biotechnology (VIB): http://www.vib.be

Flanders Inter-University Institute for Biotechnology (VIB) Annual Report 2001

Flanders Institute for the Promotion of Innovation by Science and Technology (IWT): http://www.iwt.be

Flanders Institute for the Promotion of Innovation by Science and Technology (IWT) Annual Report 2001

Flemish Institute for Technological Research (VITO): http://www.vito.be

Fonds National de la Recherche (FNRS): http://www.fnrs.be

Fund for Scientific Research – Flanders (FWO): http://sun.fwo.be/

Ministère de la Région Wallonne:

Direction générale des technologies de la recherche et de l'énergie: http://mrw.wallonie.be/dgtre/
Direction générale des ressources naturelles et de l'environnement: http://environnement.wallonie.be/

Ministry of the French Community:
Direction générale de l'Enseignement non obligatoire et de la recherche scientifique DGENORS: http://www.cfwb.be

Region of Brussels Capital: http://www.bruxelles.irisnet.be

Technopol Brussel – Bruxelles: http://technopol.lrt.be

Annex 1: Overview of policy types and instruments

	Vertical policies			Horizontal policies				
				Generic Science & Technology policies				
Policy types and goals	**Policies for knowledge base support**	**Policies for commercialisation**	**Policies with a socio-economic and ethical dimension**	**Knowledge bas**	**Commercialisation & firm creation**	**Regulation matters for the biotechnology industry**	**Legislation on intellectual property rights**	**Measures to assure the availability of financial capital in high-growth sectors**
Instruments and programmes								
Federal Level								
• Belgian Committee for Bio-ethics			✔					
• Funding from specific ministries for specific research institutes and research projects				✔				
• OSTC funding for research centres: Belgium Co-ordinated Collections of Micro-Organisms				✔				
• OSTC: Inter-University Poles of Attraction (IUAP)				✔				
• Ministry of Finance: Increased tax deduction rate for R&D investments and patents acquisitions					✔			
• Ministry of Finance: Tax deduction for increase in R&D personnel					✔			
• Several ministries: Biosafety Council + Service of Biosafety and Biotechnology						✔		
• Federal Office for Intellectual Property Rights							✔	
• Ministry of Finance: support for acquisition of patents by an increased rate of tax deduction for R&D investments							✔	
Flanders								
• Flanders Inter-University Institute for Biotechnology (VIB)	✔	✔	✔			✔	✔	
• VIB + GIMV: Biotech Fund Flanders		✔						
• Department of Education: Funding for research at universities				✔				
• FWO-Flanders: fellowships, research projects, networks				✔				
• Funding for research institutes: VITO				✔				

	Vertical policies			Horizontal policies				
Policy types and goals	**Policies for knowledge base support**	**Policies for commercialisation**	**Policies with a socio-economic and ethical dimension**	**Generic Science & Technology policies**		**Regulation matters for the biotechnology industry**	**Legislation on intellectual property rights**	**Measures to assure the availability of financial capital in high-growth sectors**
				Knowledge bas	**Commercialisation & firm creation**			
Instruments and programmes								
Flanders continued								
• IWT: Generic Basic Research at Universities (GBOU)				✔	✔			
• IWT: Flemish Innovation Collaborations (VIS)					✔			
• IWT: Non-university Higher Education Fund (HOBU)					✔			
• IWT: Programme for the Stimulation of Innovation in SMEs (KMO)					✔			
• IWT: University Interfaces					✔			
• PLATO Programme					✔			
• Regional Development Agencies (GOM)					✔			
• Regional Technology Advisory Centres					✔			
• Incubators and Innovation Centres						✔		✔
• Vlerick Business Angels Networks (BAN)						✔		✔
• Investment Company for Flanders (GIMV)						✔		✔
• Flemish Guarantee Fund								✔
Wallonia								
• DGTRE - BIOVAL	✔							
• Centres of Excellence - CRB	✔	✔						
• DGRTE: 'Les Recherches d'Initiative'				✔				
• DGENORS-Funding for university institutions				✔				
• DGENORS - FNRS				✔				
• DGENORS - Actions de Recherche Concertées				✔				
• DGENORS – Fonds Spécial pour la Recherche				✔				

	Vertical policies			Horizontal policies				
Policy types and goals	**Policies for knowledge base support**	**Policies for commercialisation**	**Policies with a socio-economic and ethical dimension**	**Generic Science & Technology policies**		**Regulation matters for the biotechnology industry**	**Legislation on intellectual property rights**	**Measures to assure the availability of financial capital in high-growth sectors**
				Knowledge bas	**Commercialisation & firm creation**			
Instruments and programmes								
Wallonia continued								
• DGTRE: Technico-Economic Studies					✔			
• DGTRE: FIRST Europe					✔			
• DGTRE: FIRST doctorate enterprise					✔			
• DGTRE: Feasibility Studies for Technical Support					✔			
• DGTRE: Technology Transfer					✔			
• DGTRE: Horizon Europe					✔			
• DGTRE: Fund for the Industrialisation and Commercialisation of Results of Research Financed by the Region					✔			
• DGTRE: University Interfaces					✔		✔	
• DGTRE: Support for Immaterial Investment					✔			
• DGTRE: Arrêtè Royal 123					✔			
• DGTRE: FIRST Spin-off						✔		✔
• DGTRE: Pre-activity grant						✔		✔
• Business Innovation Services						✔		✔
• Business Angels Network						✔		✔
• Société Régionale d'Investissement de Wallonie (SRIW)						✔		✔
• IPR to Universities							✔	
Brussels-Capital Region								
• Research in Brussels				✔				
• Prospective Research for Brussels				✔				
• Support for the development of prototypes, new products and processes					✔			
• Arrêté Royal 123					✔			
• Technopol					✔			
• Website: www.investinbrussels.be								✔

	Vertical policies			Horizontal policies				
Policy types and goals	**Policies for knowledge base support**	**Policies for commercialisation**	**Policies with a socio-economic and ethical dimension**	**Generic Science & Technology policies**		**Regulation matters for the biotechnology industry**	**Legislation on intellectual property rights**	**Measures to assure the availability of financial capital in high-growth sectors**
				Knowledge bas	**Commercialisation & firm creation**			
Instruments and programmes								
Brussels-Capital Region Continued								
• Erasmus European Business and Innovation Centre: Business Angels Connect						✔		✔
• Brussels Regional Development Centre (SRIB/GIMB)						✔		✔

Annex 2: Overview of Belgian and EU performance indicators

Indicators		**Belgium**			**EU**		
		1995/1996	1999/2000	growth in %	1995/1996	1999/2000	growth in %
BT publications	total	1176	1848	57.1%	33856	49214	45.4%
	per million capita	116	180	56.0%	90.98	130.89	43.9%
Citations to BT publications	total	5291	8402	58.8%	134600	225988	67.9%
	per total BT publications	4.5	4.55	1.1%	3.98	4.59	15.5%
Internationally co-authored papers	total	546	972	78.0%	12126	20202	66.6%
	per total BT publications	0.46	0.53	13.3%	0.36	0.41	14.6%
BT publications basic research	number	382	562	47.1%	10858	15713	44.7%
BT publications applied research	number	215	365	69.8%	6773	9379	38.5%
BT publications experimental development	number	120	175	45.8%	3394	4878	43.7%
BT publications technology development	number	15	25	66.7%	807	1035	28.3%
Publications Plant BT	number	248	311	25.4%	6085	7454	22.5%
Publications animal BT	number	132	266	101.5%	3168	4910	55.0%
Publications environmental BT	number	45	86	91.1%	1052	2496	137.3%
Publications industrial BT	number	50	89	78.0%	1375	2466	79.3%
Publications cell factory	number	226	388	71.7%	6507	9214	41.6%
Publications diagnostics/therapeutics	number	522	836	60.2%	16090	23541	46.3%
Publications basic BT	number	31	63	103.2%	1419	2443	72.2%
Venture Capital BT	PPP in 1000	21454	60441	181.7%	267238	1169612	337.7%
Biotech companies (1)	total	35	65	85.7%	666	1346	102.1%
	per million capita	3.45	6.34	83.8%	1.79	3.57	99.2%
IPOs (2)	number	1	0	-100.0%	31	46	48.4%
BT patent applications	total	140	265	89.3%	2723	4609	69.3%
	per million capita	13.8	25.9	87.7%	7.32	12.26	67.5%
Approved biomedicines (3)	number				10	22	120.0%

(1) The amount of Biotech companies and the per capita numbers refer to the years 1996 and 2000; (2) Due to low numbers the two periods correspond to 1995-1997 and 1998-2000; (3) Due to low numbers the two periods correspond to 1995-1997 and 1998-2001

Annex 3: Overview of performance indicators of EU member states

Countries	BT publications total			Citations to BT publications total			BT co-publications total			Venture Capital BT PPP in 1000			Biotech companies total (1)			BT patent applications total		
	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %
Austria	797	1216	52.57%	3233	6323	95.58%	335	607	81.19%	-	-	-	-	-	-	69	109	57.97%
Belgium	1176	1848	57.14%	5291	8402	58.80%	546	972	78.02%	21454	60441	181.72%	35	65	85.71%	140	265	89.29%
Denmark	893	1336	49.61%	3238	6747	108.37%	429	672	56.64%	3166	43202	1264.56%	29	64	128.57%	153	217	41.83%
Finland	862	1220	41.53%	3730	5709	53,06%	328	576	75.61%	2646	19183	625.10%	30	77	156.67%	60	71	18.33%
France	5413	7548	39.44%	19059	33957	78.17%	1712	2919	70.50%	41188	176752	329.13%	101	177	75.25%	407	717	76.17%
Germany	6778	10174	50.10%	26859	47475	76.76%	2294	3887	69.44%	58945	581118	885.87%	104	330	217.31%	790	1535	94.30%
Greece	294	545	85.37%	870	1536	76.55%	108	227	110.19%	-	-	-	-	-	-	2	7	250.00%
Ireland	269	422	59.88%	845	1965	132.54%	118	189	60.17%	3540	276.24	-92.20%	26	31	19.23%	18	38	111.11%
Italy	3375	4978	47.50%	12380	19747	59.51%	1141	1805	58.19%	2217	25537	1051.84%	32	52	62.5%	103	149	44.66%
Netherlands	2632	3306	25.61%	10708	16014	49.55%	1048	1549	47.81%	19821	56834	186.74%	50	85	70.00%	249	355	42.57%
Portugal	192	396	106.25%	560	1272	127.14%	92	227	149.45%	2412	963	-60.05%	-	-	-	1	10	900.00%
Spain	2032	3390	66.83%	5027	11592	130.59%	606	1108	82.84%	49	12444	25473.72%	15	25	66.67	46	79	71.74%
Sweden	1848	2622	41.88%	7770	11603	49.33%	753	1297	72.24%	298	15386	5059.42%	65	165	153.85%	107	184	71.96%
United Kingdom	7342	10351	40.98%	34993	53571	53.09%	2587	4144	60.19%	111503	176747	58.51%	180	275	52.78%	578	876	51.56%

	BT publications per million capita			Citations to BT publications per total BT publications			BT co-publications per total BT publications			Biotech companies per million capita (1)			BT patent applications per million capita		
	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %	1995/ 1996	1999/ 2000	Growth in %
Austria	99	150	51.07%	4.06	5.20	28.08%	0.42	0.50	18.76%	-	-	-	8.5	13.4	57.65%
Belgium	116	180	56.00%	4.5	4.55	1.11%	0.46	0.53	13.30%	3.45	6.34	83.80%	13.8	25.9	87.70%
Denmark	168	252	49.92%	3.63	5.05	39.12%	0.48	0.50	4.70%	5.32	12.03	126.13%	29.1	40.8	40.21%
Finland	168	236	40.48%	4.33	4.68	8.08%	0.38	0.47	24.08%	5.85	14.87	154.19%	11.8	13.6	15.25%
France	93	128	38.10%	3.52	4.50	27.84%	0.32	0.39	22.27%	1.73	2.99	72.83%	7.0	12.1	72.86%
Germany	83	123	48.30%	3.96	4.67	17.93%	0.34	0.38	12.88%	1.27	3.97	212.60%	9.7	18.5	90.72%
Greece	28	51	82.64%	2.96	2.81	-5.07%	0.37	0.41	12.97%	-	-	-	0.2	0.7	250.00%
Ireland	74	117	57.90%	3.14	4.66	48.41%	0.44	0.45	2.10%	7.17	8.55	19.25%	5.0	10.4	108.00%
Italy	59	87	47.55%	3.67	3.97	8.17%	0.34	0.36	7.25%	0.56	0.91	62.50%	1.8	2.6	44.44%
Netherlands	169	209	23.63%	4.07	4.83	18.67%	0.40	0.47	17.42%	3.22	5.36	66.46%	16	22.5	40.63%
Portugal	19	40	105.00%	2.92	3.21	9.93%	0.47	0.57	20.95%	-	-	-	0.1	1.0	900.00%
Spain	52	86	65.96%	2.47	3.42	38.46%	0.30	0.33	9.60%	0.38	0.63	65.79%	1.1	2.0	81.82%
Sweden	209	294	40.68%	4.20	4.43	5.48%	0.41	0.49	21.40%	7.35	18.47	151.29%	12.1	20.6	70.25%
United Kingdom	125	175	40.02%	4.77	5.18	8.60%	0.35	0.40	13.62%	3.07	4.64	51.14%	9.9	14.8	49.49%

(1) The number of biotech companies and the number of biotech companies per million capita refer to the years 1996 and 2000

Annex 4: List of organisations and respondents

Algonomics N.V, Mr. B. Eisenburger

Catholic University of Leuven, Department of Developmental Biology of Flanders Inter-University Institute for Biotechnology (VIB), Prof. dr. D. Huylebroeck

CropDesign, Dr. W. Broekaert

Eurogenetec, Dr. D. Marechal

Euroscreen S.A, Dr. R. White

InnoGenetics, Mr. Luc van Dessel

Tigenix N.V, Prof. dr. F. Luyten

Thromb-X N.V, Prof. dr. D. Collen

Université Catholique de Louvain, Departement of Biology, Laboratory of Cytogenetics, Prof. dr. J.M. Kinet

Université Libre de Liège, Laboratory of Molecular Biology and Genetics, Prof. dr. J. Martial

University of Antwerp, Department of Molecular Genetics of Flanders Inter-University Institute for Biotechnology (VIB), Prof. dr. C. van Broeckhoven

University of Gent, Department of Plant Systems Biology of Flanders Inter-University Institute for Biotechnology (VIB), Prof. dr. M. Zabeau

ZenTech, Dr. J.C. Haveaux