

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

National Report of Spain

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Table of contents

Summary	4
1. Introduction and background	6
1.1 General introduction	6
1.2 Characteristics of the national S&T and the innovation system	6
1.3 National support and framework conditions for biotechnology	7
1.4 Main biotechnology research actors in Spain	12
2. Funding of biotechnology R&D, transfer and commercialisation	15
2.1 Introduction	15
2.2 Non-policy-directed funding of biotechnology research	16
2.3 Policy-directed funding of biotechnology research and commercialisation	16
2.3.1 National Programme of Biomedicine	19
2.3.3 Generic Instruments of the Ministry of Education (MEC)	20
2.3.4 Instruments of the Centre for Development of Industrial Technology (CDTI)	23
2.3.5 National Programme of Biotechnology	24
2.3.6 Genoma España - Promotion of Genomics and Proteomics Research	26
2.3.7 Instruments at the sub-national level	26
2.4 Participation in 6th FP	27
3. Performance of the national biotechnology innovation system	29
3.1 Introduction	29
3.2 Performance in creating a knowledge base and supporting the availability of human resources	29
3.3 Performance in knowledge transmission and application.....	33
3.4 Industrial development.....	34
3.5 Market conditions	34
4. Conclusions	36
4.1 Introduction	36
4.2 Public funding of biotechnology through policy instruments.....	36
4.3 Specific features of the instruments	38
4.4 Policy goals	39
4.5 Biotechnology research application areas.....	42
4.6 Stimulation of biotechnology activities through the instruments	44
4.7 Dynamics: comparison with period 1994-1998	47
5. Future developments	49
Annex 1: List of Tables	50
Annex 2: List of Charts	51

Annex 3: List of contact persons.....	52
Annex 3: List of contact persons.....	52
Annex 4: References	53
Annex 5: Performance	55
Annex 6: Abbreviations	66

Summary

In general terms, and in a European context, the Spanish innovation system is characterised firstly by its weak commitment to research and development (R&D) activities, secondly, by the relatively low involvement of the business sector in technological innovation, and thirdly, by the regional concentration of resources for R&D in two regions: Madrid and Catalunya (Catalonia). Since the mid 1980s, public policy has been explicitly implementing measures coordinated at the national level under so-called National Plans aimed at strengthening the innovation system.

The Law 13/1986 (Law of Science) set up the framework for the definition and implementation of research, technology and innovation policy in Spain. This framework involves the "National Plans for Scientific Research, Technology Development and Innovation (NP)", four-year strategic plans outlining policy objectives, promotion programmes and responsibilities of the different ministries involved. The analysis presented in this report focuses on the fourth and fifth National Plans designed for the periods 2000-2003 and 2004-2007. The 17 Autonomous Communities (CC.AA) design and implement regional research, development and innovation plans. The Communities have the responsibility of designing these plans and allocating the budget according to their own principles. In other words, each community designs its own plan freely, defining the funding priorities and the main policy goals.

At the national level, besides the universities, the Consejo Superior de Investigaciones Científicas CSIC (National Research Council) is the main public research institution in Spain conducting biotechnology research mainly financed through block grants (in 2005 67.4 % of the funds were institutional funding). Moreover, the following national programmes were included in the inventory of policy instruments promoting biotechnology in the period 2002-2005: National Programme of Biomedicine (different calls), National Programme of Agro-Alimentary Resources and Technologies (calls of the DGI-MEC), Generic Instruments of the Ministry of Education (MEC), Instruments of the Centre for Development of Industrial Technology (CDTI), the National Programme of Biotechnology (different calls) and the activities of the Foundation Genoma España - Promotion of Genomics and Proteomics Research

We estimate that 875M EUR were invested in the period 2002-2005 in promoting the biotechnology knowledge base and its commercialisation through policy-directed and non-policy-directed instruments. With regard to the proportion of regional funding, we estimate that regional policy instruments made up 19% of the total funding allocated via policy-directed instruments. The central government thus remains the main promoter of the biotechnology knowledge base and its industrial application. According to the information available, the promotion of biotechnology in Spain has mainly focused on the support of research activities. 86% of the funding allocated in the period 2002-2005 was invested in the promotion of basic and applied research and training of human resources. However, the data should be interpreted with caution, since not all generic instruments promoting industrial investment in R&D at the national level may be included in the estimations.

With regard to the types of instruments used to allocate the funding, biotechnology has been mainly promoted through policy-directed funding (58% of the total funding in the period 2002-2005). These were mainly generic instruments. Only 38% of the policy-directed funding was allocated through biotechnology-specific instruments. Moreover, the data available for the policy-directed instruments at the national level indicate that health biotechnology and plant and animal biotechnology were the application areas receiving the largest share of funding, specially the promotion of genome research.

With regard to the performance of the Spanish biotechnology innovation system the report considers 3 areas thereof: the knowledge base, knowledge transfer and application and market conditions.

As regards the volume of biotechnology research activities and human resources in terms of biotechnology publications per million capita (pMC) and graduates in life sciences pMC, the Spanish biotechnology innovation system is behind the EU25 and USA levels. In terms of biotechnology publications pMC, Spanish performance in biotechnology knowledge production is nearing the EU25 level. However, according to OECD data on the number of graduates in life sciences, compared to the European level the human resources indicator for Spain suggests that there is room for improvement in the ability of the Spanish innovation system in training students in life sciences. The per capita indicator (number of graduates pMC) in the most recent period is below the EU level. Furthermore, the indicators provide empirical evidence for the relative importance of health biotechnology in terms of publications. In this concern, Spain is not different from the EU25 or the USA. Generic biotechnology is the second largest biotechnology sub-field. Again this holds for Spain, EU25 and USA. With regard to the other fields, it can be pointed out that the sub-fields plant and food biotechnology are relatively more important in Spain than in the USA and EU25.

As far as knowledge transfer and application are concerned, the indicators selected (mainly based on patent applications and start-ups) and the data suggest that the Spanish biotechnology innovation system has serious difficulties in producing industrial applications and in establishing biotechnology start-ups.

The weaknesses of the Spanish biotechnology innovation system persist in the development of biotechnology-based products for the health sector. During the time period 1995 – 2002 no biomedicines were reported from Spain. For the biotechnology based agro-food products, the data suggest a more optimistic situation: between 1996 and 2001, Spain reported a total number of 189 field trials. These results outperformed EU15 in the same period in per capita terms with 5 field trials pMC (against 4 field trials pMC in EU15).

1. Introduction and background

1.1 General introduction

According to EUROSTAT¹, with a gross domestic product (GDP) of 905 455M EUR and a population of 43 million inhabitants, in 2005 Spain's GDP per head was 1.4% lower than the EU25 average. After a dynamic economic development in terms of real GDP growth between 1997 and 2000, Spain slowed down economic growth in 2001 and started to recover again in 2003. The real GDP annual growth rate moved up steadily from 2.7 in 2002 up to 3.5 in 2005. The unemployment rate has been decreasing continuously since 1995, from 18.4% in 1995 to 9.2% in 2005. The efforts in research and development activities (R&D) have been growing at a very low rate (way below the EU25 average). In 2004, gross domestic expenditure on R&D (GERD) as a percentage of GDP was 1.07% (EU25 1.86%). The private sector plays a secondary role in the Spanish innovation system in terms of R&D expenditures. In 2004 industry financed only 48% of the R&D activities in Spain.

1.2 Characteristics of the national S&T and the innovation system

In general terms, and in a European context, the Spanish innovation system is characterised firstly by its weak commitment to research and development (R&D) activities, secondly, by the relatively low involvement of the business sector in technological innovation, and thirdly, by the regional concentration of resources for R&D in two regions: Madrid and Catalunya (Catalonia). Since the mid 1980s, public policy explicitly implemented measures coordinated at the national level under so-called National Plans aimed at strengthening the innovation system. This section develops these general issues concerning the Spanish innovation system and innovation policy.

With regard to the Spanish commitment in R&D, even though Spain is the fourth largest country in Europe in terms of gross domestic product GDP (accounting for 837 billion Euros in 2004), investment in R&D has been traditionally lower than the European average. Since the mid 1980s, Spain has continually increased the budget for R&D. According to the data available, between 2000 and 2004 the gradual increase of Spanish public funds dedicated to R&D was larger than the increase of the European average. Moreover, according to the current plans for promoting innovation, by 2007 Spain aims to invest 1.4% of the GDP in R&D (MCYT 2003).² However, despite the increasing budgetary efforts, in the mid term the investments in R&D as a percentage of the GDP will not reach the European average.

The role played by the business sector can be analysed with the share of business investment in R&D. The most recent EUROSTAT data available allows an analysis in a European context in the year 2001. In this year the Spanish business sector financed

¹ This paragraph draws on data from EUROSTAT. <http://www.eurostat.org>

² MCYT. (2003). "Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica 2004-2007." Retrieved October 2005, from http://www.mec.es/ciencia/jsp/plantilla.jsp?area=plan_idi&id=3.

47.2% of the national R&D efforts, while the estimated EU25 average of business investment in R&D accounted for 55.4% of the total R&D efforts.

Regarding the regional distribution of the efforts in R&D, data of the Spanish National Institute for Statistics (INE) gives evidence for the concentration of 75% of the R&D resources in 5 of the 18 Autonomous Communities in 2003. The Autonomous Communities of Madrid and Catalunya (Catalonia) were responsible for 50% of the expenditures on R&D.

1.3 National support and framework conditions for biotechnology

The Law 13/1986 for the Promotion and General Contribution of Scientific and Technical Research (Law of Science) set up the framework for the definition and implementation of research, technology and innovation policy in Spain. This framework involves on the one side the "Interministerial Commission of Science and Technology (CICYT)" as the institution responsible for planning and coordinating science, technology and innovation policy in Spain and, additionally, the "National Plan for Scientific Research, Technology Development and Innovation (NP)", a four-year strategic plan outlining policy objectives, promotion programmes and responsibilities of the different ministries involved.

Together with the activities of the European Union (in particular the R&D Framework Programmes and the activities financed by the Structural Funds³) and the initiatives of the Autonomous Communities through the regional Plans for R&D, the NP constitutes the fundamental tool for research, technology and innovation policy in Spain. The first NP was designed in 1988 and has been updated and implemented every four years.⁴

In general terms the NP has the following strategic objectives:

1. To increase the level of Spanish science and technology in terms of size and quality;
2. To increase competitiveness of enterprises and to encourage their innovation capacity;
3. To improve the exploitation of R&D results by the enterprises and by Spanish society as a whole;
4. To strengthen the internationalisation of Spanish science and technology;
5. To increase the level of qualified human resources in the private and public sector and to improve mobility among different centres;
6. To raise the level of scientific and technological knowledge of Spanish society;
7. To improve the co-ordination, evaluation and technical monitoring procedures of the NP.

³ These correspond to the activities to be undertaken with the European Social Fund (ESF) for objective 3 regions and the European Regional Development Fund for objective 1 and 2 regions.

⁴ The analysis presented in this report refers to policy-directed instruments for the period 2002-2005. Accordingly, the analysis focuses on the fourth and fifth National Plan designed for the periods 2000-2003 and 2004-2007.

Table 1.1. gives details of the structure of the National Plans.

Table 1.1: Building blocks of the National Plan for Scientific Research, Technology Development and Innovation (NP).

<p>1.1. Scientific-technological areas</p> <ul style="list-style-type: none"> • Biomedicine • Biotechnology (genomics and proteomics) • Industrial design and production • Material sciences • Chemical processes and products • Natural resources • Agro-food resources and technologies (conservation of genetic resources of agro-food interest and agrarian resources and technologies) • Information and communication technologies • Socio-economic research (knowledge society) 	<p>1.2. Sector areas</p> <ul style="list-style-type: none"> • Aeronautics • Food • Automotive • Civil construction and preservation of cultural and historical heritage • Defence • Energy • Space • Environment • Socio-sanitary • Information society • Transport and land planning • Tourism, leisure and sport
<p>2. Types of policy instruments (modalities of participation)</p> <ul style="list-style-type: none"> • Policy instruments to improve human resources • Financing of projects to develop R&D activities • Policy instruments aiming at commercialising or promoting R&D results (technological innovation) • Policy instruments to strengthen the scientific and technical infrastructure • Special actions (instruments that do not fit in the previous groups) 	
<p>3. Financial instruments</p> <ul style="list-style-type: none"> • Subsidies (to cover the total or partial cost of the activity) • Concurrent subsidies (to partially cover the cost of the activity) • Reimbursable credits (low or zero interest) • Credit guarantees (guarantee by the state administration) • Seed capital (start-up funds) • Joint investment funds 	

Source: CICYT (2000)⁵

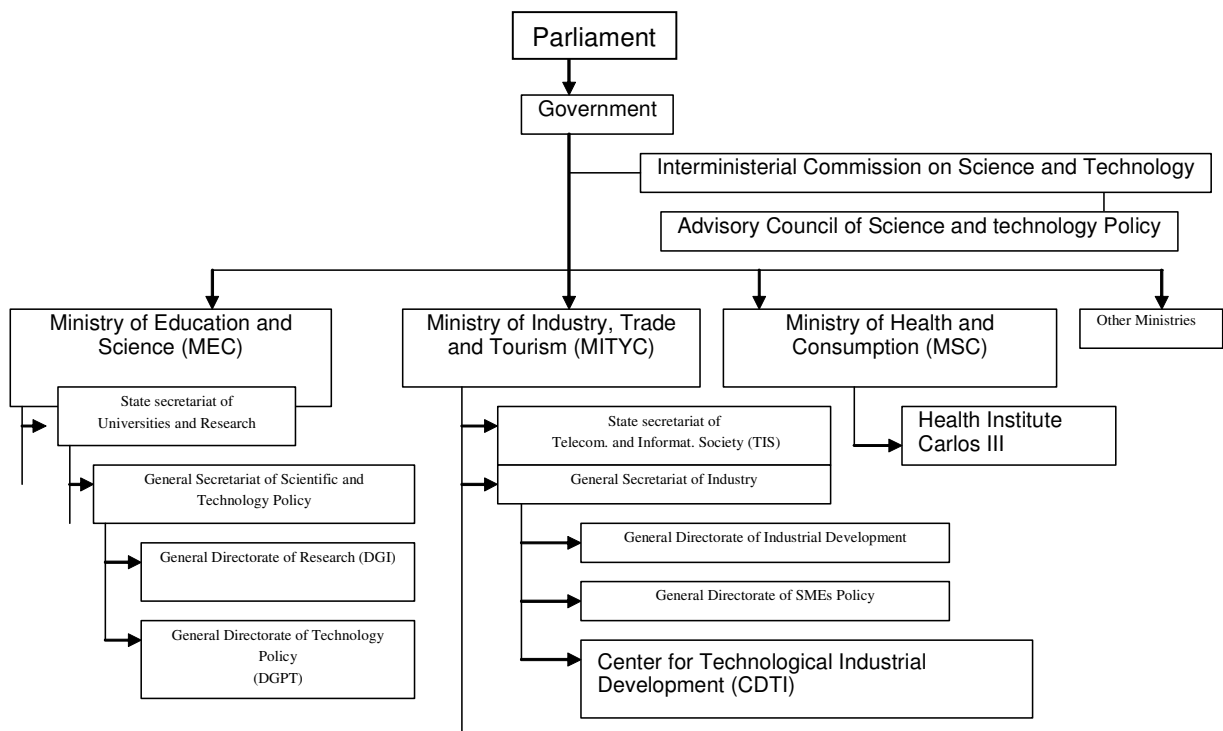
⁵ CICYT. (2000). "National Plan for Scientific Research, Technological Development and Innovation 2000-2003 - Volume I Objectives and Structure." Retrieved October 2005, from http://www.mec.es/ciencia/plan_idi/files/pnidi-1i.pdf.

The structure of the NP involves three building blocks:

1. A set of strategic scientific-technological and economic (or sector) areas, which define the content of the national programmes;
2. A set of policy instruments that define the different modalities of participation and articulate the different policy objectives;
3. The budget and the financial instruments to allocate it.

The budget available for science, technology and innovation policy is outlined in chapter 47 of the General National Budget. The resources for chapter 47 have been continually increasing since 1996 and accounted in 2005 for 5 018M EUR (658 more than in 2004).⁶ This budget is allocated among different ministries responsible for implementing promotion programmes according to the guidelines of the NP. The ministries and bodies more involved in implementing the programmes articulated in the NP are given in .

Figure 1.1: Institutions in the Spanish Biotechnology Funding System (August 2005)



Sources: European Commission (2004)⁷, FECYT (2005)⁸, MEC (2005)⁹, MITYC(2005) ¹⁰

⁶ This information draws on public statistics provided by the Ministry of Finance on the consolidated National Budget Ministerio de Hacienda. (2005) "Presupuestos Generales del Estado - Estadísticas Presupuestarias " Retrieved 2005/08/30/, from http://www.igae.meh.es/Internet/Cln_Principal/ClnPresupuesto/PresupuestosGeneralesEst/EstadisticaInformes/EstadisticaInformes.htm

⁷ European Commission (2004). European Trend Chart on Innovation. Country Report Spain. Covering Period September 2003 - August 2004. Brussels, European Commission

⁸ FECYT. (2005). "Conozca la Ciencia y Tecnología en España." Retrieved 2005/08/25/, from www.technociencia.es

The planning, implementation and coordination of the NP and the activities of the different ministries and autonomous bodies involved in innovation policy are the responsibility of the "Interministerial Commission on Science and Technology (CICYT)". This body has a consultative and support department, the "Advisory Council on Science and Technology", which is responsible for the promotion of the participation of the scientific community and other social and economic actors in the design of science and technology policy.

During the reporting period (2002-2005), the governance system of science and technology policy has undergone major modifications due to the changes in the government after the general elections of March 2004. The most important change was the dissolution of the Ministry of Science and Technology (MCYT) created in 2000. The creation of this ministry in the year 2000 represented a new political approach aimed at concentrating the competences related to science, technology and innovation in a single political body. With the government elected in March 2004 the system of governance returned to the previous framework with two main ministries responsible for science, technology and innovation issues: the Ministry of Education and Science (MEC) and the Ministry of Industry, Trade and Tourism (MITYC). The main competences of the former MCYT were transferred to the "State Secretary for Universities and Research Policy of the MEC". The competences of this body are:

- Management and control of activities and actions included in the NP
- Responsibility for scientific research and technological development
- Co-ordination of Spanish participation in international programmes on scientific research
- Encouragement of large-scale installations
- Co-operation with Autonomous Communities and with other ministries.

Competences related to information and communication technologies (ICT), industrial development and issues pertaining to SMEs are the responsibility of the "State Secretariat of Telecommunication and Information Society" of the MITYC. Another important body within the MITYC is the "General Secretariat of Industry," which has been given the responsibility of coordinating sectoral innovation policy and subsidies related to industrial research and development (issues managed by the "General Directorate for Industrial Development") on the one hand, and of promoting the development and creation of SMEs and their competitive strength (issue managed by the "General Directorate for SMEs Policy") on the other hand.

Moreover, the "Centre for Technological Industrial Development (CDTI)" is a public business entity under the "General Secretariat of Industry" responsible for promoting entrepreneurial innovation. This body has four principal functions: i) to finance corporate

⁹ MEC. (2005). "Organigram of the Ministry of Education and Science." Retrieved 2005/08/28/, from <http://www.mec.es/mecd/jsp/plantilla.jsp?area=organizacion&id=2>

¹⁰ MITYC. (2005). "Organigram of the Ministry of Industry, Tourism and Commerce." Retrieved 2005/08/28/, from <http://www2.mityc.es/es-ES/Ministerio/Estructura/>

R&D projects; (ii) to manage and to promote Spanish participation in international technology programmes; (iii) to support technology transfer in the business environment, and (iv) to encourage the creation and consolidation of technology-based companies. The centre offers two types of financial aids: "Direct financing" (which promotes corporate R&D activities with long-term credits covering between 60% and 70% of the costs at 0% interest) and "Bank financing" through the ICO-CDTI financing line (which promotes R&D activities with loans at very low interest rates). The direct financing line supports corporate activities at different stages of the innovation process (CDTI 2002)¹¹.

Finally, an important body for innovation policy is the Spanish Foundation for Science and Technology (FECYT) created by the central administration in 2001 to link public science with industry and society. Its purpose is to foster co-operation between the main players of the Spanish innovation system.

According to a survey of public attitudes to new technologies in Europe (European Commission 2005)¹², in Spain 72% of the respondents believe that developments in biotechnology and genetic engineering can positively affect our way of life over the next 20 years. With this result, Spanish society is one of the most optimistic in Europe concerning the future applications of biotechnology and genetic engineering. In terms of specific applications Spanish citizens are quite open to the use and development of biotechnology.

Compared to the other EU Member States, Spanish responders were quite tolerant about the cloning of human beings so that couples can have a baby, even if one partner has a genetic disease. Only 42% would never approve of such a practice (EU average of 59%).

The attitude to the cloning of human embryo stem cells to treat people with diseases is also slightly more permissive than the European average. 19% would approve of it in all circumstances (EU average 11%), 13% of citizens approve it only in exceptional circumstances (EU average of 20%) and 43% approve it only if it is highly regulated and controlled (EU average of 41%).

The survey explores public attitudes to several applications of genetics. Interestingly, in almost every case the percentage of Spanish citizens who would never approve these applications is considerably lower than the EU average:

- 43% will never approve the use of genetic tests for children to identify talents and weaknesses (EU average 54%);
- 34% will never approve the use of genetic treatments to prolong our expected life span by 25 years (EU average 42%);
- 26% will never approve developing genetic tests for everyone to identify diseases they might get (EU average 34%);
- 28% will never approve genetic treatments to kick bad habits like smoking or alcoholism (EU average 33%);

¹¹ CDTI (2002). Annual Report 2002. Madrid, Centre for the Development of Industrial Technology.

¹² European Commission. (2005). "Special Eurobarometer 225- Social Values, Science and Technology." Retrieved 01.08.2006, from http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf

- 25% are totally opposed to using genetic testing to produce a child that could be a bone-marrow donor for a sibling with a life-threatening disease (EU average 31%);
- 28% are totally opposed to storing everyone's genetic data so that criminals could be more easily caught (EU average 21%)
- and 19% will never approve storing the population's genetic data to study the causes of human disease (EU average 17%).

The survey also explores public attitudes to genetic modification. The attitude of Spanish citizens is one of the most tolerant of the EU Member states when it comes to the development of genetically modified crops to increase the variety of regionally grown food. Only 27% of the citizens would never approve this application of biotechnology (EU average of 37%). This tolerant attitude vis-à-vis the EU average is persistent in the case of environmental applications. 16% of the respondents would never approve developing genetically modified bacteria to clean up after environmental catastrophes (EU average 19%).

In general terms, the results of the survey suggest widespread acceptance for most potential applications of biotechnology and genetic engineering in Spain.

1.4 Main biotechnology research actors in Spain

In order to map the biotechnology research and development landscape in Spain in the period 2002-2005, we draw on three sources:

- OECD (2006). *Biotechnology Statistics*, OECD.¹³
- Pulido, A., E. Fontela, et al. (2005). *Perspectivas Económicas de la Biotecnología en España*. Madrid, Genoma España.
- Diaz Benito, V. M. (2002). *El sector de la biotecnología en España: su estudio a través del concepto de "sistema de innovación"*. Facultad de ciencias políticas y sociología Madrid, Universidad Complutense de Madrid.

The first two sources use the OECD biotechnology definition. We draw on these source to analyse the total expenditures in biotechnology research and development and innovation in Spain and to discuss the biotechnology business sector. The third source is mainly used to identify the most important biotechnology public research organisations in Spain.

According to the latest OECD biotechnology statistics(OECD 2006)¹⁴, in 2004 278 firms, 102 government sector institutes, 40 universities and 7 non-profit institutes carried out biotechnology research and development in Spain. Total research and development expenditure on biotechnology by both the public and the business sector was PPP\$ 653.3.

¹³ The OECD report draws on data from the Research and Development and Innovation Survey of the Spanish National Statistics Institute (INE). The survey is annual, mandatory and includes the OECD definition of biotechnology.

¹⁴ OECD (2006). *Biotechnology Statistics*, OECD.

The government sector had the largest share of expenditure with 36% followed by the higher education sector (33%) and the business enterprise sector (30%).

Diaz Benito (2002)¹⁵ stresses the importance of the CSIC in the Spanish biotechnology research landscape. He argues that even though the National Programme for Biotechnology has greatly contributed to the diffusion of biotechnology research capabilities in Spain, the Spanish National Research Foundation has strong influence in the biotechnology knowledge base.

Drawing on the participation of research groups in research projects financed by the public National Programme of Biotechnology in the period 2003-2006, we have identified the government non-university research institutions and universities in Spain active in biotechnology research. Table 1.2 gives the most relevant centres of the CSIC in terms of project participation in the National Programme of Biotechnology.

Table 1.2: Most relevant research centres of the CSIC in terms of project participation in the National Programme of Biotechnology (2003-2006)

CSIC Research Centre¹⁶	Location
CENTRO NACIONAL DE BIOTECNOLOGIA (CNB)	MADRID
ESTACION EXPERIMENTAL DEL ZAIDIN (EEZ)	GRANADA
INSTITUTO DE BIOLOGIA MOLECULAR Y CELULAR DE PLANTAS (IBMCP)	VALENCIA
CENTRO DE INVESTIGACIONES BIOLÓGICAS (CIB)	MADRID
INSTITUTO DE BIOLOGIA MOLECULAR DE BARCELONA (IBMB)	BARCELONA
CENTRO DE BIOLOGIA MOLECULAR SEVERO OCHOA (CBM)	MADRID
INSTITUTO DE MICROBIOLOGIA BIOQUÍMICA (IMB)	SALAMANCA
INSTITUTO DE BIOQUÍMICA VEGETAL Y FOTOSÍNTESIS (IBVF)	SEVILLA
INSTITUTO DE RECURSOS NATURALES Y AGROBIOLOGIA (IRNASE)	SEVILLA
INSTITUTO DE AGROQUÍMICA Y TECNOLOGIA DE ALIMENTOS (IATA)	BURJASSOT

Source: BioPolis Research

¹⁵ Diaz Benito, V. M. (2002). El sector de la biotecnología en España: su estudio a través del concepto de "sistema de innovación". Facultad de ciencias políticas y sociología Madrid, Universidad Complutense de Madrid.

¹⁶ The CSIC does not translate the names of the research centres and institutes on the information available through the internet www.csic.es. In order to facilitate the understanding of the research content we translate the centre names as follows: National Centre of Biotechnology (CNB), Experimental Station EL Zaidin (EEZ), Institute of Plant Molecular and Cell Biology (IBMCP), Centre of Biological Research (CIB), Barcelona Institute of Molecular Biology (IBMB), Centre of Molecular Biology Severo Ochoa (CBM), Institute of Biochemical Microbiology (IMB), Institute of Plant Biochemistry and Photosynthesis (IBVF), Institute of Natural Resources and Agro-biology (IRNASE), Institute of Agro-chemistry and Food Technology (IATA).

The most important universities in terms of the number of projects participating in the National Programme of Biotechnology in the period 2003-2006 are listed in table 1.3.

Table 1.3: Most relevant universities in terms of project participation in the National Programme of Biotechnology (2003-2006)

University	Location
Barcelona University	BARCELONA
Complutense University	MADRID
Sevilla University	SEVILLA
Oviedo University	OVIEDO
Autónoma University of Madrid	MADRID
Autónoma University of Barcelona	BARCELONA
Salamanca University	SALAMANCA
Málaga University	MÁLAGA
Madrid Politechnical University	MADRID
Granada University	GRANADA

Source: BioPolis Research

Finally, as regards the business sector, Pulido, Fontela, et al. (2005)¹⁷ identify 367 companies involved in the biotechnology industry. These include 102 core biotechnology companies (companies completely dedicated to biotechnology), 114 companies partly dedicated to biotechnology, 100 companies users of biotechnology and 53 service companies in the biotechnology industry. More than 55% of the companies are concentrated in Madrid and Catalunya (Catalonia).

If we consider the landscape of core biotechnology companies, these are more widely distributed across Spain. 35% are located in Madrid, 13.7 % in Barcelona, 15% in Andalucía, 6.8% in the Basque Country and 6.8% in Valencia.

¹⁷ Pulido, A., E. Fontela, et al. (2005). *Perspectivas Económicas de la Biotecnología en España*. Madrid, Genoma España.

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

In this chapter the funding of biotechnology research through policy and non-policy-directed instruments and of biotechnology commercialisation through policy-directed instruments is presented. Data were collected through desk research (publications, documents, websites of national and regional public funding organisations and/or governmental departments), survey among representatives of funding organisations that manage the generic and biotech-specific programmes, interviews with representatives of organisations that are involved in non-policy-directed and policy-directed funding. The funding organisations contacted and the contact persons who participated in the survey and/or who were interviewed can be found in Annex 3 (List of Contact Persons).

Section 2.1 introduces the definitions of the main conceptual terms. Section 2.2 presents the non-policy-directed funding and section 2.3 the policy-directed funding. Charities and foundations also play an important role in funding biotechnology research in some countries; they will be addressed in section 2.4. The final section provides a short overview of the European funding of biotechnology research in Spain through the 6th Framework Programme.

2.1 Introduction

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

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

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

through which biotechnology may be supported. In the BioPolis project only the funds for block grants to (government) research institutes and to research councils through the open-call systems are included. ??

2.2 Non-policy-directed funding of biotechnology research

Table 2.1 gives the information available on the non-policy-directed funding of biotechnology research in Spain in the period 2002-2005.

As already mentioned above, besides the universities the Spanish National Research Council (CSIC) is the main public research institution in Spain conducting biotechnology research. The CSIC is mainly financed through block grants (in 2005 67.4 % of the funds were institutional funding) and conducts research in 8 techno-scientific fields. Unfortunately, the data available on funding do not specify the amount of resources directed to biotechnology research. For this reason the share of institutional funding directed to biotechnology research has been estimated.¹⁸

Table 2.1 Non-policy-directed funding of biotechnology research

Funding organisation	Public Research Institutions / Response Mode programmes	Period	Funds in M EUR
Ministry of Education	Spanish National Research Council	2002-2005	365

Source: BioPolis Research

2.3 Policy-directed funding of biotechnology research and commercialisation

This section presents the policy-directed instruments promoting biotechnology research and commercialisation identified in Spain for the period 2002-2005. Table 2.2 shows an overview of the instruments classified by the criteria national/ regional and generic/ biotechnology-specific.

The following sections go through the following generic and biotechnology-specific instruments:

Generic Instruments

- National Programme (NPrg.) of Biomedicine (different calls)

¹⁸ For the estimation, three techno-scientific fields at the CSIC were selected: (i) biomedicine and biology, (ii) food sciences and technology and (iii) agricultural sciences. These three fields represented in 2005 37% of the total research staff. Assuming the same distribution in terms of funding, we consider that 37% of the total institutional funding received in 2005 was invested in life sciences research. Moreover, since these fields include research other than biotechnology research, we consider only 60% of this budget to estimate biotechnology institutional research funding in 2005. Assuming that this is an average funding per year, we calculate the funding for the period 2002-2005. The estimation probably overestimates biotechnology funding in the techno-scientific fields selected, however, it compensates with biotechnology research conducted in other techno-scientific fields which have not been considered.

- National Programme of Agro-Alimentary Resources and Technologies Calls of the General Directorate of Research of the Ministry of Education (DGI-MEC)
- Generic instruments of the Ministry of Education (MEC)
- Instruments of the Centre for Development of Industrial Technology (CDTI)

Biotechnology-specific Instruments

- National Programme of Biotechnology
- Special Action in Genomics and Proteomics
- Foundation Genoma España - Promotion of Genomics and Proteomics Research

Besides these initiatives at the national level, the following actions have been launched at the international level, specially through the ERA-NET initiatives:¹⁹

- Two trilateral calls in Plant Genomics together with France (ANR/Genoplante) and Germany (BMBF/GABI) with a budget of 2.5 and 3.5 M EUR respectively.
- Two ERA-NET calls in Pathogenomics and Systems Biology (1.5 and 1.8 M EUR respectively)

¹⁹ These initiatives are not considered to analyse national biotechnology innovation policy in Spain (and are not included in the figures presented in chapter 4).

Table 2.2 National and regional public policy-directed biotechnology stimulating instruments during the period 2002 – 2005 in M EUR

Instrument	Funding institution	Budget 2002-05	% of Total
National			
<i>Generic Instruments</i>			
NPrg. Biomedicine*	MEC - DGI -	67.2	13.1%
NPrg. Biomedicine	MEC - DGTP		n.a.
NPrg. Biomedicine and NPrg Health technologies	ISC III	7.79	1.5%
NPrg. Agrofood Resources and Technologies	DGI - MEC	43.4	8.5%
CDTI Technology Innovation Projects	CDTI	1.7	0.3%
CDTI Technology Development Projects	CDTI	11.9	2.3%
CDTI Collaborative Industrial Research Projects	CDTI	12.5	2.4%
CDTI Technology Promotion Projects	CDTI	0.5	0.1%
CDTI NEOTEC	CDTI	7	1.4%
PETRI	MEC	5.1	1.0%
Training Grants*	MEC	38.7	7.6%
Research Contracts*	MEC	46.3	9.1%
Mobility Grants*	MEC	3.2	0.6%
NPrg. General Promotion of Knowledge*	MEC - DGI	9.7	1.9%
Scientific and Technological Disclosure and Dissemination	MEC - DGI		n.a.
<i>Biotechnology-specific instruments</i>			
NPrg. Biotechnology (Research Projects and Special Actions)	MEC - DGI	48.2	9.4%
NPrg. Biotechnology (Research Projects and Special Actions)	MEC - DGTP	45.7	8.9%
Special Action in Genomics and Proteomics**	MEC - DGI	31.7	6.2%
Genoma España	MEC and MSC	33.87	6.6%
Regional			
Research and Development Projects	C.C.A.A	72.5	14.2%
Technology Development and Innovation Projects	C.C.A.A	24.3	4.8%
Total		511.26	100%

Source: BioPolis Research

*The budget represents the lowest estimation available

**The budget does not include an international call in plant genomics with France (Genoplante) and Germany (GABI) and funding to support the costs of equipment, facilities and co-ordination tasks.

2.3.1 National Programme of Biomedicine

The National Programme of Biomedicine aims to promote basic and applied biomedical research in public research institutions and companies. The main instruments are open calls to allocate subsidies and credits to finance research activities. The programme is coordinated by two national ministries: the Ministry of Science and Education and the Ministry of Health and Consumer Affairs. Three organisational bodies are responsible for managing the allocation of funding: the General Directorate of Research (DGI) and the General Directorate of Technology Policy (DGTP), both belonging to the Ministry of Education (MEC) and finally the Health Institute Carlos III (ISCIII) of the Ministry of Health and Consumer Affairs (MSC). These 3 bodies publish specific open calls every year within the framework of the National Programme of Biomedicine. Since the programme is quite broad, covering different scientific and technological fields, for the purpose of the BioPolis project it is considered a generic (i.e. not biotechnology-specific) instrument.

- NPr Biomedicine: Open calls of the General Directorate of Research of the Ministry of Education (MEC-DGI)

The main objectives of these calls are the promotion of research on molecular, biochemical and cellular mechanisms shaping diseases, as well as the application of new technologies with special attention to genomics, proteomics and bioinformatics for the treatment of problems related to human pathology. A further main objective is the development of therapeutic tools for the treatment of pathologies and the related symptoms (MCYT 2004)²⁰. The calls have awarded funding to university research groups, non-profit research institutions, research units of the CSIC and other public research centres. Universities are the main recipients of these calls.

According to Pulido (2005)²¹ in the period 2002-2003 33.4M EUR were directed to biotechnology research activities. We estimate that in the period 2002-2005 the funding volume reached 67.2M EUR. This budget represents the lowest estimation available.

- NPr Biomedicine: open calls coordinated by the General Directorate of Technology Policy of the Ministry of Education (MEC-DGTP)

These calls aim to support industrial research and technology development in the process of developing and producing pharmaceuticals for human and veterinary use, as well as raw materials for drug development. The projects of industrial research cover the whole chain of drug discovery and development from the identification and validation of new targets, the elaboration of new molecules through combinatorial chemistry, drug evaluation in its different stages up to the development of generic drugs to increase the offer of drugs available (MEC 2005a)²².

²⁰ MCYT (2004). Memoria de Actividades de I+D+I 2002. Madrid, Ministerio de Ciencia y Tecnología.

²¹ Pulido, A., E. Fontela, et al. (2005). Perspectivas Económicas de la Biotecnología en España. Madrid, Genoma España.

²² MEC (2005). Memoria de Actividades de I+D+I 2003. Madrid, Ministerio de Educación y Ciencia.

The main recipients of these calls are large companies and small and medium-sized enterprises (SMEs). Universities and non-profit research institutions obtain a small percentage of the funding allocated through these calls which involves both subsidies and credits. Furthermore, due to the concentration of companies in Madrid and Catalunya (Catalonia), in the period 2000-2003 these regions have accumulated 46% of the budget for the National Programme of Biomedicine (MCYT 2004²³; MEC 2005a²⁴). There is no information available on the funding of biotechnology related research through these calls.

- NPr. Biomedicine and NPr. of Health Technologies: open calls of the Health Institute Carlos III (ICIII) under the responsibility of Ministry of Health and Consumer Affairs (MSC)

The promotion activities coordinated by the Health Institute Carlos III of the MSC involve funding of basic and clinical research projects as well as projects to prove and evaluate novel medical technologies. The main recipients of these calls are public hospitals and research institutions of the national health system. University research groups are an important target group of these calls as well. According to the data provided by the ICIII, in the period 2002-2005 these calls allocated 7.8M EUR to finance biotechnology research activities.

2.3.2 National Programme of Agro-Alimentary Resources and Technologies

- NPr. Agro-Alimentary Resources and Technologies: open calls of the General Directorate of Research of the Ministry of Education (MEC-DGI)

The open calls aim at funding research projects in the agro-food, animal farming and forestry sectors. The scientific and technological fields eligible for funding are defined very broadly, covering the conservation of the genetic resources of agro-food interest, agrarian resources and technologies in the broadest sense. The calls are directed to research groups at universities and public research institutions.

In the period 2002-2003, 20.1M EUR were directed to biotechnology research activities (Pulido, Fontela et al. 2005). We estimate that in the period 2002-2005 the funding volume reached 43.4M EUR.

2.3.3 Generic Instruments of the Ministry of Education (MEC)

The Ministry of Education implements a range of instruments within the National Plan that do not target any specific scientific field and can be considered generic instruments for the purpose of the BioPolis project. These are:

- (i) Projects to stimulate the transfer of research results (PETRI)
- (ii) Instruments promoting human resources

²³ MCYT (2004). Memoria de Actividades de I+D+I 2002. Madrid, Ministerio de Ciencia y Tecnología.

²⁴ MEC (2005a). Memoria de Actividades de I+D+I 2003. Madrid, Ministerio de Educación y Ciencia.

- (iii) National Programme for the General Promotion of Knowledge (PGC)
- (iv) Grants for scientific and technological disclosure and dissemination activities

- Projects to stimulate the transfer of research results (PETRI)

The initiative targets the promotion of technology transfer. It is designed to encourage the release of goods, processes and services onto the market which were developed by public centres on the behalf of private companies. Funding is directed to PROs. To be eligible for funding, research groups must have an industrial partner. In the period 2002-2005, 5.1M EUR were invested in biotechnology projects through this initiative.

- Instruments promoting human resources

The National Plans NP IV and NP V implemented in the period under consideration include policy instruments to increase the capabilities of R&D units. Like in the past, the NP pursues the objective of increasing the number of qualified personnel in the public and private sectors. Additionally, the IV NP for the period 2000-2003 included the explicit objective to promote innovation activities by supporting schemes for personnel recruitment in firms (European Commission 2003)²⁵. These objectives are pursued by trying to increase the number of researchers and technicians in research centres and in enterprises, and by improving their mobility between the public and private sector. The relevant policy instruments can be grouped in the following types:

Training Grants

The annual reports of the NP summarising the initiatives implemented for the years 2002 and 2003, and the annual report of the activities carried out in 2004 present data on 18 different types of training grants promoting (i) pre-doctoral training, (ii) training for technologists without the need to complete a doctoral thesis and (iii) post-doctoral training aiming at completing advanced training, preferably abroad. Among the 18 different types of grants, the promotion of pre-doctoral training or researchers (FPI Initiative) and of university personnel (FPU Initiative) are the most important in terms of funding volume. In the period 2002-2003 these two initiatives amounted to 73% of the funding directed to training grants.

Regarding the areas of application, there is no information on grants awarded in the field of biotechnology. For the field “molecular and cellular biology and genetics” the volume invested in training grants for the period 2002-2003 was 19.3M EUR. We estimate that for the period 2002-2005 the volume of grants was 38.7M EUR. This budget represents the lowest estimation available.

²⁵ European Commission (2003). European Trend Chart on Innovation. Country Report Spain. Covering Period April 2002 - August 2003. Brussels, European Commission,.

Research Contracts

Under this heading the NP include contracts for the recruitment of personnel for R&D and innovation tasks. These aim to improve the capabilities of research institutions and enterprises, also SMEs, and usually require the co-financing of the beneficiary institutions. Within this type of instrument, the programme Ramón y Cajal, the Torres Quevedo Programme and the Juan de la Cierva Programme can be mentioned:

- The Ramón y Cajal Programme. As a response to the claims of the research community about the lack of opportunities in the national research system, this initiative was launched in 2001 with the purpose of permanently installing researchers in the Spanish research system. The programme co-finances the cost of researchers' contracts in a public research institution or university. Since 2001 the programme has published annual calls to co-finance 5-year research contracts.
- The Torres Quevedo Programme has the same rationale as the Ramón y Cajal Programme, but focuses on the placement of doctorates and technologists in firms by co-financing research contracts for the period of 3 years. The programme's main goal is to transfer research results from R&D institutions to enterprises through the mobility of doctors and skilled personnel (European Commission 2003)²⁶.
- The Juan de la Cierva Programme aims at recruiting young post-doctoral researchers with 3-year contracts and integrating them in research teams conducting research projects in order to further develop their scientific skills. Therefore, applicant research centres need to be carrying out research projects funded by the National Plan or within the Framework Programmes of the EU (European Commission 2004)²⁷.

As for the areas of application, as in the case of the training grants, there is no information on the research contracts in the field of biotechnology. For the field "molecular and cellular biology and genetics" the volume invested in research contracts for the period 2002-2003 was 23.1M EUR. We estimate that for the period 2002-2005 the volume of contracts was 46.3M EUR. This budget represents the lowest estimation available.

Mobility Grants

The National Plans include different types of mobility grants for Spanish and foreign scientists and technologists at different stages of their academic career. The purpose of these grants is to promote research stays for doctoral students and assistants and professors abroad. The installation of Spanish scientists and technologists in foreign research centres (as well as the support for scientists trained abroad to work in Spanish research groups) aims to gradually adapt the training priorities of Spanish researchers to international standards as well as the diffusion of knowledge (CICYT 2000)²⁸.

²⁶ European Commission (2003). European Trend Chart on Innovation. Country Report Spain. Covering Period April 2002 - August 2003. Brussels, European Commission,.

²⁷ European Commission (2004). European Trend Chart on Innovation. Country Report Spain. Covering Period September 2003 - August 2004. Brussels, European Commission,.

²⁸ CICYT. (2000). "National Plan for Scientific Research, technological Development and Innovation 2000-2003 - Volume I Objectives and Structure." Retrieved October 2005, from http://www.mec.es/ciencia/plan_idi/files/pnidi-1i.pdf.

As for the areas of application, again there is no information on the mobility grants in the field of biotechnology. For the field “molecular and cellular biology and genetics” the volume invested in mobility grants for the period 2002-2003 was 1.6M EUR. We estimate that for the period 2002-2005 the volume of contracts in this field was 3.2M EUR. This budget represents the lowest estimation available.

- National Programme for the General Promotion of Knowledge (PGC)

This programme was included in the National Plan 2000-2003. Managed by the MCYT (today Ministry of Education), the programme covered the promotion of basic research in scientific fields that are not included in the priority techno-scientific areas defined by the NP presented in table 1.1. The aim of this initiative is to support basic research which does not explicitly pursue specific objectives of application, but rather the improvement of scientific excellence in a certain field of knowledge. The programme promotes research in mathematics, natural sciences, human sciences, social sciences and law. Moreover, the programme involves a strategic action for discourse activities in science and technology. In the period 2002-03, this instrument accounted for 157M EUR (MEC 2005a)²⁹. According to the information available, 9.7M EUR were invested in biotechnology research (Pulido, Fontela et al. 2005). This budget represents the lowest estimation available.

- Grants for Scientific and Technological Disclosure and Dissemination activities

Among the generic instruments that do not fit in the previous groups (and are neither technology- nor sector-specific), the NP include the Grants for Scientific and Technological Disclosure and Dissemination activities. The main goal of these grants is to increase the public awareness of scientific and technological culture in Spanish society. In the years 2002 and 2003, the initiatives that were not technology-specific were lunched by the Ministry of Science and Technology (today Ministry of Education) and the ISC III and amounted to 8.469M EUR (MEC 2005a)³⁰. There is no information available on the amount of funding directed to biotechnology-related activities in the period 2002-2005.

2.3.4 Instruments of the Centre for Development of Industrial Technology (CDTI)

As already mentioned above, the CDTI plays a key role in promoting corporate research and development activities. Among the different modalities of projects promoted by the CDTI, the following types can be considered as general projects for research and development:

- Collaborative industrial research projects (CIPR) involve research which does not have an immediate commercial viability, with high risk and is carried out in collaboration with universities and/or other research centres. In the period 2002-2005, 12.5M EUR were invested to finance biotechnology projects.
- Technology development projects (TDP) have an explicit applied nature and are oriented towards the development of new industrial products or processes. In the pe-

²⁹ MEC (2005a). Memoria de Actividades de I+D+I 2003. Madrid, Ministerio de Educación y Ciencia.

³⁰ MEC (2005a). Memoria de Actividades de I+D+I 2003. Madrid, Ministerio de Educación y Ciencia.

riod 2002-2005, 11.9M EUR were invested to finance this type of biotechnology projects.

- Technology innovation projects (TIP) focus on the incorporation and assimilation of new technologies within the companies. In the period 2002-2005, 1.6M EUR were invested to support biotechnology.

These promotion initiatives belong to the so called “direct financing” line of the Centre of Development for Industrial Technology (CDTI), which grants long-term credits covering between 60% and 70% of the R&D costs at 0% interest. Additionally, the CDTI offers a slightly different financing instrument (the ICO-CDTI credits) which promotes R&D activities with loans at low interest rates. There is no information available on the financial volume directed to promote biotechnology R&D through the ICO-CDTI credits.

Apart from promoting research and development activities, the CDTI promotes the application and commercialisation of R&D results through the so-called technology promotion projects (TPP) and through the NEOTEC initiative.

- Technology promotion projects (TPP) target the diffusion of technologies by supporting licensing activities of companies. In the period 2002-2005, 0.5M EUR were invested to promote biotechnology.
- NEOTEC. This initiative, coordinated by the CDTI, aims at promoting new technology-based firms (NTBFs) coming from universities and public research and technology centres. According to the European Trend Chart (European Commission 2002)³¹, NEOTEC offers three support schemes: (i) advisory and training services; (ii) credits for NTBFs and (iii) loans for capital risk companies to encourage investments in NTBFs. In the period 2002-2005, 6.9M EUR were invested in promoting biotechnology projects.

2.3.5 National Programme of Biotechnology

The National Programme of Biotechnology aims to promote technologies oriented towards the use of living organisms to produce goods and services through the application of molecular biology and genetic engineering. The programme has different scientific areas of promotion and is managed by two general directorates of the Ministry of Education: the General Directorate of Research and the General Directorate of Technology Policy.

- NPr. Biotechnology: open calls of the General Directorate of Research of the Ministry of Education (MEC-DGI)

Through these calls the General Directorate of Research of the Ministry of Education promotes mainly biotechnology fundamental research at universities and at research units of the CSIC through subsidies for 3-year research projects. The calls promote projects in four research lines: (i) biotechnology for diagnostics and analysis; (ii) generic biotechnology (mainly focused on transgenic organisms), (iii) design and optimisation of

³¹ European Commission (2002). European Trend Chart on Innovation. Country Report Spain. October 2002. Brussels, European Commission,.

biologic processes and (iv) interdisciplinary research on biotechnology and society(MCYT 2004).³²

In the period 2002-2005, the funding directed to biotechnology in the form of grants amounted to 48.2M EUR.

- NPr. Biotechnology: open calls of the General Directorate of Technology Policy of the Ministry of Education (MEC-DGTP)

Through these calls (also called the PROFIT Programme), the General Directorate of Technology Policy of the Ministry of Education promotes mainly industrial research at SMEs and large companies through subsidies and credits. Research units of public institutions and non-profit organisations receive funding in these open calls, but are not the target group. The objectives of these calls are:

- To promote innovation in biotechnology companies and firms carrying out biotechnology research and development;
- To promote the application of biotechnology among industrial and service companies;
- To increase the diffusion of technological advances in national and international markets;
- To support the development of genomics and proteomics oriented towards the application in the health and agro-food sectors and in bioprocesses.

The calls promote projects in different research lines: (i) biotechnology for diagnostics and analysis; (ii) development of biotechnological, fermentative and enzymatic processes and (iii) genetic improvement of microorganisms, plants and animals (MCYT 2004).³³

In the period 2002-2005 the funding directed to biotechnology in the form of grants amounted to 45,7M EUR.

- NPr. Biotechnology: special action in genomics and proteomics

This action is managed by the General Directorate of Research of the Ministry of Education with the purpose of promoting the creation of scientific knowledge, technology development and transfer in the fields of genomics and proteomics in their relevant areas of application: diagnostics and therapeutics, development of novel drugs and vaccines, development of novel processes and products in the agro-food and environmental sectors, etc. The action is carried out via an open call every two years and the recipients are CSIC and university research groups. Health, plant, animal and microbial genomics have been the main focus of the strategic action on genomics and proteomics.

In the period 2002-2005 the funding allocated through two open calls amounted to 31.7M EUR.³⁴

³² MCYT (2004). Memoria de Actividades de I+D+I 2002. Madrid, Ministerio de Ciencia y Tecnología.

³³ MCYT (2004). Memoria de Actividades de I+D+I 2002. Madrid, Ministerio de Ciencia y Tecnología.

2.3.6 Genoma España - Promotion of Genomics and Proteomics Research

Genoma España, the Foundation for the Development of Genomic and Proteomic Research, was established in 2002 and is supported by the Spanish state through the Ministries of Health and Consumer Affairs and Education and Science. According to the internet site³⁵, the objectives of the foundation are (i) to encourage research into genomics and proteomics, (ii) to help in the development of biotechnology businesses and (iii) to achieve financing for Spanish research groups working in these areas.

In the period 2002-2005 the funding allocated to promote the development of genomics and proteomics research amounted to 33.9M EUR.

2.3.7 Instruments at the sub-national level

The 17 Autonomous Communities (CC.AA) design and implement regional research, development and innovation plans. The Communities have the responsibility of designing these plans and allocating the budget according to their own principles. In other words, each community designs its own plan freely, defining the funding priorities and the main policy goals. However, there are common initiatives between the national and regional governments to finance research infrastructure and research centres.

Pulido, Fontela et al. (2005)³⁶ present comprehensive data on the biotechnology funding of the Autonomous Communities for the period 2000-2003. This source categorises the public funding according to three criteria:

- Biotechnology funding in research and development projects
- Biotechnology funding in innovation and technology development projects
- Biotechnology funding in infrastructure

For the purpose of the BioPolis inventory of biotechnology public funding, we draw on this source to estimate funding at the sub-national level for the period 2002-2005. We only consider the first two types of funding. We estimate that in the period 2002-2005 the funding allocated through the programmes of the Autonomous Communities amounted to 72.5M EUR for R&D projects and 24.3M EUR for innovation and technology development projects.

According to the information available, in the period 2002-2005 three Autonomous Communities defined biotechnology as a strategic field for promotion and launched biotechnology-specific promotion programmes. These were the Basque Country (bio-BASK 2010), Murcia (BioCarm 2003-2006) and Galicia (sectoral programme 2002-2005).

³⁴ The budget does not include an international call in plant genomics with France (Genoplante) and Germany (GABI) and funding to support the costs of equipment, facilities and co-ordination tasks. If these promotional activities are considered, the funding amounts to 40M EUR.

³⁵ www.gen-es.org last accessed in August 2005.

³⁶ Pulido, A., E. Fontela, et al. (2005). *Perspectivas Económicas de la Biotecnología en España*. Madrid, Genoma España.

bioBASK 2010 was initiated in 2002 by the Basque government with the aim of developing a new business sector related to bioscience in the Basque country. The specific objectives of the programme are (i) the diversification of the industrial sector, (ii) the creation of 40 new companies and (iii) the generation of 3 000 jobs related to the life science industry in the region. These goals should be attained with the establishment of a BioPark in the Basque country, characterised by the existence of a critical mass in some niches, excellent research capabilities and the exploitation of results for industrial purposes. The programme is organised in three strategic areas: (i) generation of know-how, (ii) business development and (iii) revitalisation of the sector (bioBASK2010 2006)³⁷

The programme BioCarm was launched for the period 2003-2006 by the government of the Autonomous Community of Murcia (in the framework of the regional plan for science and technology), with the aim of promoting the development of biotechnology in Murcia. The programme concept is quite broad, covering development of the knowledge base, promotion of collaborative activities in biotechnology research, establishment of biotechnology companies in the region and the adoption of biotechnology for industrial applications for the agro-food and chemicals sector as well as for environmental solutions(Fundación Seneca 2005)³⁸.

In Galicia, the Plan Gallego de Investigación, Desarrollo e Innovación Tecnológica (2002-2005) (the regional research, development and innovation plan) defines a sectoral programme called “Biotechnology and Pharmaceutical and Life Sciences Technologies”. The sectoral programme involves annual open calls for companies (SMEs and large firms) as well as public research organisations (PROs) which can apply for grants and subsidies to finance research and development activities in the areas of biotechnology and pharmaceutical and life sciences technologies. The programme is funded by EU structural funds.

2.4 Participation in the 6th Framework Programme (FP)

Table 2.5 shows the participation of Spanish research groups in the 6th Framework Programme in the thematic priorities relevant for biotechnology. The information shows the number of Spanish groups involved as co-ordinators and as participants in the projects and the percentage of total participations.

³⁷ bioBASK2010. (2006). "What is BioBASK 2010?" Retrieved November 2006, from www.biobask.org.

³⁸ Fundación Seneca (2005). BioCARM Programa Sectorial de Biotecnología - Prospectiva Científico-Tecnológica en el ámbito de la región de Murcia. Murcia, Fundación Seneca.

Table 2.3 Involvement of Spain in biotechnology/life sciences programmes of the 6th Framework Programme

Sixth Framework Programme¹⁾	Participation as project manager in # of projects (% of total)	Participation as member of the project team in # of projects (% of total)²⁾
Thematic priority		
1. Life sciences, genomics and biotechnology for health	24 (3%)	444 (5%)
2. Nanotechnologies, section bio-nanotechnology	0 (0%)	2 (2%)
5. Food quality and safety	4 (4%)	115 (7%)

¹⁾ First and second call, all types of projects

²⁾ Persons/groups can participate in more projects, resulting in more participation

Source: BioPolis Research

In the thematic priority nanotechnologies, section “Bio-nanotechnology”, there were no projects coordinated by a Spanish team. In the case of life sciences, 3% of the projects were coordinated by a Spanish team. In the case of food quality and safety, 4% of the projects had a Spanish coordinator.

In terms of participation as member of research consortia, again the thematic priority “Food” presents the largest Spanish participation quota followed by “Life Sciences” and nanotechnologies.

3. Performance of the national biotechnology innovation system

3.1 Introduction

This chapter analyses the performance of the Spanish biotechnology innovation system for two or three time periods – depending on data availability – as shown by a range of indicators for scientific and commercialisation performance. Each time period includes several years in order to avoid capturing erratic trends. National trends are benchmarked against the performance of the EU25 Member States and the USA.

The presentation of the performance of the Spanish biotechnology innovation system is structured along the four main areas of the system: the knowledge base, processes of knowledge transfer and application, industrial development and markets for biotechnology-based products. For each area, the different indicators for Spain, the USA and EU25 will be shown. To establish a comparison, the values achieved by EU25 have been chosen as reference in each indicator. The absolute figures are presented in Annex 5.

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

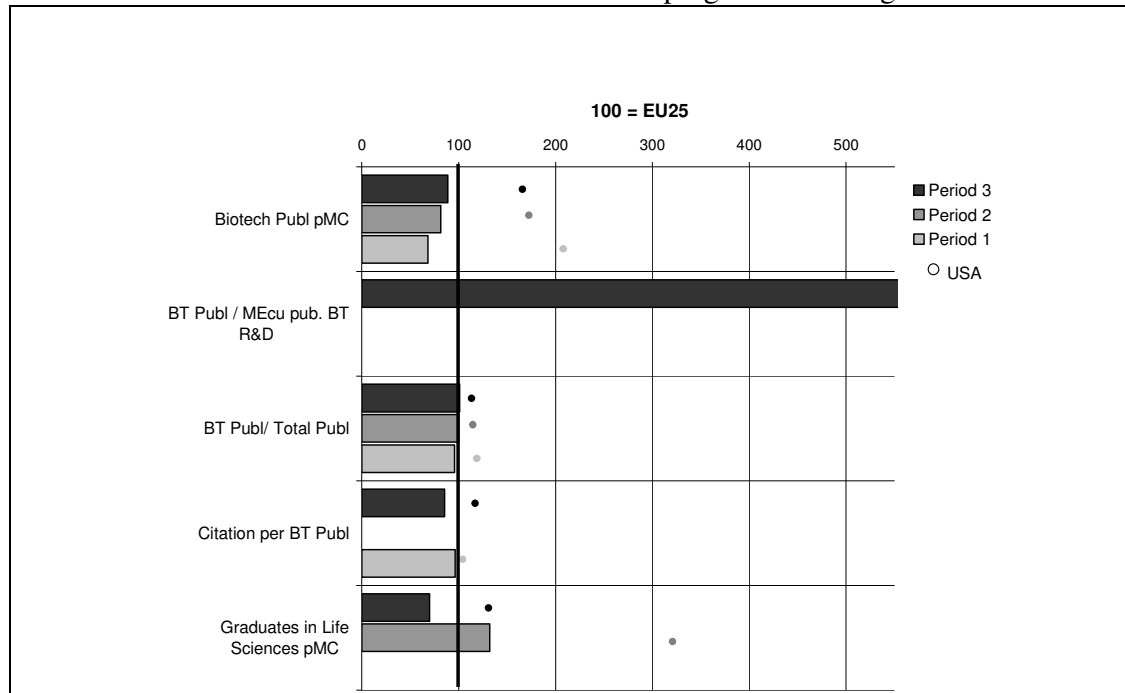
The indicators chosen for the assessment of the overall performance in creating a knowledge base and supporting the availability of human resources are given in Chart 3.1.

The indicator relating biotechnology publications to expenditures in biotechnology research and development achieves scores well above the European level. The indicator suggests an outstanding performance of the Spanish biotechnology innovation system regarding the use of resources available for research activities (in terms of publications).³⁹ In terms of citations per biotechnology publication, however, the Spanish performance is decreasing, reaching levels below the EU average in the most recent period under consideration (2000/2004). As for the volume of biotechnology research activities and human resources in terms of biotechnology publications per million capita (pMC) and graduates in life sciences pMC, the Spanish biotechnology innovation system is behind the EU25 and USA. In terms of biotechnology publications pMC, Spanish performance in biotechnology knowledge production is nearing the EU25. However, compared to the European level, the human resources indicator for Spain suggests a worrying trend in the ability of the Spanish innovation system to train students in life sciences.

Charts 3.2.1, 3.2.2, 3.3. and 3.4. give bibliometric indicators per biotechnology sub-field. The indicators give a simple specialisation profile of the research activities in biotechnology in Spain compared to the EU25 and to the USA and the changes between two different periods.

³⁹ For details on the absolute values of the indicators and methodological issues, see annex 5.

Chart 3.1: General Trend in Performance developing the knowledge base⁴⁰



Source: BioPolis Research

Data: Science Citation Index, OECD Education Database, European Commission 1999

Note: The European reference region for indicator 2 (BT Publ./MEcu pub. BT R&D) is EU15.

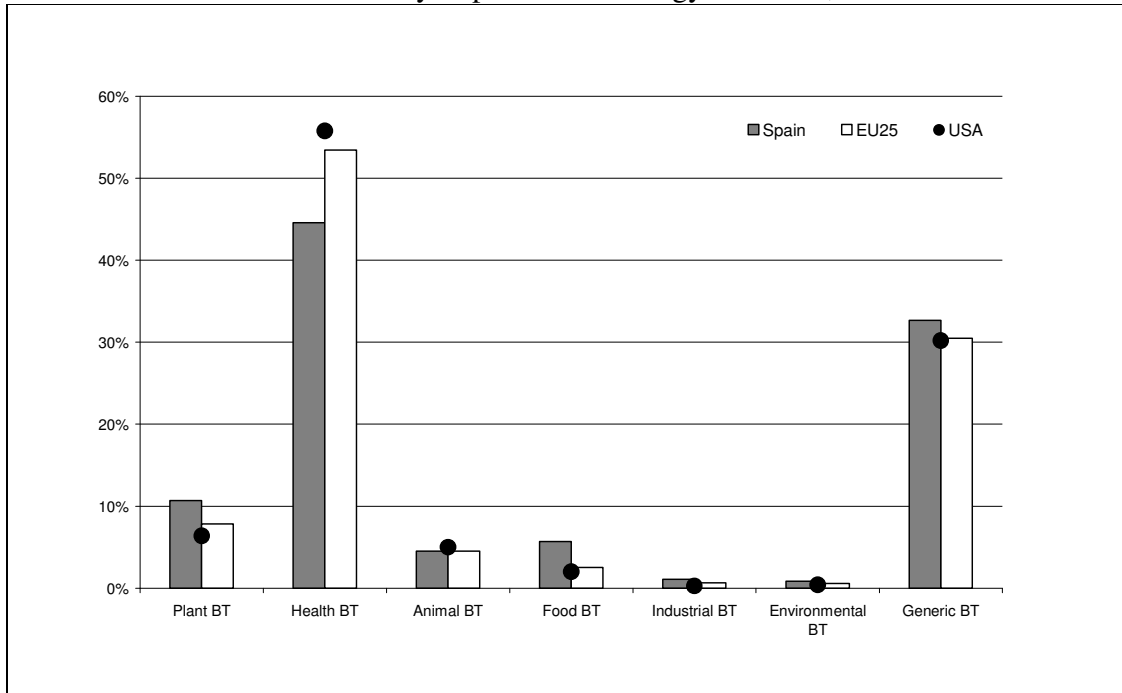
Chart 3.2.1 shows a set of bibliometric indicators for the period 1994-1996 which aims to present the specialisation profile of the biotechnology scientific output in Spain. For 7 research biotechnology fields the chart gives the share of publications within the total biotechnology output. Chart 3.3 shows the same set for the period 2002-2004 and chart 3.4 the growth rates between the two periods.

The indicators on charts 3.2.1, 3.2.2 and 3.3 provide empirical evidence for the relative importance of health biotechnology in terms of publications. In this concern Spain is not different from the EU25 or the USA: among the 7 biotechnology sub-fields considered, health biotechnology is in both periods the largest sub-field. If we compare the results for both periods, health biotechnology even gains importance. However, in the case of Spain the focus on health biotechnology is slightly weaker than in the USA and the EU25. Generic biotechnology is the second largest biotechnology sub-field. Again, this holds for Spain, EU25 and USA. The differences among the three regions in the share of this field are not significant.

⁴⁰ For a detailed discussion of the strengths and limitations of science and technology indicators, see Moed, H.F.; Glänzel, W.; Schmoch, U. (eds.) (2004): Handbook of Quantitative Science and Technology Research. The Use of Publication and Patent Statistics in Studies of S&T Systems., Dordrecht: Kluwer Academic Publishers.

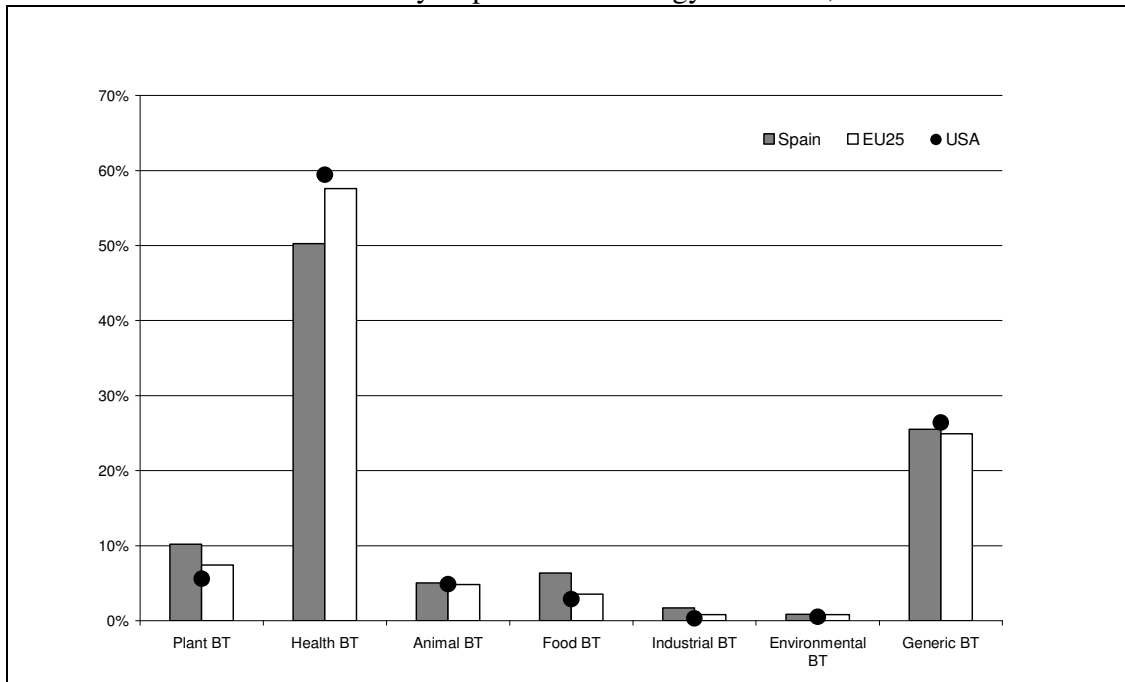
With regard to the other fields, it can be pointed out that the sub-fields plant and food biotechnology in Spain are relatively more important than in the USA and the EU25. The relatively large knowledge base of these sub-fields in Spain can be observed for the 2 periods we are considering.

Chart 3.2.1: Bibliometric Analysis per Biotechnology Sub-field, 1994 – 1996



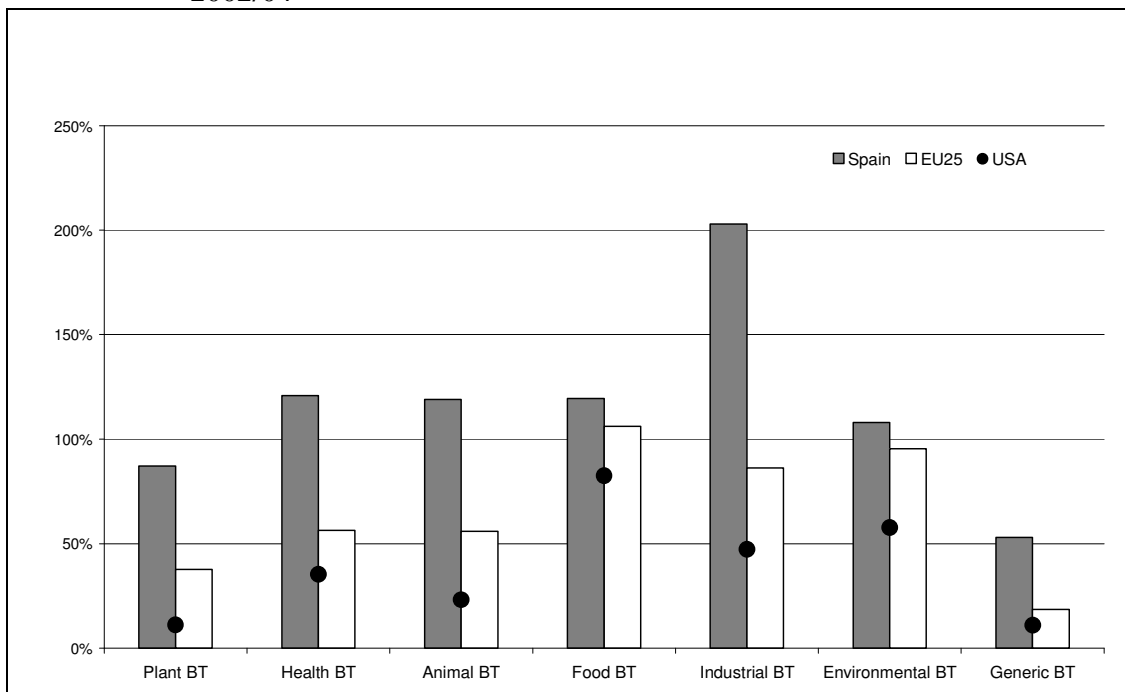
Source: BioPolis Research. Data: Science Citation Index

Chart 3.2.2: Bibliometric Analysis per Biotechnology Sub-field, 2002 – 2004



Source: BioPolis Research. Data: Science Citation Index

Chart 3.3: Data on Performance per Biotechnology Sub-field, Growth Rate 1994/96 – 2002/04



Source: BioPolis Research
Data: Science Citation Index

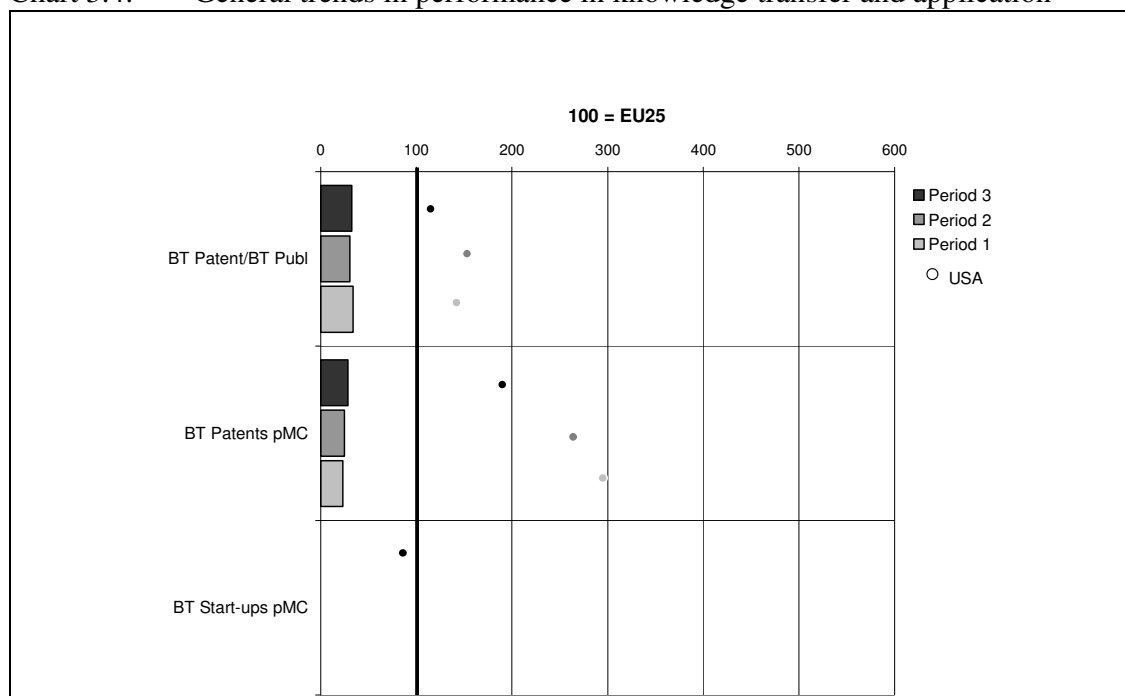
Regarding the rate at which knowledge is being produced in the different biotechnology sub-fields in terms of publications, industrial biotechnology is the most dynamic field. As given in chart 3.4, in all fields the knowledge base grows at a faster rate than in the EU25 and USA. The results suggest that a process of knowledge production is taking place in Spain.

3.3 Performance in knowledge transfer and application

The indicators chosen to assess the overall performance in knowledge transfer and application are given in chart 3.5.

As for the first of the three indicators – biotechnology patents per biotechnology publication – Spain lies far below the EU25. Moreover, if we consider the 3 time periods, the poor performance is quite persistent over time. With 0.02 patents in biotechnology per publication in period 3 (2001-2003), the Spanish performance is very disappointing, with levels below the EU15 (0.07) and the USA (0.08). In terms of this indicator, the data suggest a serious problem in the process of knowledge transfer and application.

Chart 3.4: General trends in performance in knowledge transfer and application



Source: BioPolis Research

Data: Database of European Patents (Host Questel Orbit , EPPATENT), Database of International Patent Applications (WOPATENT), EuropaBio

Note: the European reference region for indicator 11 (number of biotech start-ups pMC) is EU15.

As far as the second indicator (biotechnology patents pMC) is concerned, the results are coherent with the poor Spanish performance. In all three periods the indicator for Spain is

below the EU25 level. Even though the indicator shows a positive trend, in period 3 with 6 biotechnology patents per million capita the Spanish performance remains worrying.

3.4 Industrial development

There are no comprehensive data available to assess Spanish performance in developing a biotechnology industry vis-à-vis the EU25 and USA in the period 2002-2005. For a short overview of the Spanish biotechnology industry, see section 1.4.

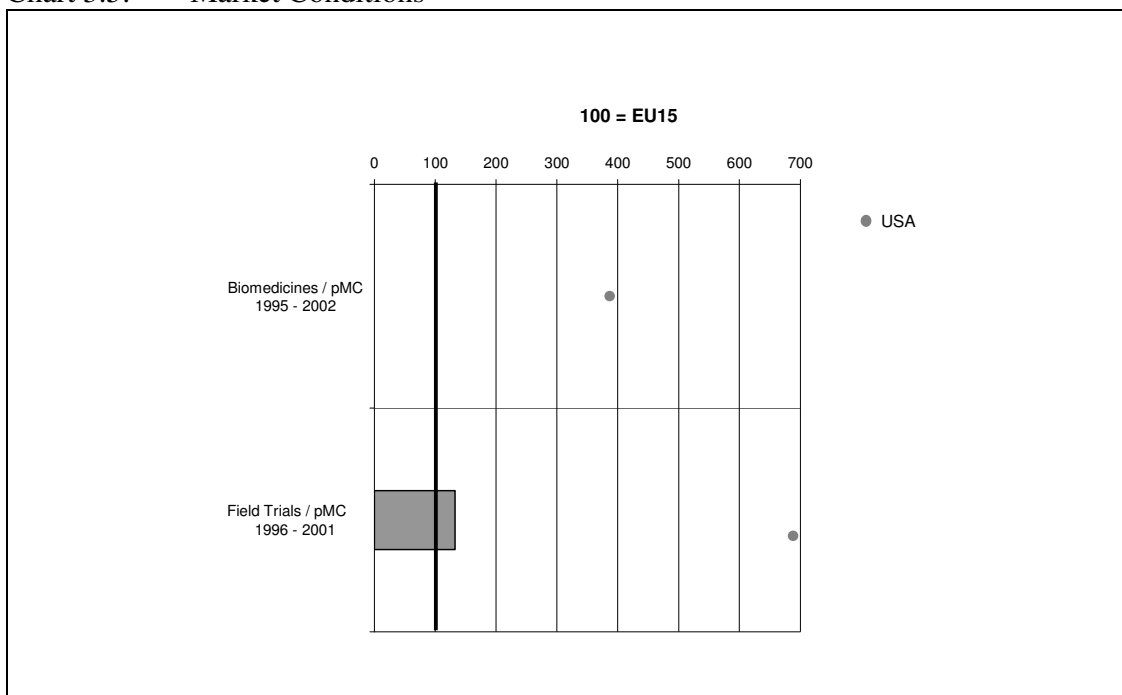
3.5 Market conditions

The indicators chosen to assess the overall performance in biotechnology industrial development are given in chart 3.6.

During the time period 1995 – 2002, no biomedicines were reported from Spain.

As to the indicator on field trials, between 1996 and 2001, Spain reported a total number of 189 field trials. These results outperformed the EU15 in the same period in per capita terms with 5 field trials pMC (against 4 field trials pMC in the EU15).

Chart 3.5: Market Conditions



Source: BioPolis Research

Spanish performance in the market for biotechnology products is fair. While Spain seems to have serious problems in bringing biomedicines into the market, the agro-food sector seems to be quite successful in developing biotechnology-based products.

4. Conclusions

4.1 Introduction

This chapter aims to provide an analytical overview of the information described in the previous chapters. The information is presented in tables giving selected aspects of the policy instruments implemented in Spain at the national and regional levels in the period 2002-2005. The key aspects of the Spanish biotechnology policy approach considered in the analysis are:

- Funding volume per type of policy instrument
- Target groups of the policy instruments and co-financing conditions
- Policy goals addressed by the policy instruments in terms of funding
- Biotechnology research fields covered by the policy instruments
- Biotechnology activities stimulated through the policy instruments
- Trends in the types of policy instruments implemented (comparison with the period 1994-1998)

The next sections comment on these issues.

4.2 Public funding of biotechnology through policy instruments

Table 4.1 provides information on public funding of biotechnology through non-directed, generic and specific instruments for the period 2002-2005.⁴¹ Moreover, the funding information available has been classified according to the policy goals of the instruments implemented to allocate the funding. The table thus gives funding information on “research”⁴², “commercialisation”⁴³ promotion and “other”⁴⁴ policy goals.

We estimate that 875M EUR were invested in the period 2002-2005 in promoting the biotechnology knowledge base and its commercialisation through policy-directed and non-policy-directed instruments. According to the information available, the promotion of biotechnology in Spain is mainly focused on the support of research activities. According to the data available, 86% of the funding allocated in the period 2002-2005 were invested in the promotion of basic and applied research and training of human re-

⁴¹ The data included in the table correspond to the information presented in chapter 2. Data have been gathered by using secondary literature, by conducting short telephone interviews and by circulating a standardised questionnaire among the responsible policy-makers.

⁴² Refers to funding targeting the following policy goals: (i) to stimulate high level of biotechnology research, (ii) to stimulate high level of industry-oriented (and applied) research, (iii) to stimulate knowledge flow and collaboration among scientific disciplines, (iv) to guarantee the availability of human resources.

⁴³ This refers to funding targeting the following policy goals: (i) to stimulate the transfer of knowledge from academia to industry and its application to industrial resources (ii) to promote the adoption of biotechnology for new industrial applications, (iii) to stimulate firm creation, and (iv) to promote business investment in R&D.

⁴⁴ This refers to funding targeting the following policy goals: (i) to stimulate social acceptance of biotechnology and (ii) to promote bio-safety research and risk assessment.

sources. However, the data should be interpreted with caution since not all generic instruments promoting industrial investment in R&D at the national level may be included in the estimations. Accordingly, the results may underestimate the funding directed to promote industrial application of biotechnology and industrial development.

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

	2002-2005 (in M EUR)
RESEARCH	
1. Non-policy-directed¹⁾	
Public Research Institutions ²⁾	364
Response Mode	n.a.
Total Non-policy-directed Research	364
2a. Policy-directed Generic National	216.29
2b. Policy-directed Biotech-specific National	96.38
2c. Policy-directed Regional ³⁾	72.5
Total Policy-directed Research	385.17
Total Research	749.17
COMMERCIALISATION	
3a. Policy-directed Generic National	38.7
3b. Policy-directed Biotech-specific National	61.39
3c. Policy-directed Regional ³⁾	24.3
Total Commercialisation	124.3
4. OTHER National	1.7
Total Policy-directed (2 +3 +4)	511.26
GRAND TOTAL (1+2 +3 +4)	875

Source: BioPolis Research

¹⁾No detailed biotechnology funding information available.

²⁾Data refer to research funding of the Spanish Research Council (CSIC). Figures are estimations based on the information published on www.csic.es for the year 2005 on the institutional funding of the CSIC and the share of researchers in life sciences ("biology and biomedicine", "agricultural sciences" and "food sciences and technologies").

³⁾Data draw on the figures published by Pulido, Fontela et al (2005) for the years 2002 and 2003. Figures for the years 2004 and 2005 have been estimated by considering the growth rate between 2002 and 2003. Differentiation between generic and biotech-specific instruments is not possible.

With regard to the types of instruments used to allocate the funding, biotechnology has been mainly promoted through policy-directed funding (58% of the total funding in the period 2002-2005). These were mainly generic instruments. Only 38% of the policy-directed funding was allocated through biotechnology-specific instruments.

With regard to the proportion of regional funding, regional policy instruments made up 19% of the total funding allocated through policy-directed instruments. The central government thus remains the main promoter of the biotechnology knowledge base and its industrial application.

4.3 Specific features of the instruments

Table 4.2 includes the policy-directed instruments per type according to the categories national/ regional and generic/ biotechnology-specific. Additionally, the table shows the target groups of each instrument and whether the subsidies or grants were based on the co-financing principle (the subsidy does not finance the entire costs of the actions promoted).

Table 4.2 Policy Instruments, Funding agency, co-financing features and Recipients

Instrument	Funding institution	Participants/ Recipients			Co-financing
		PRO	SME	LF	
National					
<i>Generic Instruments</i>					
NPrg. Biomedicine	MEC - DGI -	√			
NPrg. Biomedicine	MEC - DGTP	√	√	√	√
NPrg. Biomedicine and NPrg Health Technologies	ISC III	√			
NPrg. Agrofood Resources and Technologies	DGI - MEC	√			
CDTI Technology Innovation Projects	CDTI		√	√	√
CDTI Technology development Projects	CDTI		√	√	√
CDTI Collaborative Industrial Research Projects	CDTI	√	√	√	√
CDTI Technology Promotion Projects	CDTI		√	√	√
CDTI NEOTEC	CDTI		√		√
PETRI	MEC	√			
Training Grants -	MEC	√			
Research Contracts	MEC	√			
Mobility Grants	MEC	√			
NPrg. General Promotion of Knowledge	MEC - DGI	√			
Scientific and Technological Disclosure and Dissemination	MEC - DGI	√			
<i>Biotechnology-specific Instruments</i>					
NPrg. Biotechnology (Research Projects and Special Actions)	MEC - DGI	√			
NPrg. Biotechnology (Research Projects and Special Actions)	MEC - DGTP	√	√	√	√
Special Action in Genomics and Proteomics	MEC - DGI	√			
Genoma España	MEC and MSC	√	√	√	
Regional					
Research and Development Projects	CC.AA	√			
Technology Development and Innovation Projects	CC.AA	√	√	√	√

Source: BioPolis Research

4.4 Policy goals

Table 4.3 presents the policy-directed instruments per type according to the categories national/ regional and generic/ biotechnology-specific. Additionally, the table shows the policy goals explicitly addressed by each instrument. The policy goals considered are:

1. To stimulate high level of biotechnology research
2. To stimulate high level of industry-oriented (and applied) research
3. To stimulate knowledge flow and collaboration among scientific disciplines
4. To guarantee the availability of human resources
5. To stimulate the transfer of knowledge from academia to industry and its application to industrial resources
6. To promote the adoption of biotechnology for new industrial applications
7. To stimulate firm creation
8. To stimulate social acceptance of biotechnology
9. To promote business investment in R&D
10. To promote bio-safety research and risk assessment

The identification of the policy goals targeted by each instrument draws on the information available. In order to assign the share of funding to the relevant policy goals, the most representative policy goals were identified for each instrument.⁴⁵ Finally, for each policy goal (1 to 10), the table gives an estimation of the funding allocated by each instrument.

The data available suggest that policy-directed instruments were mainly directed to promote a high level of biotechnology research (policy goal 1 with 265.5M EUR). Next, the availability of human resources (policy goal 4) was an important policy goal in terms of funding (with 92.32M EUR). The most disregarded policy goal (always in terms of funding) was the promotion of social acceptance of biotechnology and the promotion of bio-safety research and risk assessment. In terms of allocated funding, regional policy instruments concentrate largely on promoting research (policy goal 1 with 72.5M EUR) and on the valorisation of research results (technology development and innovation) (policy goal 5 and 9 with 24.3M EUR).

⁴⁵ For instance, even though an instrument may implicitly target several goals such as a high level of biotechnology research (1), knowledge flow (3) and availability of human resources (4), if it is not possible to weight the goals in terms of funding, the most relevant policy goal of the instrument is selected allocating the total funding volume to this policy goal.

Table 4.3 Coverage of policy goals by national and regional policy-directed instruments and funding by policy goal for the period 2002-2005 (in M EUR)⁴⁶

	1*	2	3	4	5	6	7	8	9	10
National										
<i>Generic</i>										
National Programme of Biomedicine - Open calls coordinated by the General Directorate of Research of the Ministry of Education ³⁾	√									
National Programme of Biomedicine - Open calls coordinated by the General Directorate of Technology Policy of the Ministry of Education ¹⁾					√				√	
National Programme of Biomedicine and Health Technologies- Open calls coordinated by the Health Institute Carlos III under the responsibility of Ministry of Health and Consumer Affaires (MSC)	√									
National Programme of Agrofood resources and Technologies - Open calls coordinated by the General Directorate of Research (DGI) of the Ministry of Education ³⁾	√									
Grants for Scientific and Technological Disclosure and Dissemination activities ¹⁾								√		
PETRI					√					
Mobility Grants				√						
Research Contracts				√						
Training Grants				√						
National Programme for the general promotion of knowledge (PGC) ³⁾	√									
CDTI Technology Development Projects									√	
CDTI - Collaborative Industrial Research Projects					√					
CDTI - Technology Innovation Projects						√				
CDTI - Technology Promotion Projects									√	
CDTI - NEOTEC							√			
Total National Generic Instruments M EUR²⁾	128.1	-	-	88.2	17.6	1.7	7	-	12.4	-

⁴⁶ Even though an instrument may implicitly target several policy goals such as a high level of biotechnology research (1), knowledge flow (3) and availability of human resources (4), if it is not possible to weight the goals in terms of funding, the most relevant policy goal of the instrument is selected.

Table 4.3 continued

	1*	2	3	4	5	6	7	8	9	10
National										
Biotech-specific										
National Programme of Biotechnology - Open calls coordinated by the General Directorate of Technology Policy of the Ministry of Education					√				√	
National Programme of Biotechnology - Open calls coordinated by the General Directorate of Research (DGI) of the Ministry of Education ³⁾	√									
National Programme of Biotechnology - Special action in genomics and proteomics ³⁾	√	√								
Genoma España - Promotion of Genomics and Proteomics Research	√		√	√		√	√		√	√
Total National Biotechnology-specific Instruments in M EUR	64.9	16.7	10.66	4.12	22	4.5	3.69	-	31.2	1.7
Total National Policy-directed Instruments in M EUR ²⁾	192.9	16.7	10.66	92.32	39.6	6.2	10.69	-	43.6	1.7
Regional policy-directed instruments in M EUR										
Autonomous Communities' Research and Development Projects	√									
Autonomous Communities' Technology Development and Innovation Projects					√				√	
Total Regional Policy-directed Instruments in M EUR	72.5	-	-	-	12	-	-	-	12.3	-
Total Policy-directed instruments in M EUR²⁾	265.5	16.7	10.66	92.32	51.6	6.2	10.69	-	55.9	1.7

Source: BioPolis Research

1) No information / estimations available on the budget invested per policy goal

2) The figures include only those national instruments for which comprehensive data per policy goal are available.

3) The most relevant policy goals of the instrument have been selected.

*

1 High level of biotechnology research

2 High level of industry-oriented (and applied) research

3 Knowledge flow and collaboration among scientific disciplines

4 Availability of human resources

5 Transfer of knowledge from academia to industry and its application to industrial resources

6 The adoption of biotechnology for new industrial applications

7 Firm creation

8 Social acceptance of biotechnology

9 Business investment in R&D

10 Bio-safety, Risk assessment

4.5 Biotechnology research application areas

Table 4.4 presents the biotechnology research application areas stimulated by the national policy-directed instruments and the funding going into each research area in the period 2002-2005. The applications areas considered are:

- 1) Plant biotechnology
- 2) Animal biotechnology
- 3) Environmental biotechnology
- 4) Health biotechnology
- 5) Food biotechnology
- 6) Industrial biotechnology
- 7) Basic biotechnology
- 8) Ethical, legal, social aspects of biotechnology

For each type of policy instrument, the table gives an estimation of the funding allocated in each research area.

The data available for the policy-directed instruments indicate that health biotechnology and plant and animal biotechnology are the application areas receiving the largest share of funding.

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

	Biotechnology application areas							
	1*	2	3	4	5	6	7	8
National Generic								
NPrg. Biomedicine DGI - MEC				✓				
NPrg. Biomedicine and Health technologies ISC III				✓				
NPrg. Biomedicine DGTP - MEC								
NPrg. Agrofood Resources and Technologies DGI - MEC	✓				✓			
NPrg. General Promotion of Knowledge DGI - MEC							✓	
CDTI Innovation Financing Schemes ¹⁾	✓	✓	✓	✓	✓	✓	✓	
Training Grants – MEC ¹⁾	✓	✓	✓	✓	✓	✓	✓	
Research Contracts – MEC ¹⁾	✓	✓	✓	✓	✓	✓	✓	
Mobility Grants – MEC ¹⁾	✓	✓	✓	✓	✓	✓	✓	
National Biotech-specific								
NP Biotechnology (Research Projects and Special actions) DGI – MEC	✓	✓	✓	✓	✓	✓	✓	
NP Biotechnology (Research Projects and Special Actions) DGTP – MEC	✓	✓	✓	✓	✓	✓	✓	✓
Genoma España - Development of Genomics and Proteomics Research							✓	
Special Action in Genomics and Proteomics DGI-MEC	✓	✓		✓		✓	✓	
Regional Instruments ¹⁾	✓	✓	✓	✓	✓	✓	✓	
Grand Total ²⁾	42	42	5	364	21	12	26	n.a.
% of Grand Total ²⁾	8.16	8.16	0.89	71.29	4.02	2.32	5.16	-

Source: BioPolis Research

¹⁾ Only estimations or qualitative information available

²⁾ These figures have been derived from the data published by Genoma España (2005) for the period 2000-2003. In this publication the areas Plant and Animal Biotechnology (1 and 2) are considered together and represent 16.32% of the funding for the period 2000-2003.

*

1 = Plant biotechnology

2 = Animal biotechnology

3 = Environmental biotechnology

4 = Health biotechnology

5 = Food biotechnology

6 = Industrial biotechnology

7 = Basic biotechnology

8 = Ethical, legal, social aspects of biotechnology

4.6 Stimulation of biotechnology activities through the instruments

Table 4.5 presents the biotechnology activities stimulated by the national policy-directed instruments. The biotechnology activities considered are:

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

The identification of the activities promoted by each instrument draws on the information available. For each type of activity (1 to 19) the table gives an estimation of the funding allocated by each instrument. In order to assign the share funding to the relevant activities, the most representative activities being promoted were identified for each instrument.⁴⁷ The data available suggest that policy-directed instruments stimulated mostly basic research at PROs (with 234M EUR), and biotechnology training (with 88.2M EUR). Next, applied research (with 59.2M EUR) receives attention from public policy. Collaborative research between industry and academia (55.3M EUR) and grants for industrial research (48.4M EUR) have also been relatively well promoted compared to other activities in the innovation system.

All in all, the results suggest that research and training were the main focus of attention of biotechnology policy in Spain in the period 2002-2005.

⁴⁷ For instance, even though an instrument may implicitly promote several activities, if it is not possible to assign the exact funding to each activity, the most relevant activities of the instrument are selected and the budget for each activity is a rough estimation.

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

Biotechnology Activities ³⁾																			
	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
National Policy Instruments																			
<i>Generic</i>																			
Grants for Scientific and Technological Disclosure and Dissemination activities ¹⁾																			
N Pgr. of Biomedicine – MEC DGI	√	√																	
N Pgr. of Biomedicine – MEC DGTP ¹⁾								√									√		
National Programme of Biomedicine and Health Technologies- Health Institute Carlos III	√	√		√															
N Pgr. of Agrofood resources and Technologies – MEC DGI	√																		
Research Contracts						√													
Training Grants						√													
Mobility Grants						√													
National Programme for the general promotion of knowledge (PGC)	√																		
PETRI								√											
CDTI Technology Development Projects																	√		
CDTI Collaborative Industrial Research Projects								√											
CDTI Technology Innovation Projects																√			
CDTI Technology Promotion Projects																	√		
CDTI NEOTEC													√	√					
<i>Biotech-specific</i>																			
N Pgr. of Biotechnology – MEC DGTP								√									√		
N Pgr. of Biotechnology – MEC DGI	√																		
National Programme of Biotechnology - Special action in genomics and proteomics	√	√																	
Genoma España - Promotion of Genomics and Proteomics Research	√	√	√	√				√		√		√	√						
Total National Funding in M EUR²⁾	162.	59.	6.97	3.01	-	88.2	-	43.3	-	3.24	-	1.1	5.96	3.5	-	1.7	36.1	-	-

Table 4.5 continued

	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Regional Policy Instruments																			
Autonomous Communities' Research and Development Projects	√																		
Autonomous Communities' Technology Development and Innovation Projects								√									√		
Total Regional Funding in M EUR ²⁾	72.5	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	12.3	-	-
Total Funding in M EUR ²⁾	234.7	59.2	6.7	3.0	-	88.2	-	55.3	-	3.24	-	1.11	5.96	3.5	-	1.7	48.4	-	-

Source: BioPolis Research

¹⁾ No information / estimations available on the budget invested per activity

²⁾ The figures include only those instruments for which comprehensive data per activity are available.

³⁾ Even though an instrument may implicitly promote several activities, if it is not possible to assign the exact funding to each activity, the most relevant activities of the instrument are selected and the budget for each activity is a rough estimation.

* Many different types of activities are supported by the policy instruments:

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

4.7 Dynamics: comparison with the period 1994-1998

Table 4.6 Comparison of biotechnology research funding in the periods 1994-1998 and 2002-2005 through non-policy-directed and policy-directed instruments (in M EUR)

Funding	Average total funding per annum for biotechnology research in 1994-1998	Average total funding per annum for biotechnology research in 2002-2005
National	9.4*	169
Regional	n.a	18
Total	9.4*	187

Source: BioPolis Research. * Data include policy-directed instruments only

Table 4.6 gives a comparison of the annual average biotechnology research funding in the periods 1994-1998 and 2002-2005 through non-policy-directed and policy-directed instruments.⁴⁸ Despite the limitations for comparability due to the lack of data for non-policy-directed instruments and regional instruments in the period 1994-1998, the data suggest that the promotion of biotechnology has experienced a tremendous growth in these two periods in terms of funding.

Table 4.7 compares the periods 1994-1998 and 2002-2005 in terms of instruments targeting selected policy goals. The table aims to give a rough picture of the presence of policy instruments explicitly targeting the policy goals given on the left hand side. According to the information available, the Spanish policy profile is very broad and has been widened in the last years. In the period 2002-2005 biotechnology-specific policy instruments explicitly targeting the adoption of biotechnology for new industrial application and business investment in R&D have been implemented. In the field of monitoring the social acceptance of biotechnology, there seems to be sufficient scope for promotional activities.

As regards the funding of biotechnology areas, the funding profile has not changed much since 1994-1998: health biotechnology remains the area of application receiving the largest share of funding.

⁴⁸ The figures for the period 1998-2002 refer to policy-directed funding only. Average total funding per annum for biotechnology research in 2002-2005 through policy-directed funding only was 78M EUR (national), 18M EUR (regional) and 96M EUR (total).

Table 4.7 Presence of policy-directed instruments for specific policy goals in the periods 1994-1998 and 2002-2005

Presence of instruments					
Policy areas	Policy goals	1994-1998		2002-2005	
		G*	S**	G	S
1. Creation of knowledge base and human resources	1. To promote a high level of biotechnology basic research	√	√	√	√
	2. To promote a high level of industry-oriented (and applied) research	√	√	√	√
	3. To support knowledge flow and collaboration among scientific disciplines	√	√	√	√
	4. To assure availability of human resources	√		√	√
2. Knowledge transfer and application	5. To facilitate transfer of knowledge from academia to the industry and its application for industrial purposes	√	√	√	√
	6. To stimulate the adoption of biotechnology for new industrial applications	√		√	√
	7. To assist firm creation	√	√	√	√
3. Market	8. To monitor and improve the social acceptance of biotechnology	√		√	
4. Industrial development	9. To encourage business investment in R&D	√		√	√

Source: BioPolis Research

G = generic instruments; ** S= Biotechnology-specific instruments

5. Future developments

As already mentioned in chapter 1, the promotion of biotechnology research, development and innovation activities in Spain is structured in the framework of the National Plans. These constitute the fundamental tool for research, development and innovation policy in Spain. Moreover, at the sub-national level, the Autonomous Communities launch their own regional plans for research, development and innovation.

Currently, at the national level the National Plan is running for the period 2004-2007. Accordingly, the information available on the plan does not suggest major changes in the policy approach to supporting biotechnology in Spain at the national level. In May 2006 the Spanish government announced the programme *Compromiso Ingenio 2010*, which aims to increase the investments in research and development activities to reach 2% of GERD/GDP by 2010. Moreover, the programme aims to reduce the administrative barriers to applying for funding in the research and development sector. The programme *Compromiso Ingenio 2010* has a budget of 2.800 M EUR and three main generic instruments: CENIT, CONSOLIDER and AVANZ@. The three instruments are generic. CENIT has a budget of 1 000 M EUR to co-finance collaborative projects between industry and academia. CONSOLIDER counts with 1500 M EUR to promote established excellent research units with competitive open calls. In 2006, out of 17 projects approved, 4 projects are related to biotechnology research and have been financed with a budget of 17.4 M EURO for a 5-year period. Finally, AVANZ@ aims to increase the share of companies using e-commerce from 8 to 55%.

At the regional level, however, we observe an increasing concern for the promotion of biotechnology with specific programmes. For instance, the Autonomous Community of Madrid approved its latest regional plan (IV PRICIT 2005-2008) in April 2005 defining biotechnology as main strategic techno-scientific field of promotion (madridmasd 2006)⁴⁹. The plan foresees 23M EUR to promote research in the field of biosciences (health sciences and biotechnology, basic knowledge in biomedicine, biomaterials, biosensors, genomics, proteomics and metabolomics). In the case of Catalunya (Catalonia), the situation is quite similar. The Generalitat de Catalunya (the regional government) approved the latest regional plan (PRI 2005-2008) identifying biotechnology as a technological priority for promotion in the chemical, pharmaceutical and food sectors (Generalitat de Catalunya 2005)⁵⁰. If we consider the biotechnology programmes already running in the Basque Country, Galicia and Murcia, the information available suggest an increasing focus of regional policy instruments on the promotion of biotechnology.

⁴⁹ madridmasd. (2006). "23 millones de euros para la investigación en Biociencias en la Comunidad de Madrid." Noticias Retrieved February 2006, from www.madridmasd.org.

⁵⁰ Generalitat de Catalunya. (2005). "Pla de Recerca i Innovació." Retrieved August 2006, from www.10.gencat.net/pricatalunya/eng/index.htm.

Annex 1 list of tables

Table 1.1:	Building blocks of the National Plan for Scientific Research, Technology Development and Innovation (NP).....	8
Table 1.2:	Most relevant research centres of the CSIC in terms of project participation in the National Programme of Biotechnology (2003-2006).....	13
Table 1.3:	Most relevant universities in terms of project participation in the National Programme of Biotechnology (2003-2006).....	14
Table 2.1	Non-policy-directed funding of biotechnology research.....	16
Table 2.2	National and regional public policy-directed biotechnology stimulating instruments during the period 2002 – 2005 in M EUR.....	18
Table 2.3	Involvement of Spain in biotechnology/life sciences programmes of the 6 th Framework Programme.....	28
Table 4.1	Public funding of biotechnology through non-directed, generic and specific instruments for the period 2002-2005 (in M EUR).....	37
Table 4.2	Policy Instruments, Funding agency, co-financing features and Recipients	38
Table 4.3	Coverage of policy goals by national and regional policy-directed instruments and funding by policy goal for the period 2002-2005 (in M EUR)	40
Table 4.3	continued	41
Table 4.4	Coverage of biotech research application area and funding through policy-directed instruments by biotech application research area for the period 2002-2005 (in M EUR).....	43
Table 4.5	Coverage and funding of biotech activities in the period 2002-2005 through policy-directed instruments (in M EUR).....	45
Table 4.6	Comparison of biotechnology research funding in the periods 1994-1998 and 2002-2005 through non-policy-directed and policy-directed instruments (in M EUR).....	47
Table 4.7	Presence of policy-directed instruments for specific policy goals in the periods 1994-1998 and 2002-2005.....	48

Annex 2 List of figures and charts

Figure 1.1:	Institutions in the Spanish Biotechnology Funding System (August 2005).....	9
Chart 3.1:	General Trend in Performance developing the knowledge base.....	30
Chart 3.2.1:	Bibliometric Analysis per Biotechnology Sub-field, 1994 – 1996	31
Chart 3.2.2:	Bibliometric Analysis per Biotechnology Sub-field, 2002 – 2004	32
Chart 3.3:	Data on Performance per Biotechnology Sub-field, Growth Rate 1994/96 – 2002/04.....	32
Chart 3.4:	General trends in performance in knowledge transfer and application	33
Chart 3.5:	Market Conditions	34

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| Genoma España | http://www.gen-es.org/ |
| Ministry of Science and Education | http://www.mec.es/ |
| Spanish National Research Council | http://www.csic.es/ |

Annex 5 Performance

Introduction

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

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

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

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

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

	Indicator	Chart	Comments	Time periods
			Small country effect	
Ind. 6	Graduates in life sciences pMC	3.1	Index: Reference Region EU17 =100 and US data for comparison	(2) 1998 (3) 2002
Ind. 7	BT publications in subfields, as % of total BT publications	3.2.1	Data in % EU25 and US data for comparison	1994-1996
		3.2.2		2002-2004
Ind. 8	Growth rate of BT publications in subfields	3.3	EU25 and US data for comparison Small field effect	Growth rate between 1994-96 (period 1) and 2002-04 (period 3)
Ind. 9	Biotech patent applications pMC	3.4	EU25 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 10	Number of biotechnology companies pMC	3.5	European (data available) and US data for comparison	(2) 2001 (3) 2004
Ind. 11	Number of biotech start-ups pMC	3.4	European (data available) and US data for comparison	(3) 2001-2003 (only one period)
Ind. 12	Number of biotech IPOs pMC	3.5	European (data available) and US data for comparison	(3) 2002-2005
Ind. 13	Venture capital in € pC	3.5	European (data available) and US data for comparison	(2) 2002 (3) 2004
Ind. 14	BT acceptance index	No Chart - Discussed in text of chapter 3	Source: BT Policy Benchmarking 2005. The biotechnology acceptance index is a composite index and draws on questions Q.12, Q.13.1 and Q14.01 and Q14.09 of the Eurobarometer 58.0	2002
Ind. 15	Eurobarometer 225	No Chart - discussed in text of chapter 3	See section 3.3 and sections 3.4.1, 3.4.2, and 3.4.3 of the Special Eurobarometer 225 ⁵¹	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100	1995-2002

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

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

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

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

rate was -100%. Given that a relative growth rate was used, small fields tended to have relatively larger growth rates.

- To benchmark each country we chose EU25 (or EU15 if data was not fully available) as the reference region. In those cases where data for EU25 or EU15 were not available, the reference corresponds to the sum of national data available. Moreover, to ease the presentation of indicators with different scales in a given chart, an index value was used.

Raw data for the Charts in chapter 3

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

	BT publications			Population (million)		
	94-96	98-00	02-04	1996	2000	2004
EU25	97521	128716	145646	447	451	457
Spain	5872	9283	11964	39	40	42
USA	119802	135508	154402	264	276	292
	BT publications/pMC			Index EU25=100		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	218	285	319	100	100	100
Spain	149	232	283	68	81	89
USA	454	492	529	208	172	166

Source: BioPolis Research

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

Population data: EUROSTAT and OECD

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

	BT publications	Non-policy-directed funding	Policy-directed funding		Total public spending on BT (M Ecu)	BT publications/ M Ecu BT public expenditure	Index
			Biotech specific	Generic			
	2002-2004	1994-1998	1994-1998	1994-1998	1994-1998	2002-2004/1994-1998	
EU25	145646				n.a.		
Spain	11964		34	13	47	255	1586
USA	154402				n.a.		n.a.

Source: BioPolis Research

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

BT public expenditures in research: Inventory Project, Table 3.4 Executive Summary

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

	BT publications			Total publications		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	97521	128716	145646	860652	1024327	1117392
Spain	5872	9283	11964	54024	73800	90848
USA	119802	135508	154402	889506	941191	1045894
	Share of BT publication			Index EU25=100		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	11%	13%	13%	100	100	100
Spain	11%	13%	13%	96	100	101
USA	13%	14%	15%	119	115	113

Source: BioPolis Research

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

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

	Citations to BT publications		Index EU25=100	
	94-98	00-04	94-98	00-04
EU25	6.14	7.28	100	100
Spain	5.91	6.22	96	85
USA	6.39	8.54	104	117

Source: BioPolis Research

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

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

	Graduates in Life Sciences		Population (million)	
	1998 / 1999	2002	1998 / 1999	2002
EU17	46859**	81316	552**	431
Spain	4439	5389	40	41
USA	75253*	70950	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	91**	189	100	100
Spain	112	132	123	70
USA	273*	246	70	132

Index EU17=100 for 1998 is EU-16, because for Portugal no data available

* data for 1998; ** data for 1999

Source: BioPolis Research

Graduates data OECD Education Database

Population source for US is the OECD

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

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Spain	100%	11%	45%	5%	6%	1%	1%	33%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BioPolis Research

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

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

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Spain	100%	10%	50%	5%	6%	2%	1%	26%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BioPolis Research

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

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

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	97217	7629	51944	4375	2434	624	576	29635
Spain	6063	647	2702	273	344	67	50	1980
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BioPolis Research

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

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

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	140984	10494	81220	6821	5017	1162	1126	35144
Spain	11867	1211	5967	598	755	203	104	3029

USA	141680	7910	84234	6872	4070	436	724	37434
-----	--------	------	-------	------	------	-----	-----	-------

Source: BioPolis Research

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

Raw data for Chart 3.3. Growth rate of BT publications in subfields between the periods 1994/96 – 2002/04

	1994-1996/2002-2004						
	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	38%	56%	56%	106%	86%	95%	19%
Spain	87%	121%	119%	119%	203%	108%	53%
USA	11%	35%	23%	83%	47%	58%	11%

Source: BioPolis Research

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

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

	BT patents			Population (million)		
	94-96	98-00	01-03	1996	2000	2003
EU25	4924	8921	10119	447	451	455
Spain	100	195	265	39	40	42
USA	8590	14396	12348	264	276	292*
	BT patents/pMC			Index		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	11	20	22	100	100	100
Spain	3	5	6	23	25	29
USA	33	52	42	295	264	190

Source: BioPolis Research

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

Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

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

	BT patents			BT publications		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	4924	8921	10119	97521	128716	140219
Spain	100	195	265	5872	9283	11228
USA	8590	14396	12348	119802	135508	148853
	BT patents/ BT publications			Index EU25=100		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	0.05	0.07	0.07	100	100	100
Spain	0.02	0.02	0.02	34	30	33
USA	0.07	0.11	0.08	142	153	115

Source: BioPolis Research

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

Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

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

	BT companies				Population in T			
	2001	2002	2003	2004	2001	2002	2003	2004
Europe	1879	1878	1861	1815	452016	452641	454580	456863
EU Available	1643	1650	1782	1605	319337	319484	408602	322210
Spain	n.a.	n.a.	71	n.a.			41551	
USA	1457	1472	1473	1444	285102	287941	290789	291685
	BT companies pMC				Index			
	2001	2002	2003	2004	2001	2002	2003	2004
Europe								
EU Available	5	5	4	5	100	100	100	100
Spain	n.a.	n.a.	1.70	n.a.	n.a.	n.a.	39	n.a.
USA	5.11045	5.112158	5.06553	4.95054	99	99	116	99

Note: EU Available is the result of the sum of available EU Member States

Source: BioPolis Research

Biotech companies data: Ernst and Young 2002-2005, EuropaBio

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

	BT start-ups		Population in T	
	2001-2003	2003	2003	
Europe (EU15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051	
Spain	0	0		
USA	355	83	290789	
	Biotech start-up/pMC	Index	Biotech start-up/pMC	Index
	2001-2003	2001-2003	2003	2003
Europe (EU15 - Cyprus - Greece + Norway + Switzerland)	1.4	100	0.36	100
Spain	0.00	0	0.0	0
USA	1.2	86	0.29	79

Source: BioPolis Research

Start-ups data: EuropaBio

Raw data for Chart 3.5. Number of BT IPO's pMC: absolute and indexed values

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Available	29	452927	454869	457154	461593	456636
Spain	0	40851	41551	42345	43038	41946
USA	52	287941	290789	291685		290138
	IPO /pMC	Index				
	2002-2005	2002-2005				
EU Available	0.00	100				
Spain	0.00	0				
USA	0.00	282				

Note: EU Available is the result of the sum of available EU Member States

IPO data: Ernst and Young 2002-2006, London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burril & Company

Source: BioPolis Research

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

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

Source: BioPolis Research

VC data: E&Y Beyond Borders 2002, 2003, 2004

Raw data for Chart 3.6. Number of Biomedicines pMC

	Biomedicines	Population (Million)	Biomedicines / pMC	Index
	1995-2002	2002		1995-2002
EU15	39	378	0.10	100
Spain	0	41	0.00	0
USA	115	289	0.40	387

Note: EU15 is the result of the sum of the 15 old EU Member States

Source: BioPolis Research

Number of medicines: Benchmarking of public biotechnology policy 2005

Raw data for Chart 3.6. Number of field trials pMC

	Field Trials	Population in M	Field Trials pMC	Index
	1996-2001	2001	1996-2001	1996-2001
EU15	1334	379	4	100
Spain	189	40	5	133
USA	6745	278	24	688

Note: EU15 is the result of the sum of the 15 old EU Member States

Source: BioPolis Research

Field trails: Biotechnology Innovation Scoreboard 2002

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

BT acceptance index 2002		
	Index average	N (sample size)
EU15*	100.29	16828
Spain	98.67	986

*Weighted Average according to the weight "W13" of the Eurobarometer 58.2, which considers population differences among countries and corrects for inconsistencies in the national samples

Source: BioPolis Research

BT acceptance index: Benchmarking of public biotechnology policy 2005

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EUROSTAT <http://epp.eurostat.cec.eu.int/>

OECD Education Database <http://www.oecd.org/>

OECD Statistics <http://www.oecd.org/>

STN International <http://www.stn-international.de/>

Questel Orbit <http://www.questel.orbit.com/index.htm>

Annex 6 Abbreviations

BT	Biotechnology
CC.AA	Autonomous Communities
CDTI	Centre for Development of Industrial Technology
CICYT	Interministerial Commission of Science and technology
CIPR	Collaborative Industrial Research Projects
CSIC	Spanish National Research Council
DGI-MEC	General Directorate of Research of the Ministry of Education
ESF	European Social Fund
FECYT	Spanish Foundation for Science and Technology
FPI	Training of researcher staff
FPU	Training of university staff
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
ISCIII	Health Institute Carlos III
LF	Large Firms
M EUR	Million Euro
MCYT	Ministry of Science and Technology
MEC	Ministry of Education
MEC – DGTP	General Directorate of Technology Policy of the Ministry of Education
MICYT	Ministry of Industry, Trade and Tourism
MSC	Ministry of Health and Consumer Affairs
NP	National Plan for Scientific Research, Technology Development and Innovation
NPrg.	National Programme
PGC	General Promotion of Knowledge
pMC	per million capita
PSO	Public Sector Organisations
Publ.	Publications
SME	Small and Medium Enterprises
TDP	Technology Development Projects
TIP	Technology Innovation Projects
TPP	Technology Promotion Projects

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