

RIP-WATCH

ANALYSIS OF THE REGIONAL DIMENSIONS OF INVESTMENT IN RESEARCH

CASE STUDY REGIONAL REPORT: BAVARIA (GERMANY)

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Case Study Regional Report on the Regional Dimensions of Investment in Research

OBJECTIVE

The main objective of this regional case study report is to provide a better understanding of the structural and techno-economic characteristics of the European region analysed, to present the key factors conducive to increased investment in R&D, and to identify the key R&D policy challenges the region is facing.

BACKGROUND

In partnership with DG Research, the Institute of Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) has been conducting a watching brief on policy developments aimed at promoting both private and public investment in R&D (RIP-WATCH). One of the stated aims of this policy watch activity is to take stock of developments aimed at increasing investments in R&D in the European regions.

In the design phase of the activity, a typology of the European regions was produced. A balanced mix of regions was selected from each of the nine regional types identified, representing fifteen member states of the European Union.

REGIONS COVERED

Phase 1		Phase 2	
1. Andalusia (ES)	2. Catalonia (ES)	11. Bavaria (DE)	12. Corsica (FR)
3. Carinthia (AT)	4. Crete (EL)	13. Emilia-Romagna (IT)	14. Etelä-Suomi (FI)
5. Dél-Dunántúl (HU)	6. Jihozápad (CZ)	15. Lorraine (FR)	16. Midi-Pyrénées (FR)
7. Norte (PT)	8. Sicily (IT)	17. Saxony (DE)	18. Scotland (UK)
9. Styria (AT)	10. Wielkopolskie (PL)	19. Västsverige (SE)	

THE REPORTS

The regional reports are structured according to the following two interrelated dimensions of regional techno-economic systems:

- **Regional knowledge base**, including the research, technological development and innovation (RTDI) infrastructure, human resources, RTDI efforts and outcomes and knowledge-transmission mechanisms in the region.
- **Regional economic structure**, including the productive structure, regional clusters and networks, international position and financial capacities and instruments.

Each report examines these dimensions from two points of view: their current state, as reflected in a selected set of regional indicators, and their policy context (i.e. policy framework, actors, objectives and instruments).

In addition to the regional case study reports, a **synthesis report** will be produced that combines and interprets the information contained in the case study reports. This will present the strengths and weaknesses of the regions covered and the factors that determined the trajectories of development of their R&D and innovation capacities. It will also discuss the main R&D and innovation challenges identified.

The JRC-IPTS launched the second phase of the activity in December 2006 with the contribution of the ERAWATCH Network. The work was undertaken between December 2006 and May 2007 by a project team led by LOGOTECH S.A. (EL) with the participation of Advansis Ltd, (FI), Faugert & Co Utvärdering AB (SE), Fraunhofer Institute for Systems and Innovation Research (ISI) (DE), Institute for Policy and Practice of Centre on Knowledge, Innovation, Technology and Enterprise (KITE) of University of Newcastle (UK), PREST – Manchester Institute of Innovation Research (UK), and Technopolis France (FR).

The regional case study reports produced in the study are now available on the ERAWATCH web-site at <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=intService.home>

The synthesis report will also be available on the ERAWATCH web-site.

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Abbreviations

MC	Management Committee
PM	Project Management
ToR	Terms of Reference
ANBERD	Analytical Business Enterprise Research and Development Database
BERD	Expenditure on R&D in the business enterprise sector
EPO	European Patent Office
GBAORD	Government budget appropriations or outlays for R&D
GDP	Gross domestic product
GERD	Gross Domestic Expenditure on R&D
GUF	General university funds
HERD	Expenditure on R&D in the higher education sector
ISIC	International standard industrial classification
IPTS	Institute for Prospective Technological Studies, Seville, Spain
NACE	Nomenclature générale des Activités économiques dans les Communautés Européennes
N.E.C	Not elsewhere classified
PPP	Purchasing Power Parity

1 Introduction

The Free State of Bavaria (*Friestaat Bayern*) is one of 16 federal states (*Bundesländer*) in Germany. It is located in the south-east of Germany, and has borders with Austria and the Czech Republic. With about 12.5 million inhabitants, it is the second most populous state in Germany, after North-Rhine-Westphalia. Approximately 10% of its citizens live in the capital, Munich, 4% in Nuremberg and around 2% in Augsburg. Therefore, altogether 16% of the population lives in the three largest cities in Bavaria. Since the fall of the 'iron curtain' and EU enlargement, Bavaria now lies right in the centre of Europe. This contributes to its economic success, given that Hungary, the Czech Republic and Poland rank among the top 10 export countries for Bavaria. However, most of the economic success of Bavaria is built on its manufacturing industries, namely the automotive industry, machinery and electronic products.

Figure 1: Bavaria's location within Europe



In 2005 Bavaria produced a regional GDP of €398,450 million, which accounts for 17.8% of Germany's total GDP. Between the years 2000 and 2005 the annual growth rates of regional GDP exceeded those of Germany, with just a one exception in 2003, when the GDP growth of Bavaria remained behind that of Germany. GDP per inhabitant was €31,990 in 2005, which is higher than in all other regions in Germany and is well above both the German average of €27,175 and the EU-25 average of €23,500. Unemployment in Bavaria is very low. The unemployment rate of 7.8% is well below the German average of 11.7%. In addition, long term unemployment is significantly below the German average. To help ensure further success Bavarian GERD grew steadily during recent years. At 2.95%, it exceeds the German average, which is 2.52%. Bavaria accounts for 20.1% of overall GERD in Germany.

2 Regional Knowledge Base

2.1 Description of the regional knowledge base

2.1.1 Knowledge creation capacity

Bavaria had a **total R&D spending** of €11,333 million in 2003, more than 20% of the total R&D spending in Germany (€54,538 million). With investments equivalent to approximately 15 percent of the state budget, Bavaria invests more than any of the other non-city states in R&D in Germany. In 2003 2.95% of the region's GDP was invested in R&D (GERD). The business sector accounts for 80% of spending and therefore contributes most to overall R&D expenditures. Government R&D expenditures account for 8% of R&D spending and the higher education sector 12%. The share of R&D coming from private non-profit organisations is negligible in Bavaria. Bavarian GERD has grown steadily over the last few years. Whereas in 1999 2.79% of regional GDP was invested in R&D, today 2.95% is dedicated to R&D, exceeding the German national average of 2.52%. However, a GERD of 2.95% still falls short of the Lisbon goal of 3%. The business enterprise sector contributes 80.2% of overall Bavarian GERD, the government sector and the higher education sector 8.0% and 11.2%, respectively (see Table 3 Annex 3).

R&D personnel: In total 124,740 people in headcount terms (93,964 people in full time equivalent terms) were employed directly on R&D in Bavaria in 2003. According to the sectoral distribution of R&D spending, 77% of R&D personnel (in FTE) work in the business enterprise sector, 10% work in the government sector, and 13% work in the higher education sector. In comparison with the national level, the Bavarian business sector employs disproportionately more R&D personnel, whereas in the government and higher education sector the concentration of R&D personnel is closer to national averages.

Altogether Bavaria has 55 **higher education institutes**. Three different types of institutes play an important role in the higher education system in Bavaria, as in the whole of Germany: universities, polytechnic universities (*Fachhochschulen*) and art academies (*Kunsthochschulen*). Bavaria hosts 16 universities, among them 11 public and 5 private institutes. Additionally, there are 11 art academies and 28 polytechnic universities located in Bavaria. Most of the higher education institutes are based in Munich, the federal capital and economic centre of the region (a complete list of the higher education institutes which are based in Bavaria is presented in Table 3 in the Annex).

The size of the Bavarian higher education sector can be characterised by the number of students and doctorates, as well as the number of teaching staff. Altogether 249,000 students were enrolled in 2004, equivalent to 12.5% of total student numbers in Germany. Of the types of institutes, universities took in the majority, with 177,654 students enrolled, followed by polytechnic universities with 67,981. 28.3% of the students enrolled in universities studied science or engineering related subjects, with the potential to contribute more or less directly to technological developments. In 2004 4158 students left Bavarian universities with a doctoral degree, about 34.5% of them hold a doctoral degree in science or engineering, a number which has remained stable in recent years. The ratio of doctorates awarded to enrolled students has declined from 1.89% in 1999 to 1.55% in 2002. Higher education institutes employed altogether 61,054 persons, among them 5,187 professors and 23,982 other academic staff.

The development of knowledge creation in Bavaria varied between the 1990s and 2004. The number of students decreased between 1994 and 1999 and has since recovered. However, the Bavarian higher education system has a very high potential to attract students. More than 75% of the Bavarian high school graduates choosing higher education continued their course of studies at a Bavarian university. Bavarian universities also attract many students from other parts of Germany. In short, Bavaria's knowledge creation capacity is very strong. It has excellent higher education institutes that attract many students, important research centres are lo-

cated in the region and R&D spending exceeds the national average. With negligible drawbacks, at the turn of the century the general development of the figures indicate a stable broadening of the knowledge creation capacity.

The Federal Government of Germany aims to establish internationally visible beacons of research in Germany by promoting top-class university research within the framework of the Initiative for Excellence. In the first round, three German universities were selected by an independent jury to take part in this programme, among them two Bavarian universities: the Ludwig-Maximilians-Universität München and the Technische Universität München. Being selected for this programme by an independent jury is testimony to the excellent teaching and research qualities of these universities, which will be rewarded by additional financial support during the next few years to ensure further progress so as to make these universities internationally visible.

Higher Education expenditure in Bavaria (which is in Germany mostly a responsibility of the federal states) has risen continuously over the last ten years. The expenditure for universities came to €3,431 million in 1995 and increased steadily with only minor exceptions, rising to €4,246.6 million in 2004.

An overview of the **research centres** in the region completes the picture of Bavaria's knowledge creation capacity. Altogether 39 research institutes varying sizes are located in Bavaria. Additionally, Bavaria is host to 12 branch offices of institutes in other parts of Germany and overseas. The four biggest research and science organisations maintain branches and institutes in Bavaria (see: Table 1 in the Annex). Most of them are located either in Munich or Nuremberg or very close by. The Fraunhofer-Gesellschaft (FhG)¹, with its head office in Munich, operates 7 research institutes (with a further 3 branches) in Bavaria, the Max-Planck-Society (MPS)² maintains 8 facilities, the Helmholtz Association (HGF)³ 4 and the Leibniz-Association (WGL)⁴ 4 as well. Additionally, 3 federal and 17 regional research institutes, which are independent from the 4 big research societies, are located in the region. Altogether five *Blaue Liste*⁵-Institutes are located in Bavaria and act as demand oriented interdisciplinary centres for non-university research.

¹ The Fraunhofer-Gesellschaft was founded in 1949 and operates as a provider of applied-research services in Germany and throughout the world. It is the research organisation with the largest number of applications for patent protection in Germany. It is recognised as non-profit organisation. At present, the Fraunhofer-Gesellschaft maintains more than 80 research units, including 58 Fraunhofer Institutes, at locations in Germany. The majority of the 12,500 staff are qualified scientists and engineers, who work with an annual research budget of over €1 billion.

² The research institutes of the Max Planck Society perform basic research in the interest of the general public in the natural sciences, life sciences, social sciences, and the humanities. In particular, the Max Planck Society takes up new and innovative research areas that German universities are not in a position to accommodate or deal with adequately. These interdisciplinary research areas often do not fit into the university organisation, or they require more funds for personnel and equipment than those available at universities. More than 12,000 staff members and 9,000 Ph. D. students, post-docs, guest scientists and researchers work in the 80 research institutes of the MPS.

³ With its 15 research centres and annual budget of approx €2.3 billion the Helmholtz Association is Germany's largest research institution. The 25,700 employees produce top-rate scientific results in six research fields. The Helmholtz Association identifies and takes on the grand challenges of society, science and the economy, in particular through the investigation of highly complex systems.

⁴ The Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V. is a scientific organisation comprising 84 non-university research institutes and service facilities. The Leibniz Institutes are grouped into five sections. They cover humanities and education, economic and social sciences, life sciences, physical sciences, and environmental research.

⁵ The Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V. is a scientific organisation comprising 84 non-university research institutes and service facilities. The research work carried out and services provided are of national significance. For this reason the institutes' work is funded by both the Federal Government and the federal states (German "Länder"). The tasks performed by those institutes range from regional infrastructure research and economics through research projects in the area of social sci-

At the interface between R&D in higher education institutes, R&D in public research institutes and R&D in industry and enterprises, stands *The Association of Bavarian Research Cooperations* ("abayfor")⁶, an independent institution which supports research co-operation in Bavaria. The cooperative activities it organises involve scientists from several universities working together. This enables scientific potential to be brought together across university boundaries and in enterprises. During the lifetime of a co-operative project, sustained coverage of the topic is achieved in research and education at Bavarian universities as well as in practical application by Bavarian enterprises. These partnering enterprises take the research results through into products and services. They receive support from staff specifically trained and experienced in knowledge transfer. In addition to substantial own contributions, the research is financed approximately 1/3 each by Bavarian enterprises, the *Bayerische Forschungsstiftung*, and the Bavarian State Government. Being in charge of the Research Co-operations, the Bavarian Ministry of Science, Research, and Arts supports creation of new co-operative projects and ensures scientific quality through accompanying review procedures.

Firms are another important actor in regions' knowledge production. Some of the main indicators with which to measure their innovative potential are their R&D activities and their interaction with regard to knowledge-producing capacities. Many major large and internationally active companies with considerable R&D spending are found around Munich and Nuremberg, in particular.

The volume of BERD spending has increased over the last few years, rising from €6,639 million in 1995 to €9,090 million in 2003 (see: Table 2 in the Annex). The business enterprise sector contributes more than 80% towards overall R&D expenditures. The R&D expenditures of the business enterprise sector amount to 2.36% of the Bavarian GDP in 2003. Many internationally renowned enterprises, such as Siemens, Roche or General Electric, invest in R&D in Bavaria. Large research premises are maintained mostly in the metropolitan regions of Munich and Nuremberg.

Knowledge Output

Bavaria performs well when it comes to the output of knowledge, measured by patent applications per million inhabitants or in relation to the regional GDP. Bavaria made 467 patent applications per million inhabitants to the European Patent Office (EPO) in 2002, while in Germany in the same year an average of 297.3 patent applications were registered per million inhabitants. When compared with figures from other European regions this number is very high.

As well as being a centre for the generation of knowledge output, Munich is also the home of the patent applications administration. The European and the German Patent Offices are both based in Munich, which brings an awareness of innovation and patents into the city.

2.1.2 Knowledge diffusion capacity of the region

Bavaria possesses a highly differentiated technology transfer network with a wide range of support for innovating agents. The support that is provided varies from consulting activities to networking and finding suitable partners for cooperative activities in Germany and the rest of the world. Three major transfer and network organisations were founded in 1995 using the proceeds of the privatisation of *Bayernwerk*. The Bavarian State Government used this money to finance the *Offensive Zukunft Bayern*, the *High-Tech Offensive* and the development of organisations that would contribute to innovation transfer and networks in Bavaria. With these investments since the mid-1990s Bavaria has gained a significant important advantage in recent years.

ences to natural sciences, engineering and environmental research. The Leibniz Institutes are demand-oriented and interdisciplinary centres of competence. They consider themselves co-operation partners for industry, public administration and politics; scientific collaboration with universities is particularly close and intensive.

⁶ <http://www.abayfor.de/abayfor/English/abayfor/index.php>

The Bavarian State Government has set up and funds the following three major technology transfer organisations:

1. *Bayern Innovativ*⁷, *Gesellschaft für Innovation und Wissenstransfer mbH* (located in Nuremberg), which is a publicly owned company that was set up by the Bavarian State Government in 1995. A team of 60 staff is responsible for the conception and organisation of innovation congresses and further technology-transfer activities. It brings companies and institutes together for cooperation at all levels of the value chain. Bayern Innovativ has built up a network of companies and institutes from over 40 countries. Bayern Innovativ supports SMEs by entering European programmes like CRAFT and spurs cooperation between universities and business enterprises⁸.

2. *Bayern International*⁹, *Bayerische Gesellschaft für Internationale Wirtschaftsbeziehungen mbH* (located in Munich), founded by the Bavarian Government in 1995 is an organisation to promote foreign trade. This was created as a part of the "Offensive Zukunft Bayern" (Offensive for the Future of Bavaria) financed by revenues raised from the privatisation of state industry. In close cooperation with partners in the Government and the economy it supports enterprises which are located in Bavaria to establish international business co-operation projects.

3. *Bayern Kapital*¹⁰, *Risikobeteiligungs GmbH* (located in Landshut), is a Bavarian venture capital company and was founded as part of the "Bavarian Future Initiative" as a wholly-owned subsidiary of the LfA Foerderbank Bayern (Bavaria's development bank) at the end of 1995. The objective of Bayern Kapital is to finance the research and development and market introduction of new products. In this effort Bayern Kapital usually acts as co-investor in cooperation with a lead investor. To ensure continued implementation of innovation and growth in the future, Bayern Kapital set up two new funds in 2002. Bayern Kapital joined forces with the LfA Foerderbank (Bavaria's development bank) and tbg-Technologie-Beteiligungs-Gesellschaft mbH (now KfW – a bank sponsored by the German government), to create Seedfonds Bayern with a volume of €22 million with which to finance start-ups in the medical technology, environmental technology and information technology, communications, and software sectors. Technofonds Bayern II with a volume of €60 million and a target volume of €75 million, was also set up with the same partners plus the European Investment Bank. The fund aims to facilitate access to venture capital for emerging Bavarian firms planning, developing and introducing new products. Overall, Bayern Kapital now manages a fund volume of almost €190 million. Bayern Kapital invests principally in small and medium-sized companies with strong growth potential in key industrial technologies. Its investments are mainly concentrated in information technology, measurement and control equipment, medical technology and pharmaceuticals.

In addition to institutions that are founded and supported by the Bavarian State Government, further technology transfer offices are maintained by a variety of other actors and institutions in Bavaria. Each of the 10 Bavarian Chambers of Industry and Commerce keeps its own technology transfer counsellor and offers help to those enterprises which are located in their region. This service is completed by counsellors from the Chamber of Crafts which support enterprises which are mostly involved in crafts and industrial art. The Chambers of Crafts provide 9 transfer offices altogether. Additionally, 17 Bavarian polytechnic universities provide some support for technology transfer by running transfer offices. In total 14 technology transfer institutions are based in and around Bavarian universities. The Technische Universität München, which is the largest university in Bavaria, maintains 4 technology transfer offices altogether. This enables very good support for innovative ideas coming from different technical university disciplines. Among them is *gate*¹¹, Garching Technology and Entrepreneur Centre for the development and marketing of high-technology solutions, founded within the framework of the High-Tech-Offensive of the Free State of Bavaria. The high-tech centre next to the campus of the Techni-

⁷ <http://www.bayern-innovativ.de>

⁸ <http://www.baytech.de>

⁹ <http://www.bayern-international.de>

¹⁰ <http://www.bayernkapital.de>

¹¹ <http://www.en.gategarching.de>

cal University Munich is home to young entrepreneurs who wish to translate their ideas in 'mechatronics', information and communications technology, and software into market-ready products and services. Gate organises events and fairs and offers affordable space, which is extremely important in Munich and spurs networking opportunities for young entrepreneurs. In addition, Bavaria hosts four patent transfer institutes, three of them are affiliated to the Fraunhofer-Gesellschaft. Other research societies, like Max-Planck-Society run transfer offices as well.¹².

2.1.3 Knowledge absorption capacity of the region

The propensity to participate in life-long-learning in Bavaria is slightly lower than in other parts of Germany, or indeed Europe as a whole. Only 7.1% of adults aged between 25 and 64 participate in education or training, whereas in Germany 7.4% take part in such programmes and 9.7% in Europe. By contrast, the ability of the labour force to absorb new knowledge is considered to be relatively good, when compared with the EU average. Among the economically active population 82% have an upper-secondary (ISCED 3-4) or even tertiary (ISCED 5-6) education. The share of the population with a tertiary education is 24.3%. However, if compared to other countries like the US or Japan for instance, the share of the population, which has a high capacity of knowledge absorption is considerably lower.

At 24.8% the share of the human resources in science and technology as a share of the total population is slightly above the German average of 24.5%. The same can be said for the share of human resources in science and technology as a share of the labour force in Bavaria, which comes to 48.5% (48.9% in Germany). Compared to the EU-15 level of 43.5% the knowledge absorption capacity in Bavaria with regard to this indicator is good.

2.2 Policy context

2.2.1 Governance structure and actors

Germany's federal structure means that the degree of decentralisation of policy-making and level of regional governance competences is quite high. With regard to RTDI policies, the German regions (*Bundesländer*) have in principle the autonomy and the competence to control or influence decisions in soft knowledge infrastructures such as universities, science parks, innovation networks, start-up initiatives, etc. However, the high degree of autonomy does not mean that the national government has no – or only limited – interest or influence in RTDI policies. On the contrary, all major technology and innovation oriented initiatives are initiated by the national government. **Coordination** between the national and regional level primarily occurs on the basis of concrete programmes or initiatives, whereby the regional RTDI policy activities should – at least in theory – supplement national (and supranational) RTDI initiatives. In reality, due to different techno-economic performances of the regions, different tax receipts and political priorities, redundancies and problems as regards the "division of labour" between the different governance levels occasionally occur.

Apart from national RTDI policy programmes focusing on the regions (e.g. EXIST, BioRegio) which are discussed below, the co-financing of non-university research institutes (e.g. Max-Planck-Institutes, Fraunhofer-Institutes, Research Centres of the Helmholtz-Society and Institutes of the Leibniz-Society) is a key feature of the German federal research system. Particularly the institutes carrying out applied research, such as the Fraunhofer-Institutes, are important for technology-oriented regional development. Bavaria is home to 14 Max-Planck-Institutes (most of them in or around Munich), 9 Fraunhofer-Institutes, 2 Helmholtz-Centres and 5 Leibniz-Institutes. In addition to the co-financing of the research institutes, among other activities the German Research Foundation (DFG) promotes academic excellence and the advancement

¹² For a complete list of technology transfer organisations see Bayerisches Staatsministerium für Wirtschaft, Infrastruktur, Verkehr und Technologie, 2006

http://www.stmwivt.bayern.de/pdf/technologie/Bayerischer_Technologie-Transfer-Verbund.pdf

of young researchers. The DFG is also jointly financed by national government and the *Bundesländer* (federal states). Promoting research includes supporting individual projects and research cooperation, awarding prizes for outstanding research achievements, and funding scientific infrastructure and encouraging contacts in science and research. The DFG has developed several specific programmes to achieve these objectives: the individual grants programme, scientific prizes and the promoting young researchers programme. Bavaria's universities are quite successful at obtaining funds from the DFG.

2.2.1.1 National Level

The major actor responsible for RTDI policy formulation and implementation at the national level is the **Federal Ministry of Education and Research** (BMBF). The promotion of research is supported through:

- the promotion of basic research and the respective organisations working in this field,
- the promotion of key technologies, particularly in the fields of health research, biotechnology, information technology, ecological research and mobility, research and development for employment and innovative work, transport and aerospace, and marine technology,
- promotion of research in the fields of the environment, climate, ecology and health, research into education and training etc.

The budget for the BMBF in 2006 came to €8,026 billion. In 2002, the Federal Government and the *Bundesländer* together spent approximately €16.3 billion on R&D. The state thus financed a total of 32% of all R&D expenditure in Germany (BUFO 2004).

The **Federal Ministry of Economics and Technology** (BMW) is responsible for promoting the innovative capabilities of small and medium-sized enterprises (SMEs) in particular. The promotion measures focus on "innovation", "research cooperation", "innovative and technology oriented start-ups" and "technological consulting". The improvement of the financial basis of innovative SMEs is another priority of the BMW.

In addition to the RTDI policy formulated and coordinated by the BMBF and BMW, other ministries are responsible for R&D in their own areas of competence. In 2004, among all Federal Ministries, the Ministry of Defence spent the second largest sum on R&D (€1.1 billion). On the other hand, the R&D expenditures of other ministries like the Ministry of Food, Agriculture and Consumer Protection (€338 million) and the Ministry for the Environment, Nature Conservation and Nuclear Safety (€305 million) are much smaller (BUFO 2004: 615).

2.2.1.2 Regional level

As mentioned above, the German *Bundesländer* have a considerable autonomy in the field of RTDI and education policy, whereas their fiscal competences are limited. Bavaria, in the southern part of Germany, is no exception. Responsibility for regional RTDI policy in Bavaria lies with the regional government (Staatskanzlei) and is currently distributed between two main bodies: the Bavarian Ministry of Economic Affairs, Transportation and Technology (MWVT) and the Bavarian Ministry of Science, Research and the Arts (MWFK). Within the MWVT, technology policy is addressed by various departments: Dep. Innovation, Research and Technology, Dep. Industry, Foreign Trade and Dep. Medium-Sized Businesses, Services, Craft. The ministry describes itself as an "organiser" of technology transfer or innovation management. In addition, the MWVT is responsible for R&D and technology funding. Strongly involved in the Bavarian technology policy is furthermore the MWFK, which is responsible for the universities, universities of applied sciences and the large scale research institutions.¹³ For the implementation of the Bavarian RTDI policy instruments, several (semi-)public bodies have been established (e.g. "Bavaria Innovative", which is responsible for technology-transfer activities, the "Landesanstalt für Aufbaufinanzierung" and "Bayern Kapital", which are responsible for Venture Capital Fi-

¹³ In addition to MWVT and MWFK, the Bavarian Ministry of Financial Affairs (financial responsibility for the universities, large-scale research institutions and public credit institutions), the Ministry for Agriculture and Forestry (responsible for agro-biotechnology) and the Ministry of Health, Food and Consumer Protection (responsible for the funding of health-related biotechnologies).

nancing, the Technology and Start-Up Centres are responsible for the support of entrepreneurial activities, etc.). For the two recent RTDI policy frameworks "High-Tech Offensive Bavaria" (which started in 2000) and "Alliance Bavaria Innovative" (2006-2010) budgets of €1.35 billion and €50 million, respectively, were allocated by the Bavarian government.

2.2.2 Policy Objectives

2.2.2.1 National policy objectives

The current national RTDI policy objectives are formulated in the "**High-Tech-Strategy for Germany**", which was formulated and presented by the German federal government in 2006. For the first time ever, the German government has developed a comprehensive national strategy for all its ministries. All political sectors that affect research and development will be geared to a clearly defined goal. This strategy puts innovation policy at the centre of government activities. The German government is investing an additional €6 billion in R&D during the current legislative period. A total of some €15 billion will be allocated for cutting-edge technology between now and 2009 (BMBF 2006). The policy objectives defined by the federal government are as follows (ERAWATCH Base load, www.bmwi.de):

- to attain the 3% goal for R&D spending by 2010
- to promote increased industrial investments in R&D
- to provide additional public funding in key technologies through the "6 Billion Programme" (as part of the "High-tech-Strategy") (e.g. biotechnology, ICT, multimedia, nanotechnology, energy research, transportation)
- to support scientific excellence at universities via the Initiative for Excellence
- to reduce bureaucracy and help develop a more innovation-friendly environment
- to develop more favourable conditions for venture capital, foundation of companies, innovation in SMEs
- to increase the number of technology oriented and innovative start-ups
- to enhance the cross-linking of business and research in order to strengthen regional locations and thematic clusters/networks and to increase the national competitiveness
- to support the technology transfer from research institutions and universities to attain the 3% goal until 2010
- to in general, eliminate restraints for innovation (especially IPR and taxes)
- to reform the public services law for scientists

The "High-Tech Strategy for Germany" gives concrete shape to the overall RTDI policy objectives of the German governments formulated in the 1990s. The following objectives were set out:

- Enlargement and consolidation of scientific knowledge,
- Improvement of the chances to innovate,
- Improvement of the capability and competitiveness of the economy,
- Supporting scientific/technological progress,
- Developing research activities in the eastern parts of Germany,
- Stepping up international cooperation.

To achieve the 3% objective set by the European Council of Lisbon in 2000, the Federal Government and the Minister-Presidents of the *Länder* adopted the "**Joint Initiative for Research and Innovation**" on 23 June 2005. This Initiative will increase funding for the major science and research organisations which are co-financed by the Federal Government and the *Länder* (Hermann von Helmholtz Association of National Research Centres, Max Planck Society, Fraunhofer Society, Leibniz Science Association, and the German Research Association (DFG) as research funding organisation. The increase in funds by 3% p.a. until the year 2010 is to provide research organisations with an additional €150 billion p.a. The objective of the Joint Initiative is to increase the competitiveness of German research by making better use of existing potential. This means a concentration on excellence, on strengthening cooperation and net-

working across organisations, on supporting young scientists, as well as the possibility of taking up new and unconventional research approaches.

2.2.2.2 Regional policy objectives

In the late 1970s, the Bavarian government began to pursue a specific RTDI policy backed by a national programme (the Bavarian innovation programme was used to operate federal innovation programme). Since 1982, the Bavarian government implements the programme through a single administration and with own budget funds. In 1986, the technology promotion activities proceeded in two single programmes: the Bavarian Innovation Programme and the Bavarian Technology Adoption Programme. In 2000, both programmes were integrated in the Bavarian Technology Promotion Programme (vgl. Berger 2002: 11).

The priorities of the Bavarian RTDI policy during the last 50 years may be summarised as follows:

- 1950s: improvement of the transport infrastructure,
- 1960s: development of energy maintenance,
- 1970s: development of the research infrastructure and promotion of high-tech industries
- 1980s: focus on microelectronics,
- 1990s: beginning of an institutionalised high-technology promotion, speeding-up structural change, fostering entrepreneurial activities,
- since 2000: support for start-ups, focus on life sciences

The Bavarian Government defines its technology policy as a major element of its overall economic policy to strengthen the regional economy. The main assumption is that of competition between regions for investments, growth and jobs. According to the Bavarian government, the formulation of a general RTDI policy framework on the national level is not sufficient to ensure Bavarian interests. The Bavarian technology policy builds upon long-standing experience in economic-, structural- and infrastructure policy, as well as regional industry policy. These policies **traditionally** comprised innovation oriented elements regarding the promotion of structural techno-economic change. More **recently**, emphasis has been placed on the thematic direction and on the formation of the industry-policy-science relationships. Basically, today's innovation and technology policy pursues the approaches which were first implemented **decades ago** (MWVT 2000: 4; Berger 2002: 5).

The RTDI policy includes some fairly general objectives along with others that focus on a number of specific technologies. The policy aims more at "strengthening the strengths" than compensating for structural weaknesses (MWVT 2000: 6).

Through the adoption of modern product- and process-oriented technologies, the policy objectives are (MWVT 2003: 6):

- to bolster and extend Bavaria's leading position in some traditional industries like the automotive industry, mechanical engineering, plant construction,
- to develop and support basic and cross-cutting technologies like laser technology, microsystems technology, mechatronics and new materials,
- to promote innovative future technologies in Bavaria, such as biotechnology, nanotechnology and information- and communications technologies.

Against this backdrop, the major tasks of the current Bavarian RTDI policy are (MWVT 2003: 6):

- identify and pick up technology trends,
- provide an effective research infrastructure,
- provide optimal framework conditions for industrial R&D activities,
- match technology supply and technology demand, i.e. support the commercial usability of (public) research activities,

- support concrete R&D projects,
- initiate and support high-technology or innovative start-ups.

The overall concept of the Bavarian RTDI policy is documented in the **"Bavarian High-Tech Offensive"** (HTO). Since 1999 the Bavarian government has allocated €1.4 billion for future investments in HTO.

2.2.3 Policy instruments

The Bavarian technology profile is supported with traditional as well as new policy instruments. The traditional instruments include:

- The funding and upgrading of basic research activities at universities and Max-Planck institutes,
- The funding and upgrading of applied research activities, primarily at the universities of applied sciences and institutes of Fraunhofer-Gesellschaft,
- A firm level, non-technology-specific R&D support programme (BayTP),
- A technology-specific R&D support programme, e.g. in microelectronics, Microsystems technologies, new materials,
- The support of start-up and entrepreneurial activities within the context of risky technological and economic development projects (BayTOU).

Although this chapter mainly examines regional policy instruments, the most important national instruments focusing on the regions are also mentioned. In particular, the regional programmes "EXIST" and "BioRegio" – both initiated by the federal government, but with a strong impact on the selected regions – are highlighted. Both programmes clearly started a new paradigm within the context of national RTDI policies.

A) Improve innovation and R&D governance

At the national level several institutions exist to improve innovation and R&D governance. The technology and innovation policy board of the Federation of German Industries (BDI-Ausschuss für Forschungs- und Technologiepolitik) and the Bund-Länder Research and Technology study group elaborate strategies to improve innovation and R&D governance. The Bund-Länder-Commission for Education Planning and Research Support (BLK) give recommendations to the heads of the national and regional governments. The BLK aims, for example, at coordinating the planning and decisions of the national and regional government authorities as regards research policies.

At the regional level, the Bavarian government has at its disposal several advisory boards in order to improve innovation and R&D governance. The most important boards to improve regional collaboration, policy advice on RTDI governance and identification of future technology trends are the Industry Board at the Bavarian Ministry of Economic Affairs, Transportation and Technology (MWVT) and the Scientific-Technological of the Bavarian government. In addition, several industry specific boards are trying to enhance the governance and the coordination of sectoral innovation systems: namely, the Energy Board, Forum Medical Technology and Pharma, Software Forum Bavaria and the Electronic Sourcing Forum.

B) Creation of an innovation and entrepreneurial friendly environment

The "EXIST – University-based start-ups" Programme, launched in 1998, is one of the most important initiatives from the federal government to create an innovation and entrepreneurial friendly environment. EXIST intends to improve the start-up climate at universities and increase the number of start-ups from academic institutions. Models to motivate, train and support entrepreneurs have been created in regional networks. In these networks the universities work together with external partners from academia, industry and politics, such as extra-university research institutions, companies, technology and start-up centres, management consultancies, chambers of commerce, etc. Although several regions were chosen to implement the basic elements of the programme (e.g. create regional start-up support networks, offer entrepreneurship education courses at the regional universities, public awareness campaigns, etc.), the federal government pursues national objectives. The "EXIST-Programme" is based on four guiding principles:

- The permanent establishment of a "culture of entrepreneurship" in teaching, research and administration at universities,
- The consistent translation of academic research findings into economic wealth creation - also within the meaning of the universities' commission to transfer technology as reformulated in the Framework Act on Universities,
- The targeted encouragement of the great potential for business ideas and start-up personalities at universities and research institutions,
- A marked rise in the number of innovative start-ups and, thus, the creation of new and secure jobs.

The programme started in 1998 with the funding of five model regions. In 2003 a further 10 so-called EXIST-Transfer regions were supported by the BMBF. At the end of 2006 the third phase of EXIST started. In contrast to phase I and II, EXIST III focuses more on the creation of entrepreneur-friendly conditions in selected universities, rather than regional networks. Bavarian regions/universities received special funding within the EXIST programme from 2003-2005 (for the eastern Bavarian EXIST region "GROW") and since the end of 2006 for the project ODEON Acceleration at the university of Munich. In contrast to the first phase of EXIST, the eastern region of Bavaria (EXIST region "GROW") was successful in the second phase ("EXIST-Transfer"). Although, the objectives of "EXIST Transfer" were the same as those of EXIST I, the ten additional regional networks could use the know-how from the existing five model regions. For the Bavarian region or the respective universities, "EXIST-Transfer" clearly added to the improvement of the regional entrepreneurial climate. In addition, EXIST also contributed to sustainable start-up oriented network structures in the region, which can be observed after the special funding from the national government was phased-out.

At the regional level, Bavaria also implemented special programmes to create an innovation and entrepreneur-friendly environment. Since 1997, the Bavarian Government supports the so-called Business-Plan Competitions. The aim of the competitions is to support young entrepreneurs by offering professional advice and information on different aspects relevant to starting a company. Similar to EXIST, the Bavarian government developed its own university oriented start-up programme called HOCHSPRUNG ("University programme for start-ups"), which comprises a Bavaria-wide network of 14 advisors at universities whose job is to offer information, motivation and advice concerning business start-ups. In addition to HOCHSPRUNG, Bavarian entrepreneurs or business founders can access a special programme called BayTOU ("Bavarian Programme to Support Technology Oriented Start-Ups"). BayTOU focuses on the support of technological and economic risky projects in the start-up phase of companies. Since the creation of the programme in 1996 until the end of 2002, approximately 180 projects were supported with grants for the full amount of €17 million. The Bavarian policy measures to create an innovation and entrepreneurial friendly environment are completed with a dense network of public funded technology parks and with the creation of "Bayern Kapital", a public venture capital company for the provision of VC for young technology oriented firms.

C) Development of human capital

Given that the German Bundesländer have the competence over education policy, the federal government has only limited possibilities to foster the development of human capital. Nevertheless, the new High-Tech Strategy for Germany comprises several objectives or elements focussing on development of human capital: support for talent, strengthening investments in human resources and vocational training, fostering the mobility of scientists. Concrete instruments in order to achieve these objectives are currently being developed. One of the most important initiatives as regards the development of human capital is certainly the "Initiative for Excellence" which - among other objectives - refers to the creation and funding of research schools for young scientists.¹⁴ Within the framework of the "Initiative of Excellence", a total of €1.9 billion will be available until the year 2011. The federal government will contribute 75% of this sum. In the first round of funding, three Bavarian research schools (at the universities of Bayreuth, Erlangen-Nürnberg and the Technical University of Munich) (out of 26) were selected as winners.

On the regional level, additional initiatives to promote the development of human capital have been implemented by the Bavarian government. Bavaria is the only German *Bundesland* with its own concept of top-notch higher education (Elite Network of Bavaria). The contribution to academic excellence consists of three complementary elements: (1) Elite Graduate Programmes, (2) International Doctorate Programmes, (3) Support programme for the highly gifted. 21 Elite Graduate Programmes and 11 International Doctorate Programmes have been established at several Bavarian universities providing education and research opportunities for approx. 2,000 gifted students and 120 new-generation post-graduates per year. In total, €14 million have been invested in the programme with support from commerce and industry and with the assistance of the universities involved. The Bavarian "FLÜGGE" programme supports young university graduates who are willing to start a company (development of entrepreneurial human capital). Since its implementation in 1997, FLÜGGE offers young entrepreneurs the possibility of working at the university while at the same time developing their business idea.

D) Networking, co-location and clustering measures

Starting with the implementation of **BioRegio** in the second half of the 1990s, clustering measures have become a popular instrument in German RTDI policies. The major objective of BioRegio was to stimulate business creation and the location of foreign biotechnology companies in Germany, to accelerate growth in existing biotechnology companies and to ensure the supply of sufficient seed and venture capital to improve the competitive situation of Germany in biotechnology (Koschatzky 2001: 14, BMBF 2004). BioRegio can be described as a policy-led attempt to initiate sub-national innovation systems in the field of Biotechnology. Three regions with appropriate research potential were selected through a competitive procedure. The Munich BioRegio was one of the "winning regions" and thus, received privileged access to special project funding from the Federal Ministry of Education and Research (BMBF). Today, Munich is one of the most attractive locations for biotech start-ups or foreign biotech related investments. The BioRegio competition made a crucial contribution to the development of a biotechnology cluster in Munich.

On the regional level the Bavarian government's so-called "Cluster Campaign" is designed to enhance Bavaria's role as a top location for business and science, which systematically follows on from the Bavarian High-Tech Initiative. Its aim is to build state-wide networks interlinking business and scientific potential in 19 defined industry and competence clusters and thus to activate innovation and productivity potential in these clusters. The campaign is flanked by a second pillar of "Allianz Bayern Innovativ" aimed at boosting cross-sectoral regional networks. The 19 clusters identified can be divided into three types: high-tech clusters (e.g. in Biotechnology, Aerospace industry, ICT, Environment technology), production-oriented clusters (e.g. automo-

¹⁴ Other objectives of the initiative refer to so-called Excellence Clusters and the promotion of "Future concepts for top-class research at universities".

tive, chemistry, forestry and the timber industry, food industry, logistics) and cross-sectoral clusters (e.g. nanotechnologies, mechatronics, and new materials). The activities of the Bavarian cluster initiative take up these capabilities and promote the formation of networks among participating companies as well as between companies and research establishment: as the basis for developing new products and production processes as well as for positioning companies in growth markets. For each Bavarian cluster, platforms are created that bring together companies, research establishments and universities, permit intensive cooperation and hence release innovative potential. The cluster platforms were set up in mid-2006. For the cluster campaign, the Bavarian government allocates a sum of €50 million.

D) Knowledge and technology transfer to enterprises

On the national level, one of the most important initiatives in recent years is the INSTI programme ("Stimulation of Innovation"). INSTI was launched in 1995 by the Federal Ministry of Education and Research. In 2006, competencies were transferred to the Federal Ministry of Economic Affairs and Technology. The major objectives of INSTI are to create a nationwide network to improve the use of patent information, to optimise the application of property rights, strengthening of a culture of 'inventiveness' and to increase innovation activities in business. The network partners are located all over Germany and primarily act as supporters and adviser of SMEs as regards their innovation projects. In Bavaria, a total of 8 institutions are INSTI partners (e.g. the Technology and Start-Up Centre in Würzburg, the Innovation and Start-Up Centre in Bamberg, LGA Training & Consulting GmbH in Nürnberg, item communication management GmbH in Aschaffenburg etc.). The INSTI project management was delegated to the Institute of German Economy.

Knowledge and technology transfer activities on the regional level are planned and coordinated by Bayern Innovativ, the Bavarian technology transfer organisation. The main objectives of Bayern Innovativ are the transfer of novel scientific and technological findings into new products and modern processes (with a special focus on the technology transfer between academia and business) and the formation of active cooperation networks for companies and scientific institutions as a new infrastructure for the initiation of innovation projects. Bayern Innovativ is one of the key players Bavarian RTDI policy, funding a Bavaria-wide network of contact and information offices. Its contact points include, for example, the chambers of commerce, the technology transfer offices at the universities of applied sciences, several Fraunhofer Institutes, and the Garching Innovation GmbH (the technology transfer organisation of the Max-Planck Society). Since 1995, the Bavarian government allocated a total of €51 million to Bayern Innovativ. Patenting of research findings from Bavarian universities is promoted within the context of the BayernPatent initiative. This initiative was launched in 2000 on behalf of the Bavarian State Ministry of Science, Research and Art. Since 2002 it has been co-financed by the Federal Ministry of Education and Research (BMBF). BayernPatent covers the whole technology transfer spectrum from comprehensive advice to scientists on their inventions and the financing of patent costs.

E) Research collaboration of public research organisations with private sector

With regard to research collaboration between public research organisations and the private sector, the Federal Ministry of Economic Affairs and Technology supports R&D cooperation projects (within the "Joint Industry R&D" - IGF programme). The focus of the programme is on supporting science-industry cooperation and industry-industry cooperation, especially for SMEs. IGF is one of the oldest and largest (in terms of the budget) R&D programmes of the federal government which already started in 1954. During the period 2000 - 2004, approximately €454 million were allocated for IGF (BUFO 2004: 353). From 1999-2005 the German government supported research collaborations of public research organisations with private sector enterprises within the program InnoNet ("Innovative Networks"). During 2000 and 2004, the total budget of InnoNet was €43 million.

On the regional level, the Bavarian Research Foundation (BFS) promotes research collaborations of public research organisations with the private sector (joint research projects). The BFS was founded in 1990 to support future oriented projects of university and business sector research. The overall aim is to support the transfer of scientific findings into commercial applications, especially in the Life Sciences, ICTs, Microsystems Technology, New Materials, Energy and Environment, Mechatronics, Process- and Production Technology, Nanotechnology. From the time of its creation up until 2001, the BFS awarded grants for more than 250 projects or more than €280 million. The fact that firms from the business sector have to co-finance research projects, meant it was possible to raise a total budget of €600 million (BMWVT 2003: 13).

F) Support of public research

The main vehicle for funding public research on the national level is the German Research Foundation (DFG). The DFG is the central, self-governing research funding organisation that promotes research at universities and other publicly financed research institutions in Germany. Among the top 10 universities which raised DFG grants between 2002/2004, 4 universities are located in Bavaria (University of Munich, University of Würzburg, University of Nürnberg-Erlangen, and Technical University of Munich). The University of Munich raised DFG grants totalling €130.8 million and thus, is the top university of Germany. In addition to the DFG funding, the 12 Bavarian Max-Planck Institutes, 9 Fraunhofer-Institutes, and the German Aerospace Research Centre (DLR) are partly financed by national institutions.

On the regional level, public research is primarily supported within the context of Bavarian university funding. As pointed out above, education policy in Germany is under the responsibility of the *Bundesländer*. Under the common funding system of the Max-Planck-Institutes, Fraunhofer-Institutes and Institutes of other Scientific Organisations, the Bavarian government co-finances the Bavaria-based institutes listed above.

G) Financial R&D measures for the private sector

On the regional level, financial R&D support for the private sector is conducted within the Bavarian Technology Support Programme (BayTP). BayTP supports innovative and technological risky development projects until the completion of a prototype. BayTP is *the* central measure of the Bavarian government for the commercial sector. Since the implementation of the programme in 1980, approximately 400 projects were supported with grants of €68 million. In addition, 400 projects were supported with soft loans of €170 million (BMWVT 2003: 12).

Exhibit 1: RTDI policy mix affecting the region

Policy Areas ¹⁵	Policy objectives and instruments at National* level affecting the region	Policy objectives and instruments at Regional* level
Improve innovation and R&D governance	The technology and innovation policy board of the Federation of German Industries and the Bund-Länder Research and Technology study group develops strategies to improve innovation and R&D governance; the Bund-Länder-Commission for Education Planning und Research Support give recommendations to the heads of the national and regional governments.	Several boards to improve regional collaboration, policy advise on RTDI governance and identification of future technology trends: namely industry board at the MWVT and scientific-technological board of the Bavarian government.
Creation of an innovation and entrepreneurially friendly environment	The "EXIST – University-based start-ups " programme is one of the most important initiatives from the federal government. The eastern region of Bavaria and the university of Munich receive special funding from the federal government.	Various measures initiated by the Bavarian government: Business-Plan Competitions, technology parks, foundation of "Bayern Kapital", a public VC company. HOCHSPRUNG is the Bavarian pendant to EXIST with a focus on university-based start-ups. BayTOU is the regional support programme for technology oriented start-ups.
Development of human capital	The High-Tech Strategy for Germany comprises several objectives or elements focussing on development of human capital. The German Research Foundation (DFG) promotes academic excellence and the advancement of young researchers among others.	High degree of autonomy of Bavaria as regards the development of human capital Bavaria is the only German Bundesland with its own concept of top-notch higher education (Elite Network of Bavaria). The Bavarian programme "FLÜGGE" supports young university graduates who are willing to start a company.
Networking, co-location and clustering measures	During 1998-2003, the biotechnology cluster Munich (BioRegio Munich) was funded by the Federal Ministry of Education and Research (total €25 million). Currently, cluster related objectives are formulated in the High-Tech Strategy for Germany. The BMBF-Programme "Competence Centres" also supports networking.	In 2006 a regional cluster campaign was initiated by the Bavarian government. Its aim is to build state-wide networks interlinking business and scientific potential. For the cluster campaign, the Bavarian government allocates a sum of €50 million.
Knowledge and technology trans-	INSTI programme ("Stimulation of Innovation") was launched in 1995 by the	"Bayern Innovativ" as the key player with regard to technology and knowl-

¹⁵ Compilation from typologies described in the bibliography such as Boekholt, P. et al (2001), *An international review of methods to measure the relative effectiveness of technology policy instruments*, Technopolis B.V., Amsterdam;
 Soete, L. et al (2002), *Benchmarking National Research Policies: The impact of RTD on Competitiveness and Employment (IRCE)*, A STRATA-ETAN Expert Group Report, DG Research, European Commission, Brussels;
 Guy, K. and Nauwelaers, C (2003), "Benchmarking STI Policies in Europe: In Search of Good Practice", *The IPTS Report*, Vol. 71, February, IPTS, Seville;
 European Commission (2003), *Raising EU R&D Intensity: Improving the Effectiveness of the Mix of Public Support Mechanisms for Private Sector Research and Development*, Report to the European Commission by an Independent Expert Group, Brussels.
 Also TrendChart has developed its own policy mix taxonomy.

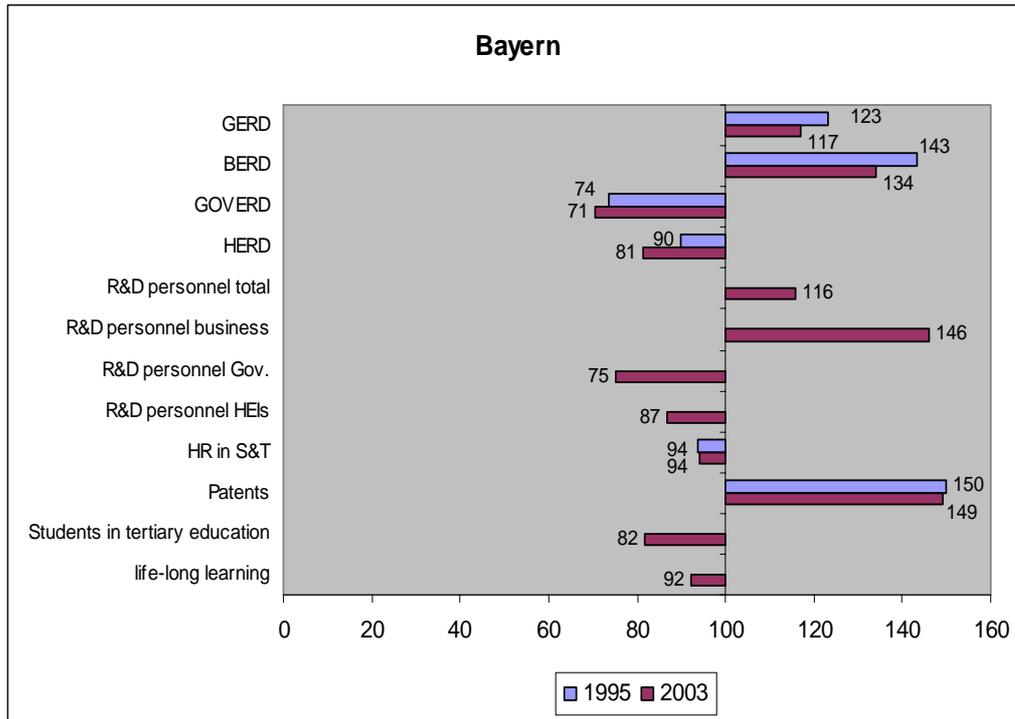
fer to enterprises	BMBF. Major objectives: create a nation wide network to improve the use of patent information, optimise the application of property rights and strengthening of an inventive culture. In Bavaria, a total of 8 institutions are INSTI partners.	edge transfer activities. Funding of a Bavaria wide network of contact and information offices. Promotion of the "Bayern Patent " initiative - patenting of research findings from Bavarian universities (advice and financing of patent costs).
Research collaboration of public research organisations with private sector	The Ministry of Economic Affairs and Technology supports R&D cooperation within the programme "Joint Industry R&D". Focus on science-industry cooperation as well as industry-industry cooperation.	Bavarian Research Foundation (BFS) promotes research collaborations of public research organisations with the private sector (grants).
Support of public research	The main vehicle on the national level is the German Research Foundation. Promoting research includes supporting individual projects and research cooperation among other.	Public research is primarily supported within the context of the Bavarian university funding.
Financial R&D measures for the private sector	ERP Innovation programme (Ministry of Economic Affairs and Technology) to support the technological competitiveness of SMEs. The state owned KfW promotional bank awards soft loans for the realisation of market oriented R&D.	Financial support for the private sector is conducted within the Bavarian Technology Support Programme (BayTP) which is the central measure of the Bavarian government for the commercial sector.

* Policies at national level are those formulated and implemented by national actors even if they have a regional dimension, while policies at the regional level are those under the complete and exclusive control of the regional authorities. Shared policies planned and/or implemented jointly by national and regional authorities (e.g. co-funding) will be regarded as regional.

2.3 Conclusions

The analysis presented in chapter 2.1 underlines the strengths of the Bavarian regional knowledge base or the regional innovation system. Investments in R&D in the region account for more than 20% to total R&D spending in Germany. With an investment share of approx. 15% of the state budget, Bavaria invests more in R&D than any other non-city state in Germany. In 2003, 2.95% of the region's GDP was invested in R&D (GERD). The business sector accounts for 80% of R&D activities and therefore contributes the most to overall R&D expenditures. Figure 2 indicates the strengths of Bavaria from a comparative perspective. Total R&D expenditures (GERD) and business expenditures are well above the German average, although its position ahead of the rest of Germany obviously declined during 1995-2003. As regards government expenditures in R&D and higher-education expenditures in R&D, Bavaria is below average. This result should not be misinterpreted as a weakness of the Bavarian knowledge base. In fact, it appears to be the result of the sheer dominance of the business sector expenditures in R&D. Analogous to the average expenditures in R&D, R&D personnel – at least in total and in the business sector – are also above the German average. As regards knowledge output, Bavaria performs similarly well, at rates above the German average. In 2002, Bavaria (together with Baden-Württemberg) submitted more patent applications per million inhabitants to the European Patent Office than any other German region.

Graph 1: Comparison of Bavaria's knowledge base with Germany



The knowledge diffusion capacity, which finally results in patent applications has been systematically strengthened since the middle of the 1990s. A tight technology transfer network was built by the Bavarian Government relying heavily on three major technology transfer organisations: *Bayern Innovativ*, *Bayern International* and *Bayern Kapital*. Around traditional industries such as automotive engineering, the chemical industry and the electronics sector new high-technology branches were supported by Bavarian policy, specifically through the "Bavarian High-Tech Offensive". Biotechnology, life sciences as well as nanotechnology and the new materials sector received support under these measures.

In terms of policy objectives and policy measures, chapter 2.2 shows that the Bavarian policy context appears to be quite beneficial to the economic and technological capability. Compared to other German *Bundesländer*, the Bavarian government implements a well capitalised RTDI policy. However, the high degree of autonomy does not mean that the national government has no or only a limited interest or influence in RTDI policies. On the contrary, major technology and innovation oriented initiatives (e.g. start-up programmes, R&D support programmes, network and cluster measures, technology support programmes, SME support) are initiated by the national government. In addition, major scientific organisations like the Fraunhofer-Gesellschaft, Max-Planck Society and the German Research Foundation are co-financed by the national government. Bavaria benefits from these national funding schemes, as the Fraunhofer- and Max-Planck Institutes in Bavaria serve as the region's technological backbone – complementary to the university research activities. Bavaria's RTDI policy objectives are on the one hand quite universal, but on the other hand focus on several specific technologies. The primary aim of policy is "strengthening the strengths" rather than compensating for structural weaknesses. The instruments include, among others, a firm-level, non-specific technology R&D support programme, a technology-specific R&D support programme (e.g. ion Microelectronics, Microsystems Technologies, New Materials) and the support of start-up and entrepreneurial activities within the context of high risk technological projects.

3 Regional economic structure

3.1 Description of the economic structure

3.1.1 Characteristics of the productive structure of the region's economy

To understand the industrial fabric of Bavaria today one has to bear in mind that the productive structure of the region has changed considerably since the end of World War II. Before 1945 Bavaria had very little industry, and its economic activities were mainly related to the agricultural sector. At that time the economic performance of Bavaria was very poor, especially when compared with the industrial centres of North-Rhine-Westphalia, the industrial heart of Germany before the start of World War II. However, this starting point turned out to enable Bavaria to catch up with other regions in Germany and Europe as it did not have to deal with old industrial monolithic structures, but could concentrate on promoting promising industries. This was fostered by a migration of well educated migrants ready to enter the Bavarian work force.

According to the German national statistical office, Bavaria produced a regional GDP of €398,450 million in 2005, whereby Bavaria contributed 17.8% of overall GDP in Germany. In 1995 the regional GDP of Bavaria came to €305,099 million, which meant a share of 16.5% of the overall GDP of Germany. Between the years 2000 and 2005 the annual growth rates of regional GDP normally exceeded the GDP growth rates of Germany, with just a few exceptions, ranging from 0.7% (2003) to 4.4% (2000). In terms of GDP per inhabitant Bavaria plays a leading role in Germany. GDP per inhabitant totalled €31,990, which is higher than in all other regions in Germany and exceeds the German average of €27,175 by far. The fact that Bavaria is a high income region becomes even more apparent when compared to GDP per inhabitant in the EU-25 which only adds up to €21,740 per year.

Since 1995 the tertiary sector in Bavaria has grown in importance. In terms of gross value-added the primary sector contributed 1.1% (1.2% in 1995), the secondary sector contributed 29.7% (33% in 1995) and the tertiary sector 69.1% (65.5%). The contribution of the tertiary sector is very high, as in Germany as a whole. As mentioned above, the economic position of Bavaria right after the World War II enabled the region to concentrate on the promotion of high-tech and promising industries.

Productivity, measured in terms of value-added per employee, in Bavaria is very high. It achieves 108.6% of the German average. Notably the tertiary sector, which accounts for more than two thirds of the economic activity, performs very well and achieves 112.7% of the German average.

Employment conditions in Bavaria are excellent. Bavaria has an unemployment rate of 7.8% in 2005, which is next to Baden-Wurttemberg the second lowest in all of Germany. Germany on average has an unemployment rate of 11.7%. Additionally, long term unemployment is significantly lower than the German average. Since the middle of the 1990s unemployment in Bavaria has always remained below the German average. Economically successful regions like Munich and Upper Bavaria are attracting employees from all over Germany. In boom times Munich becomes a magnet for qualified employees, such that during 1999 and 2000, having tremendous effects on the housing market of the city, which becomes very tight.

Altogether 13.54% of all employees in Bavaria were occupied in high and medium high technology manufacturing sector. In addition, 31.6% were employed in the knowledge-intensive service sector. This reflects Bavaria's economic orientation towards high technology products and services and a solid knowledge creation capacity, as well as a healthy knowledge base in the region. This orientation is also reflected by the prevailing clusters in Bavaria.

The number of local enterprises with at least one employee amounted to 333,696 in 2005, according to the German Labour Office (INIFES, 2006). A vast majority of the Bavarian enterprises qualify for the classification of SMEs. Only 740 enterprises with more than 500 employees are located in Bavaria. Among the group of large enterprises a concentration in the manufacturing sector predominates (see Figure 3 in Annex 3).

Industry and the service sector interact very closely in Bavaria. Industry demand stimulates the service sector, mirroring the importance of industry for the whole Bavarian economy. The automotive sector and the engineering sector are the industry sub-branches with the highest turnover. The automotive sector contributes almost 25% towards the overall turn-over, engineering 13.8% respectively (Bayerisches Staatsministerium für Wirtschaft, Infrastruktur, Verkehr und Technologie, 2006:12).

3.1.2 Systemic characteristics of the region: clusters, networks, and interactions

Bavaria's cluster campaign has two major aims: the support of the building of state-wide networks and interlinking business and scientific potential in 19 defined industry and competence clusters. The cluster campaign is flanked by the "Allianz Bayern Innovativ" which promotes cross-sectoral regional networks. Within this political context three different kinds of clusters in different sectors and throughout all of Bavaria were identified. To the so called high-tech clusters belong biotechnology, aerospace, satellite navigation, Information and communications technology, environmental technology, and medical technology. The production-oriented clusters embrace automotive engineering, chemicals, electronics, nutrition, forest and wood, financial services, media, energy technology, railway technology and logistics. In the field of cross-sectoral technologies the following clusters were identified: nanotechnology, mechatronics/robotics/efficient production systems and new materials¹⁶.

The different clusters are characterised by universal value-creation chains, an environment consisting of major user sectors, efficiency and application-orientation in research, and availability of highly qualified staff. Major multinational companies as well as many SMEs, in close proximity to research and development and higher education entities, have built a complex network and a productive environment for further sectoral developments.

For each Bavarian cluster, platforms are created that bring together companies, research establishments and universities, permitting intensive cooperation and hence innovative potential to be unleashed. This kind of cluster management includes the maintenance of networks, consisting of companies, research establishments, associations, investors, support institutions, consultants and other players relevant to the respective cluster. The task of the cluster management is to build structures for contact and communication between industry and science and encourage innovative projects¹⁷. The Bavarian State Ministry of Economic Affairs, Infrastructure, Transport and Technology¹⁸ provide a cluster policy department for general queries.

In addition to the 19 officially supported clusters by the cluster initiative the Chambers of Industry and Commerce in Bavaria¹⁹ identified 10 further regional innovation and production systems (RIPS) which form and influence the different Bavarian regions significantly. Among them are the sectors of mechanical engineering, health, wellness and tourism, the furniture industry and sports. The RIPS are not comparable to clusters in terms of their economic significance or in

¹⁶ Detailed information on the 19 Bavarian clusters can be found under: <http://www.invest-in-bavaria.de/BavariansCluster/index.html>. This included networks, enterprise and research engagement as well as selected ongoing projects.

¹⁷ Further information can be obtained under www.bayern-innovativ.de/cluster2006.

¹⁸ www.stmwivt.bayern.de

¹⁹ http://www.ihk-muenchen.de/internet/mike/ihk_geschaeftsfelder/standortpolitik/Anhaenge/Cluster_Bayern_endbericht_ohne_Unternehmen.pdf

their network structure. However, they are of economic importance for the development of the sub-regions.²⁰

3.1.3 The regional economy in the international context

In 2005 total exports of Bavarian goods increased by 8.3%, rising to a value of about €127.8 billion. Accounting for 19.9% share of total German exports, Bavaria ranks second among the German federal states, after North Rhine-Westphalia. At the same time the export quota of Bavarian industry went up to a new record value of 45.4%. Imports to Bavaria also increased by 4% to €98.9 billion in 2005. As a result, in the past year the export surplus rose by €5.9 billion to a new peak of €28.8 billion (see Figure 4 in Annex 3). These figures reflect the strong international linkages of the Bavarian economy and the competitiveness of regional firms. Exports are economically significant for the Bavarian economy and can be seen as a motor for growth and jobs in Bavaria.

In 2005 the most important market for Bavarian goods worldwide was the USA, taking a share of 12.3% of total exports, closely followed by Italy, Austria, France and the United Kingdom. In 2005 Bavarian exports to the EU partner countries increased by 9.1% to a total of €76.9 billion. Approximately 60% of Bavarian exports go to the 25 EU partners.

Reaching a total share of almost two-thirds (61.3%), motor vehicles, machines and electro-technical products were the most important groups of goods the Bavarian economy exported in 2005. Exports of motor vehicles increased by 14.2%, holding first place in the rankings with a value of €41.2 billion, exports of machines came second, with a share of 6.6% and a volume of €22.5 billion, followed by electro-technical products (see Figure 5 in Annex 3).

3.1.4 The local financial market

Munich is the second biggest financial centre in Germany, after Frankfurt, and all the large private banks have offices in the Bavarian capital. In Germany, the local financial system is dominated by the public savings banks (Sparkassen) and their umbrella organisations the state banks (Landesbanken) of the German states. In Germany the public savings banks are traditionally the prime lenders to SMEs. The reason for this is that a savings bank normally only covers one community. Therefore it is typically familiar with the local businesses and can thus better assess their creditworthiness than external players. Additionally, the statutes of the savings banks are not oriented towards profit maximisation but implicitly towards regional development which permits them to offer small volume lending under better conditions than the private banks.

Besides normal lending, most public support schemes in Germany are administered by the bank of the individual applicant which is very often, the local savings banks.

On a national level the *KfW Bankengruppe* provides various promotional programmes. Within this banking group *KfW Mittelstandsbank* (*KfW SME bank*) offers promotional loan financing of operating costs to business founders, self-employed professionals and established companies. It offers support to a wide range of enterprises in form of loans, mezzanine financing, equity capital and consulting services.

Investment projects are usually tied to a specific purpose and financed under favourable terms and conditions. Long-term loans play a central role as a classic mode of finance. Mezzanine finance helps eliminate financing barriers and strengthen the financial structures of SMEs and business start-ups. The *KfW Mittelstandsbank* helps to improve the equity base of SMEs and is also involved in round tables and advisory centres to discuss issues important to SMEs. Addi-

²⁰ Further information on each of the clusters can be found http://www.ihk-muenchen.de/internet/mike/ihk_geschaeftsfelder/standortpolitik/Anhaenge/Cluster_Bayern_endbericht_ohne_Unternehmen.pdf or <http://www.investinbavaria.com/BavariasClusters/index.html>.

tionally, it seeks close relationships with the banks in order to continue financial support. These banks verify the applicants' economic and financial situation, provide the security and frequently assume liability for the redemption of the loans.

The Federal German government, the KfW banking group and the industrial enterprises BASF, Deutsche Telekom and Siemens have joined together under the "Partners for Innovation" initiative and started High-Tech Gründerfonds with €262 million. High-Tech Gründerfonds invests venture capital in young, high-opportunity technological companies implementing promising research results in an entrepreneurial manner. The financial support is complemented by supervision and management support.

The KfW offers the following programmes mainly for SMEs and innovating enterprises.

- Mikrodarlehen (Micro Loan Programme): Small loans of up to €25,000 to help people set up in self-employment
- Startgeld (Start-up Funds): Loans for business founders, small entrepreneurs and self-employed professionals whose project does not cost more than €50,000
- Unternehmerkapital (Entrepreneur Capital): An innovative family of products for business start-ups, young and also established enterprises
- Unternehmerkredit (Entrepreneur Loan): Provides "universal loans" for investments and working capital
- Unternehmerkredit Ausland (Entrepreneur Loan - Outside Germany): Financing for investments in another country
- ERP-Regionalförderprogramm (ERP Regional Promotion Programme): ERP funds at favourable terms and conditions for investments in structurally weak areas
- ERP-Innovationsprogramm (ERP Innovation Programme): Low-interest loan finance for innovative enterprises.

However, certain conditions have to be fulfilled by the enterprises in order to qualify for one of the programmes. Further information is provided on the KfW websites²¹.

At a regional level the *Bayerische Beteiligungsgesellschaft mbH (BayBG)* is a major actor when it comes to financing SMEs. Its main task is to provide equity capital. Shareholders of the BayBG are mainly banks and also branch associations of other banks, which are mostly located in Munich but also in other parts of Bavaria. BayBG offers support with various programmes for growth, innovation, turn-around, ownership succession, partner withdrawal, spin-off projects and others. In order to do so, BayBG developed various programmes in support of local enterprises in different sectors (see: Figure 6 in Annex 3).

²¹ http://www.kfw-mittelstandsbank.de/EN_Home/Loans/The_individual_loan_programmes/index.jsp

3.2 Policy context

3.2.1 Policy Objectives

3.2.1.1 National level

Apart from the *national* education policy, the "SME-Initiative" (*Mittelstandsinitiative*) is the most important document regarding non-RTDI policies in Germany. The main objectives of the SME-Initiative – planned and implemented by the Federal Ministry of Economics and Technology – are:

1. Creation of favourable framework conditions for SMEs (e.g. improvement of regional economic support within the framework of the joint Bund-Länder agreement, tax reform for enterprises with the aim of improving international competitiveness).
2. Reducing bureaucracy (e.g. lightening the bureaucratic burden and cutting regulations)²².
3. Creation of a favourable entrepreneurial climate: "Start-Up Offensive" (e.g. facilitation of the formation of incorporated companies (GmbHs), increasing the share of new firms).
4. Strengthening the capabilities for innovation (see above) (e.g. increasing SME oriented non-technology specific support, establishing an advisory board for growth and innovation conducted by the German chancellor).
5. Modernisation of vocational training and education to ensure a skilled labour force (e.g. supporting employment for the elderly, linking education and further training)
6. Improvement of the situation as regards finance for SMEs (e.g. creation of new small loan programmes, new mezzanine programme to finance SMEs (for which the KfW is responsible, see below)).
7. Mobilisation of (non-profit) Venture Capital for Innovation (e.g. creation of attractive framework conditions for VC supply and demand).
8. SME support on foreign markets (e.g. improvement of the foreign trade act, continuation of the supply of export guarantees and investment guarantees).
9. Support for internationalisation activities by the service sector (e.g. promotion of technical service providers' efforts to cooperate with foreign partners, support of the service sector through the creation of international standards, specifications and quality seals).
10. Telecommunications policies and deregulation of postal services (e.g. complete deregulation of the terrestrial network market in 1998).

Higher Education Policy

Responsibility for the German education system is determined by the federal structure of the state. Under the Basic Law (Grundgesetz) the exercise of governmental powers and the fulfilment of governmental responsibility are incumbent upon the individual Länder except where the Basic Law permits otherwise. The number of national initiatives and competitions to improve the quality of higher education is rising and may result in future opportunities (and possibly threats) to the Bavarian higher education system. At present, the main objectives of the federal government regarding educational policies are: (1) improving the numbers of training places in the long term (e.g. "National Pact for Training and Young Skilled Staff in Germany"), (2) Modernising the education system: eQualification (e.g. "New Media in Education" funding programme), (3) Support for higher education institutions to meet new requirements resulting from the internationalisation of higher education and the growing competition.

Labour market policy

²² After little progress had been made in this area during the 1990s the new federal government in office since 2005 has recently launched the "Mittelstandsentlastungsgesetz" (law to relieve the strain of bureaucracy for SMEs). If successful this initiative may free resources that can prompt innovative activities.

The fight against unemployment is one of the key concerns of the Federal Government. In this regard the Federal Ministry of Labour and Social Affairs prioritises target-oriented advice, vocational orientation and placement. The active unemployment insurance benefits and basic security benefits for job-seekers are intended to prevent or end unemployment. Active benefits take priority over passive benefits (unemployment benefit). Two independent benefit systems have been in operation since 1 January 2005, providing financial security for people who are out of work. They differ above all in terms of the duration and amount of the benefits provided, as well as in the way they are funded. As regards the employment of foreigners, the new Immigration Act (*Zuwanderungsgesetz*) entered into force on 1 January 2005. Article 1 contains a comprehensive reform of the law on aliens in the shape of the new Residence Act (*Aufenthaltsgesetz*). The vital provisions on aliens' residence and labour market access are combined in one statute for the first time.

3.2.1.2 Regional level

Within the framework conditions set by the European Union, the Federal Government and the parties to the relevant collective labour agreements, much scope remains for the Bavarian government in several policy fields. The most important fields of action are:

- Regional policy in support of structurally weak regions,
- Policy for SMEs and the support of entrepreneurial activities,
- Support for foreign trade relations,
- Location marketing and policies focusing on FDI,
- Infrastructure policy,
- Support of vocational training, qualification, RTDI.

Global competitiveness and technological change are the key challenges for the Bavarian government. The strengthening the capabilities of Bavaria's enterprises and the well-being of its citizens are central for its policies. Against this backdrop, the main objectives of non-RTDI policies are:

- All Bavarian citizens should have the chance to get a qualified occupation: full employment is one of the major objectives.
- The dual system of vocational training and qualifications will be further developed; a large amount of apprenticeship training positions should facilitate young peoples' choice of employment.
- "Qualified growth" will be essential for the quality and standard of living; Bavaria should remain one of the economically strongest *Bundesland* in Germany.
- A further objective of the Bavarian government is that of ensuring equivalent living standards in all regions of Bavaria; specific strengths in certain regions will be supported.
- Bavaria's economic policy focuses on medium-sized businesses: large enterprises, SMEs in the manufacturing, service and crafts sector, along with freelance workers, forming a network.
- Domestic enterprises should be supported to further invest in Bavaria and to develop new services, products, technologies and markets.
- Entrepreneurs should be supported and encouraged.
- Foreign firms should be mobilised and encouraged to invest in Bavaria.
- The economic development should be sustainable and environmentally sound.

3.2.2 Policy Instruments

3.2.2.1 National level

On the national level, *direct subsidies* are one of the most important measures in the BMWi (*Branchenförderung*) general sectoral support policy, and Bavaria's strong business sector has considerably profited from these subsidies. The upgrading of the human capital base in Bavaria is supported by the Bundesagentur für Arbeit at the federal level with vocational training, and general guidelines for university policy at a tertiary education level (cf. Bologna Process).

The public promotional banks also support numerous RDTI- and non-RDTI-related activities at the national level. For example, KfW SME bank assists SMEs in raising capital via special programmes with a special focus on companies that are working on prospective technologies. The KfW Mittelstandsbank is also involved in round tables and advisory centres to discuss issues important to SMEs.

The KfW offers the following programmes, which are mainly aimed at SMEs and innovating enterprises (see also case study report for Saxony):

- Micro Loan Programme (*Mikrodarlehen*): Micro loans for up to €25,000 to enter into self-employment
- Start-up Funds (*Startgeld*): Loans for business founders, small entrepreneurs and self-employed professionals whose project does not cost more than €50,000
- Entrepreneur Capital (*Unternehmerkapital*): An innovative family of products for business start-ups, young businesses and established enterprises
- Entrepreneur Loan (*Unternehmerkredit*)/International Entrepreneur Loan (*Unternehmerkredit Ausland*): Loans for investments and working capital (in another country).
- ERP Regional Promotion Programme (*ERP-Regionalförderprogramm*): ERP funds at favourable terms and conditions for investments in structurally weak areas

A mention should also be made of the BMWi federal initiative to streamline administrative procedures for SMEs and thus to free resources that could, among other things, be mobilised for innovative activity (*Mittelstandsentslastungsgesetz*).

As regards *higher education policy* instruments, various measures have been introduced in the last couple of years to encourage industry to create training places (e.g. JOBSTARTER: a funding programme for more training places, implemented by the BMBF), to increase the use of computers and the internet in educational institutions (e.g. "New Media in Education" funding programme) and to support people in their lifelong learning, among others

Employment agencies play a key role in *labour market policy* by providing advice underpinning the process of matching supply and demand in the labour market either in advance of needs or during the job-search itself. These services, which are referred to as vocational advice, vocational orientation or labour market advice, are targeted at young people and adults, as well as at employers. Vocational orientation: This task is performed, *inter alia*, by holding discussions in schools prior to or at the time of leaving or at careers guidance events organised by careers information centres. This is also backed up with digital and printed media. Additionally, customer centres have been established in the employment agencies in order to achieve more tailored placement of training- and job-seekers.

3.2.2.2 Regional level

The **Bavarian** RTDI policy cannot be viewed separately from the Bavarian government's economic policy or from structural- and infrastructural policy. After World War II, almost all Bavarian governments ran specific industry-oriented policies with a strong focus on supporting the structural change and on capital-intensive companies with high technological potential. Against the backdrop of a manufacturing sector which was (and still is) largely SME dominated, the Bavarian government implemented several medium-sized businesses policy measures in 1974. The instruments consisted of **loans**, **guarantees** and a technology **advisory programme**. To improve the export activities of Bavarian enterprises, a foreign-trade programme was imple-

mented, which was supplemented by a trade fair programme in 1978. In the 1970s and 80s, Bavarian **regional policy** focused on structurally weak regions in the general financial support programmes. Special attention was given to the areas bordering the East European countries. As of the mid 1980s, additional resources from the European Structural Funds also became available. Policy support centred on SMEs and investments in infrastructures (from 2000-2004, the Bavarian government supported investment projects in the business sector (including tourism) with €500 million; infrastructure projects were supported with €115 million)²³. Since the 1990s, no major changes have taken place affecting non-RTDI policy measures.

In addition to the policy fields mentioned above, Bavarian **education policy** or measures to **develop human capital** have to be mentioned as the most important Non-RTDI policy measures. Compared to the rest of Germany, the financial situation of Bavarian schools and universities is above average. National and foreign enterprises investing in Bavaria underline the level of qualification of graduates and academics as a major strength of Bavaria – especially with regard to high-technology sectors. In addition, the Bavarian government strongly supports training and **qualification measures** as well as **vocational training**²⁴. The "dual system" of vocational training – with vocational schools and firms as training institutions – is also considered a major strength of Bavaria. Vocational training and qualification is one of the main focuses of Bavarian SME policy. From 2000-2004, the Bavarian Ministry of Economic Affairs allocated €43.3 million for qualification and training measures. Furthermore, several initiatives with a focus on apprenticeship have been launched since 2000: (1): the Apprenticeship Initiative 2006 to improve the supply of apprenticeship training positions, (2) Financial Support for business firms willing to offer apprenticeship training positions to young people, (3) Training Initiative "Fit for Work 2005" – common training campaign of the Bavarian government and the business sector.

Internationalisation and support for foreign trade activities: With exports worth a total of around €128 billion in 2005, Bavaria is firmly integrated in the global economy (BMWVT o.J.). Support for the internationalisation of the business sector primarily takes place in the context of a set of support instruments. Bavaria's foreign trade policy is based on the following guidelines: (1) Support for SMEs to conduct foreign trade activities ("Go International"), (2) Help for "Self-Help", and (3) a Focus on different foreign regions. By establishing "Bavaria International", the Bavarian Government in 1995 created a competent organisation to promote foreign trade. The support activities focus on the organisation of business delegations, hosting delegations, advice/information through Bavaria's foreign representations and the possibilities for firms to take part in trade fairs ("Foreign Trade Fair Participation Programme"). Although, the foreign trade support programmes of the Bavarian government have not been evaluated and no current data on the financial inputs are available, the support initiatives nevertheless appear to be quite efficient. Given that export-oriented SMEs are more innovative, R&D oriented and show better growth potential than firms which solely concentrate on the domestic market, the leverage of public support is quite high.

Entrepreneurship: The Bavarian government has supported entrepreneurial activities since the mid 1990s. The state-owned Promotional Bank of Bavaria (*LfA Förderbank Bayern*) supports entrepreneurs in nearly all sectors (crafts, manufacturing, services, hotel and catering etc.). The specific instruments it uses are loans and venture capital. In addition, several measures have been implemented to foster entrepreneurial activities in academic institutions (e.g. the HOCHSPRUNG programme mentioned above) and with regard to technology orientation

²³ See Mittelstandsbericht Bayern 2005: 55.

²⁴ Several programs have also been implemented on the national level: the support of talents in vocational training is a program initiated by the BMBF. It supports young skilled employees who are willing to get further qualified in their occupation. The "Aufstiegsfortbildungsförderungsgesetz" (*Meister-BAföG*) supports qualification regarding occupational advancement.

(BayTP). Since 2001, the LfA Promotional Bank has supported 7,800 start-up projects (LfA, 2006: 22). Due to the fact that quite a lot of public support measures for entrepreneurial activities have been implemented by various institutions (e.g. BMBF, the Bavarian government, regional (semi-)public bodies) the concrete impact per initiative is hard to assess. In general, Bavaria has one of the most dynamic start-up intensities in Germany, especially in the knowledge-intensive and technology-oriented sectors, and Munich is clearly the "hot spot" for newly-created enterprises.

Medium-sized business sector (SMEs): In the period 2000-2004, the "Bavarian Loan-Programme for the Support of Medium-Sized Enterprises" (MKP - Mittelstandskreditprogramm) was one of the most important programmes aimed at SMEs in Bavaria. The LfA Promotional Bank is in charge of the MKP. Financial support is given to all investment-related expenditures (e.g. purchase of real estate, construction costs, bonds, purchase of machinery and equipment, patents, licenses, hardware and software). Financial support is provided in the form of various types of loans and export guarantees. In 2005, loans for growth amounted to €1.1 billion (LfA 2006: 25). The stabilisation of enterprises in crisis is another support measure offered by LfA. In 2005, financial support (e.g. soft loans for the consolidation of a firm) and special advice for enterprises in crisis came to €20 million. The evaluation of the MKP underlines its huge impact and efficient allocation of public funds: the MKP addresses structurally weak regions quite efficiently, as can be seen in the above average growth of employment in these regions, and the fact that MKP-funded enterprises show a better and more stable turnover- and employment growth. Moreover the administration of the programme is very straightforward.²⁵

Innovation: Private business enterprises developing modern products and processes ready for the market or integrating innovative technologies in their labour processes can access soft loans. The LfA Promotional Bank's soft loans scheme helps with the cost of materials and employees, patents and licenses, project-related investments and external services. In 2005, LfA granted soft loans for innovation totalling €3.7 million (LfA 2006: 26).

Support measures for the crafts sector: the Bavarian crafts sector accounts for 14% of the total employment in Bavaria and 35% of the Bavarian trainees. Thus, the sector is an important sector of the Bavarian economy. The Bavarian government recognises the crafts sector as an important part of the Bavarian policy for medium-sized businesses. The most important policy instruments are financial support measures and training measures. From 2000-2004, the budget for the support of the crafts sector came to €150 million.²⁶

²⁵ See Mittelstandsbericht 2005.

²⁶ The budget derives from the regular budget of Bavaria and as well as from EFRE/ESF budgets (see Mittelstandsbericht 2005: 74)

Exhibit 2: Effects of policies complementary to RTDI instruments on the R&D and innovation capacity of the region

Policy Areas	Policies complementary to RTDI instruments affecting policy area*	Effects on R&D and innovation capacity of the region
Improving innovation and R&D governance	Various study groups and "Bund-Länder boards" to coordinate policies complementary to RTDI. Different boards of the Federation of German Industries (BDI)	Might improve the coordination in several policy fields. Effects on the regional level depend on policy priorities or the ruling party in the respective <i>Bundesland</i> .
Creation of an innovation and entrepreneurially friendly environment	<p>On the national level:</p> <p>The High-Tech Strategy for Germany formulates different objectives: standards and norms, reduction of bureaucracy, tax reduction, facilitate the constitution of foundations, public procurement (see above). Creation of an entrepreneurship culture within the EXIST programme (see above).</p> <p>On the regional level:</p> <p>Various measures by the Bavarian government: Business-Plan Competitions, Technology- and Business Parks, Incubators, grants and soft loans for SMEs and start-ups (non technology oriented), micro credits.</p>	<p>At this point, most of the objectives in the High-Tech Strategy for Germany need to tie in with concrete measures. The effect on the region depends on the extent on which Bavaria participates in these measures.</p> <p>EXIST clearly helped to improve the entrepreneurial climate in many German regions. Positive effect on the policy agenda of the different <i>Bundesländer</i>.</p> <p>Technology- and Business Parks as well as Incubators clearly help to create an innovation and entrepreneurial friendly environment. Bavaria has a dense network of such facilities.</p>
Development of human capital	Several initiatives on the national as well as regional level affecting the development of human capital: University Pact 2020 to improve the conditions for studies for an increasing number of students; to attract talents and qualified people from abroad, measures to further qualify employees of SMEs; national pact for training and expansion of a skilled labour force.	Initiatives are clearly the expression of need for action. Effects on the R&D and innovation capacity of Bavaria based on the long term considerations.
Networking, co-location and clustering measures	<p>Regional initiatives:</p> <p>Cluster initiative (see above): in addition to the high-tech clusters, production oriented clusters (in "traditional sectors" like automotive, chemistry etc.) are also supported.</p>	The Bavarian cluster initiative started in 2006. Thus, the effects on the regional R&D and innovation capacities are hardly to assess.
Knowledge and technology transfer to enterprises	see above (chapter 2.2)	
Research collaboration of public research organisations with private sector	see above (chapter 2.2.)	
Support of public research	none	none
Financial R&D measures for the private sector	<p>On the regional level:</p> <p>Bavaria's SME policy consists of various</p>	Due to high tax revenues, Bavaria's RTDI and SME policy measures are well financed. Some programmes run

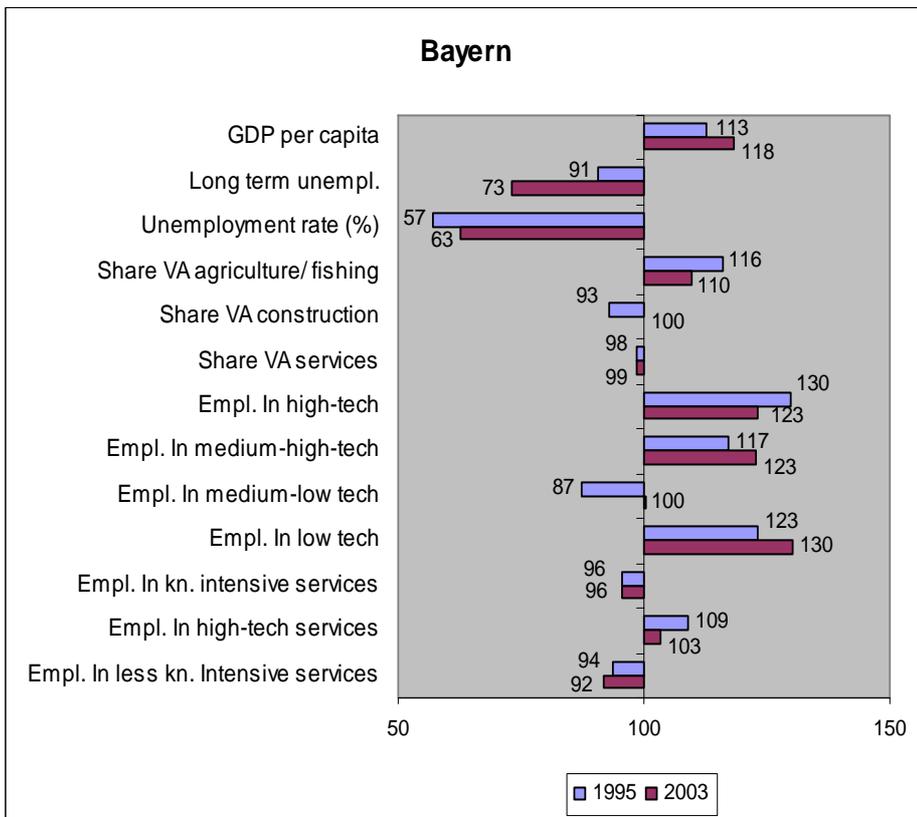
	programmes to strengthen the competitiveness SMEs: soft loans, grants, growth capital (funding of investments), amortisation for SMEs, Venture Capital.	for a long time and can be considered as being effective and efficient. Although the focus is on R&D and high-tech, innovation activities in mature branches are also supported.
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**Examples of such policies are the fiscal, industrial, regional, educational, labour, trade and competition policies.*

3.3 Conclusions

Bavaria, and notably Upper Bavaria, is one of the wealthiest regions in Germany. GDP per capita exceeds the German average by far and long term unemployment is significantly lower than in other parts of Germany. In fact, the unemployment rate in Bavaria is second lowest in all of Germany, right after Baden-Württemberg. The significance of the tertiary sector and its contribution to overall GDP has grown since 1995 by 3.6 percentage-points, which is consistent with developments in the rest of Germany. Though the overall contribution of the primary sector to GDP is very low –only 1.1% of the Bavarian GDP comes from agriculture and/or fishing– its relative weight compared to the other regions is high.

Graph 2: Comparison of Bavaria's economic structure with the economic structure of Germany as a whole



At the same time employment in high-tech and medium high-tech industries is very high and exceeds the German average, sometimes by as much as 30%. Bavaria's economy is dominated by knowledge intensive industries that have strong demand for highly qualified employees. Those sectors generally have a high R&D intensity and good innovation performance. These findings are supported by the existence of the different Bavarian clusters. Seven of the nineteen clusters identified in Bavaria are found in high-tech sectors. Additionally, three of

these clusters are active in the fields of cross-sectoral technologies, having strong demand for a highly qualified work force. Vocational training schemes and national and regional initiatives are being run to develop human capital (concerning the local HEIs, but also immigration of specialised personnel), so as to meet the demand from the Bavarian economy for highly qualified workers.

Non-RTDI policy measures designed and implemented by the Bavarian government over the last 10-15 years complement the RTDI policies quite well. As regards the attractiveness of Bavaria for R&D investments, Bavarian education policy, including university-based education, training and qualification measures, as well as vocational training, should be mentioned as one of the most important non-RTDI policy fields in Bavaria. The level of qualification of graduates and academics is seen as a major strength – for foreign firms as well as domestic ones. Obviously, one of the "success factors" of the Bavarian education policy is achieving the right balance between the funding of top-universities (and highly qualified academics) and vocational training institutions as well as poly-technical universities to guarantee the supply of technical staff. Furthermore, measures to support entrepreneurial activities, the medium-sized business and crafts sector, as well as foreign trade activities, have been in place for a number of years. Although most of these programmes have not yet been evaluated, the impact of these measures appears to be quite high.

In general, the sheer size of the government budget allocated to RTDI and non-RTDI policies and the finely-balanced mix of the different support measures –as regards both infrastructure and company-oriented measures - seem to be crucial. In addition, the broad experience of the programme's managers and a set of tried and tested instruments which been fine tuned over time, are also important "success factors".

4 Conclusions

4.1 Assessment of the RIS

Bavaria is a high-tech location. It hosts a disproportionate number of high-tech firms, with considerable innovative capacities. Firm innovation does not take place in isolation but needs an environment that allows interactions with other actors in the region. The degree to which Bavarian firms are embedded in their region is the object of this concluding chapter.

Bavaria has a strong network of higher education institutes: with 55 higher education institutes in 16 universities, the knowledge creation capacity of the region is very high. Two of the Bavarian universities belong to the German Initiative for Excellence, indicating that teaching and research have reached an outstanding level. However, there is a concentration of higher education institutes in an around Munich and Nuremberg which places them ahead of other areas. The knowledge creation capacity is concentrated in and around Munich and Nuremberg, which is supported by a culturally stimulating environment, especially in Munich.

The region's knowledge diffusion capacity has improved noticeably since the early 1990s. *Bayern Innovativ*, *Bayern International* and *Bayern Kapital*, the three most prominent technology transfer organisations which were founded around 1995 by the Bavarian government, are highly visible in Bavarian entrepreneurial networks. Networking activities, which is at the centre of their operations, reach over the federal boundaries of the Free State of Bavaria and therefore strengthen the role of Bavaria and Bavarian enterprises in a national and even international context.

Bavaria performs very well in terms of knowledge absorption capacity, placing it at the top end of the scale. The share of human resources in science and technology is also above German and EU averages. Due to high standards in the federal education system the overall capacity of the labour force to absorb new knowledge is very good. However, the propensity to participate in life-long learning is slightly lower than in other parts of Germany or Europe.

Traditionally, the various Bavarian actors identify closely with Free State of Bavaria and firms and regional actors have a strong commitment for participating in local and regional initiatives. Bavaria has a long tradition and considerable experience in RTDI policy dating back to the 1950s. Starting from a clear focus on the development of the transportation and energy infrastructure, the policies became more and more sophisticated with an emphasis on high-technology industries and supporting entrepreneurial activities. This, however, supported the growth of industry clusters and entrepreneurial networks, including access to capital. A strong regional innovation system can be seen as the foundation of Bavaria's economic success.

Exhibit 3: Strengths and weaknesses of the regional innovation system

	Strengths	Weaknesses
Knowledge creation capacity	A total of 55 higher education institutes, of which 16 are universities, two of them in the German Initiative for Excellence programme, receiving additional funding from BMBF	Concentration in and around Munich and Nuremberg, not evenly spread across Bavaria
Knowledge diffusion capacity	Highly differentiated technology transfer network, support from national level, three large initiatives on a Bavarian level, counselling from a lot of institutions like branch associations, but also with a local and regional focus, i.e. Bayern Innovativ	
Knowledge absorption capacity	Share of human resources in science and technology is above German average, compared to the EU-15 level Bavaria performs very well; high capacity of the labour force to absorb new knowledge	Propensity to participate in life-long learning is slightly lower than in other parts of Germany or Europe
Interactions of main actors	Strong commitment of regional firms and local actors to participate in local and regional initiatives	
RTD governance capacity	Long tradition and experience of RTDI policy in Bavaria (more than 50 years), Bavarian High-Tech Offensive	
Knowledge vs. economic specialisation	High-tech initiatives, high-tech clusters match the workforce with many employees in the high-tech sector and knowledge intensive service sector	Though Bavaria is very good in the specialisation of R&D and in knowledge production, it is hard for Bavaria to keep up with the tremendous need of the Bavarian economy for specialised and highly qualified personnel. The <i>Technische Universität München</i> has a distinct focus on technical disciplines, as well as other Bavarian Higher Education Institutes, however there is still a need for more highly qualified workers, especially in high-technology sectors.
Economic Structure	Several distinct clusters in high-tech industries, access to capital, programmes to support start-ups, business-plan-initiatives to provide entrepreneurs from different disciplines with sound economic knowledge	

The regional innovation system supports regional industry efficiently, with a high –and growing– level of consistency between different regional actors. New policies support networking and cooperation in those fields in which Bavaria has considerable advantages and with potential for the industrial structure and future needs.

4.2 Assessment of policies

Innovation has been fostered by means of various Bavarian RTDI policies over the last 50 years, starting from a systematic development of the transport and energy infrastructure, extending to the promotion of high-tech industries and finally, specialised programmes which were designed to strengthen various sub-sectors and entrepreneurial activities and R&D in general. Bavaria had always the desire to keep its autonomy and limit interference by national government on its internal affairs. A solid economic and knowledge base increases its degree of freedom. Therefore, the Bavarian government has designed its own policy measures to meet these needs. For example, Bavaria is the only state among the German *Bundesländer* with its own concept of identifying and funding elite universities. In terms of participation in the innovation process Bavaria has managed to involve firms through its cluster initiative, but also manages to support innovative entrepreneurs through policy programmes, provision of VC (e.g. *BayBG*, which operates regionally) as well as running round table initiatives when difficulties with regard to financing occur.

Bavarian RTDI policy focuses on the (traditional) manufacturing sector as well as on high-technology and knowledge-intensive service sectors. The Bavarian government clearly tries to intervene in the techno-economic development process by implementing different support measures. The impact of these measures or the effectiveness of the whole regional innovations system is strongly connected to the enormous amount of financial input. In the context of the "Future Offensive Bavaria" (which has been implemented in 1994) and the "Bavarian High-Tech Offensive" (implemented in 2000), approximately €4.25 billion have been allocated.

The Bavarian High-Tech Strategy was primarily developed against the backdrop of the regional technology profile, which can be characterised by strengths in the fields of ICTs, Biotechnology, Genomics and Medical Technology, Energy and Environment Technology, and Aerospace Technology. These strengths were identified in the 1990s and have been supported since then. Thus, a policy focusing on "strengthening the strengths" has been implemented. At the same time, support measures have been designed to combine new technological developments with the traditional (manufacturing) sectors in the region. The cluster-approach, initiatives to set incentives for network building processes and also the build-up of knowledge- and technology transfer structures are the key policy measures which have been implemented more recently. It is not possible to give a definitive answer as to whether all the weaknesses have been addressed by Bavarian RTDI policy. The focus is explicitly on the exploitation of regional technological strengths, which means that not every technology field is considered. One of the major weaknesses of the Bavarian innovation system – compared to other countries and regions - is the low entrepreneurial dynamic. This "traditional" weakness – which also applies to the whole of Germany - has been effectively addressed by various programmes – launched by both the federal government and the Bavarian government.

Exhibit 4: Public Policy vs. Strengths and Weaknesses of RIS

	Effective approaches	Failures
Strengths		
<i>Extremely dense and diversified landscape of well financed universities and non-university research centres</i>	Building up of the technology and research infrastructure in the 1950s/1960s. Positive preconditions for economic and technological development in that period. Priority of the policy agenda for a long time.	
<i>Highly differentiated technology transfer network – focusing on high-technology sectors as well as "traditional" branches</i>	Bayern Innovativ as the key player in technology transfer activities. Funding of a Bavaria-wide network. Importance of informal networks and spatial proximity.	
<i>Human resources in science and technology above German average</i>	Education policy as one of the policy priorities of the ruling party. Concept of top-notch higher education (Elite network Bavaria). Identification and financial support of talented people in the science sector.	
<i>Interactions of main actors quite strong - especially between the science and business sector</i>	Cluster policy as an effective approach to link the major actors. Supported also within the context of fostering technology transfer activities. At the same time public support for internationalisation activities. Danger of "over-embeddedness" of the key actors is quite low.	
<i>Long experience of RTDI policy in Bavaria – one of the first German regions with its own RTDI policy</i>	High degree of autonomy of Bavaria as regards RTDI policy in combination with the implementation of well financed technology and start-up programmes. Good mixture of support measures focusing on new and mature technologies.	
<i>High-end technologies as well as mature technologies in research institutes and business sector</i>	Matching of public support for technological modernisation and innovation activities with market-driven RTDI activities. Good complementarities.	
<i>Diverse economic structure – well functioning public support measures</i>	Diverse set of incentives or support schemes for the business sector. Good mixture of traditional and new support measures (funding of R&D on the firm-level	

	vs. infrastructure or cluster measures).	
Weaknesses		
<i>Spatial concentration of RTDI activities in a few locations</i>		Technological concentration and concentration of human resources intrinsic to the cluster concept and indicator for a powerful regional innovation system.
<i>Participation in life-long learning measures below German average</i>		No adequate public offer to enhance life-long learning.
<i>Need for specialised and highly qualified people; cultural obstacles for foreign students and qualified people</i>		Although several initiatives to attract foreign talent – both as students as well as for the business sector - have been launched by the Bavarian government, Bavaria can not compete with other regional innovations systems (e.g. like the US, UK and The Netherlands).

No potential conflicts between policy objectives and instruments were identified. The mixture of the different support measures appears to be extremely coherent. Redundancies between them seem to be the exception – at least on the regional (i.e. Bavarian) level. In contrast, policy coordination between the national and regional level clearly needs to be improved. Given the fact, that the financial input which the Bavarian government allocated for its RTDI policy is considerable, redundancies between national and regional programmes or support measures cannot totally be avoided. In an assessment of the policy fields that address other socio-economic challenges it has to be considered that the Bavarian government is not totally autonomous. It acts on the same level as other *Landesregierungen* and is embedded in the federal system of Germany and therefore sovereignty is restricted in certain fields. Thus, both traditional labour market policy and social policy measures are implemented at the national level rather than at the level of the *Bundesländer*. Bavarian RTDI policy contains no firm labour market objectives, these are nevertheless addressed implicitly (currently, the unemployment rate in Bavaria is far below the national average).

4.3 Policy challenges

Bavaria is one of the few regions which have been able so far to achieve the targets set in the Lisbon objectives. Nevertheless, challenges remain, especially to maintain its excellence in those fields where Bavaria has considerable strengths. Given that Bavaria's RTDI policy objectives are rather general, the question is which policies have the most significant positive impact. The Bavarian government combines the regulation of industrial development with a large element of free market activities. Thus, policy implementation takes place within the context of privatisation and liberalisation measures. Over the last 5-10 years, the implementation of Bavarian RTDI policy has been transferred to various private companies like "Bayern Innovativ", "Bayern BG", "Bayern Kapital" and other organisations operating outside the administration. Although RTDI policy addresses several technology fields, the extensive funding of Biotechnology seems to stand out. The support measures in this particular technology field (R&D funding in the business sector, build-up of research centres and technology parks, support for entrepreneurial activities) clearly had a positive impact on the Bavarian biotechnology sector. In addition, the Bavarian Technology Support Programme (BayTP), which was implemented in the early 1980s, is

also considered to be quite successful. Over the years, the administrative elements of the programme have been improved and the budget increased (BayTP has been selected as one of the most successful single RTDI policy measure and thus, is described more precisely in annex 4).

In terms of its strengths and weaknesses, the Bavarian RTDI policy can be summarised as follows. Within the "High-Tech Offensive Bavaria" and the "Future Offensive Bavaria", an enormous financial budget has been allocated for the further development of the technological infrastructure and the exploitation of technological potential. RTDI policy reveals a high degree of continuity, building upon existing technological or innovative potentials, and is supply oriented and addresses innovative enterprises. Proportional to the science and business enterprise sector, technology transfer and application of research activities for new and high-value added activities are major priorities.

On the other hand, some weaknesses and near future challenges can be identified. The RTDI policy with its instruments shows some inconsistencies, quite a few redundancies can be observed. Some of the instruments cannot be assigned to clearly defined objectives. The technology transfer supply has to be better matched with the concrete needs of SMEs operating in medium technology segments. In addition, Bavarian RTDI policy appears to have a surfeit of actors at the regional and sub-regional level together with an excess of intermediary institutions, and it is characterised by a heterogeneous set of actors (e.g. chambers of commerce, public funded consultant agencies etc.). Another challenge is to overcome the dominance of scientific institutions and large enterprises as key recipients of the Bavarian RTDI policy, besides supporting start-ups, SMEs are not adequately addressed by RTDI policy.

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Annex 1: Definition of policy mix typology

- **Improving R&D governance capacity:** Technical assistance type funding used by public authorities, regional agencies and public-private partnerships in developing and improving policies and strategies to support R&D investments. This could include changes in the organisation of decision making, national and regional foresight, measures for improvement of evaluation, etc.
- **Creation of an innovation friendly environment:** This category covers a wide range of actions which seek to improve the overall environment in which enterprises, universities and research organisations innovate. This category includes the following measures:
 - Regulation and initiatives addressing intellectual property rights either by improving legislation in cases of commercialisation of public or collaborative research or by covering protection costs
 - Direct or indirect support for spin-offs and New Technology Based Firms (NTBFs). Direct support includes public financial schemes such as pre-seed and initial stage capital, while indirect measures include funding of incubators, training related to entrepreneurship, etc.
- **Development of human capital:** This category includes measures aiming at upgrading human resources in R&D and innovation-related activities, such as supporting science and technology graduates to follow research and innovation-oriented careers; training of researchers in enterprises or research centres; intra- and international mobility of scientists; curriculum development in higher education aimed at developing science and technology; orientated under- and post-graduate courses, etc.
- **Networking, co-location and clustering measures:** Policies under this category focus on promoting R&D cooperation, networking and interaction. Measures promoting co-location of industrial and scientific organisations (e.g. innovation poles), funding for cluster infrastructure and activities with technological and R&D orientation are some of the possible interventions under this category.
- **Knowledge and technology transfer to industry:** This category includes policies directly or indirectly supporting knowledge and technology transfer from universities and public research organisations and the commercialisation of public research results. Direct support includes aid schemes to encourage the use of technology-related services or to support technology transfer projects from the public or private sector to the private sector. Indirect policies include development of infrastructures facilitating technology transfer such as technology parks, innovation centres, university liaison and transfer offices, etc.
- **Research collaboration of public research organisations with the private sector:** Measures supporting collaborative research projects and development of common (for use by the private and public sector) research infrastructures are included.
- **Support for public research:** Measures under this category include:
 - Public investments in research infrastructure and direct funding of public R&D e.g. setting up new facilities, or supporting centres of excellence

- Grants for R&D projects implemented in Universities and other Public Research Organisations
- Regulatory changes and incentives for universities and other public research organisations which encourage the commercialisation of research results and collaboration with industry
- **Financial R&D measures for the private sector:** Two main categories of measures are included:
 - **Direct and indirect financial R&D measures for the private sector:** Direct measures include direct public funding of R&D in the private sector e.g. grants, conditional loans etc. Indirect measures include tax incentives for firms to undertake R&D activities.
 - **Catalytic Financial R&D Measures for the private sector:** Includes instruments facilitating the access of R&D performers to external private sector sources of finance. Typical measures of this type are measures encouraging the use of *risk capital* (e.g. venture capital funds) for both R&D and innovation related activities and the *loan and equity guarantee measures*.

Annex 2: Description of key indicators used in Graphs 1 and 2

Period of coverage: Two years are used i.e., 1995 and 2004 or the closest possible years

Index: Country=100

Source: Eurostat, 2006

Graph 1: Key indicators of region's knowledge base development in comparison to country

1. Total intramural R&D expenditure as a percentage of GDP
 - GERD
 - BERD
 - GOVERD
 - HERD
 - PNPERD
2. R&D personnel as a percentage of total employment
 - All sectors
 - Business
 - Government
 - Higher education
 - Private non-profit
3. Human Resources in S&T as a percentage of labour force
4. Patent applications at EPO per million inhabitants
5. Students in tertiary education (ISCED 5+6) per thousand inhabitants.
6. Life Long Learning: Participation of adults aged 25-64 in education and training as a percentage of population

Graph 2: Key indicators on Region's economic structure and development

1. GDP per capita at current market prices.
2. Long-term unemployment rate (on total unemployment).
3. Unemployment rate (%).
4. Value-added at basic prices (€ million): Share (%) of sectors to total.
 - Agriculture/ fishing
 - Mining and quarrying
 - Manufacturing
 - Electricity, gas and water supply
 - Construction
 - Services (excl. extra-territorial organisations and bodies)
5. Annual data on employment in technology and knowledge-intensive sectors at the regional level : Percentage of total employment
 - High technology manufacturing: NACE Rev. 1.1 codes 30, 32 and 33
 - Medium high technology manufacturing: NACE Rev. 1.1 codes 24, 29, 31, 34 and 35
 - Medium low technology: NACE Rev. 1.1 codes 23 and 25 to 28
 - Low-technology: NACE Rev. 1.1 codes 15 to 22 and 36 to 37
 - Total knowledge-intensive services: NACE Rev. 1.1 codes 61, 62, 64 to 67, 70 to 74, 80, 85 and 92
 - Knowledge-intensive high-technology services: NACE Rev. 1.1 codes 64, 72, 73
 - Total less-knowledge-intensive services: NACE Rev. 1.1 codes 50, 51, 52, 55, 60, 63, 75, 90, 91, 93, 95 and 99

Annex 3: Tables and Figures

Table 1: Research institutes in Bavaria

	MPS	FhG	HGF	WGL	federal institutes	regional institutes	total
Bayern	6	7	2	4	3	17	39
including branch offices							
Bayern	8	10	4	4	8	17	51

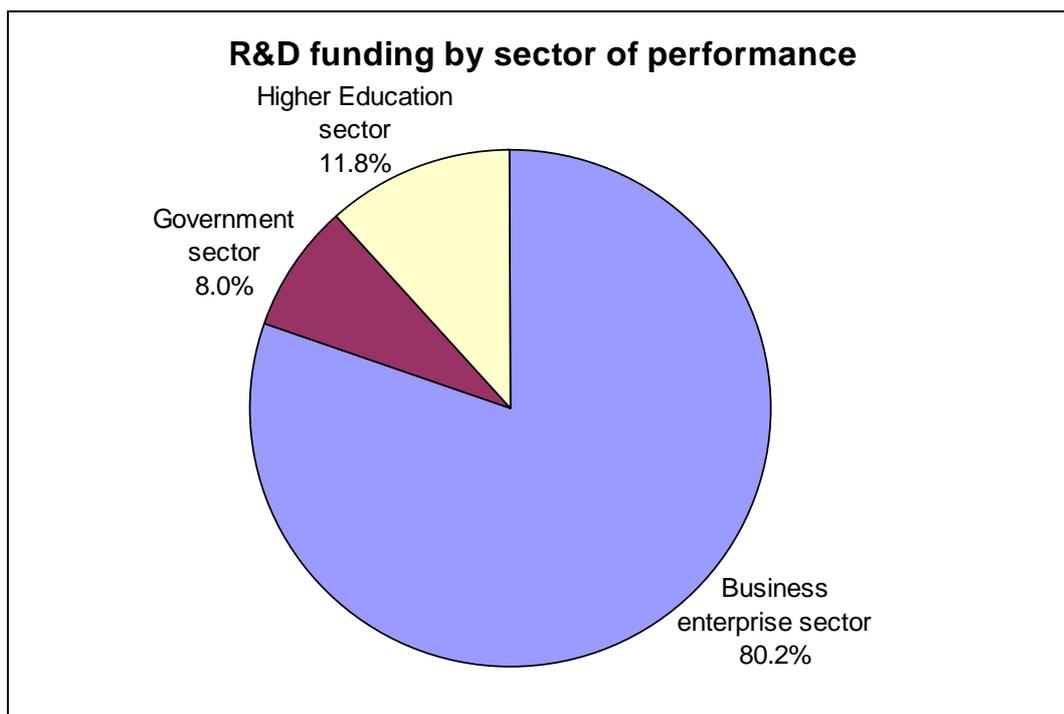
Source: own calculations

Table 2: BERD development

year	1995	1997	1999	2001	2003
BERD (mio eu-ro)	6639.322	6488.68	7566	8682	9090.194
BERD Percentage of GDP	2.08	2.04	2.2	2.35	2.36

Source: Eurostat

Figure 2: R&D funding in Bavaria in 2003



Source: Eurostat and own calculations

Table 3: List of Higher Education Institutes

Universities	
1	Universität Augsburg
2	Otto-Friedrich-Universität Bamberg
3	Universität Bayreuth
4	Katholische Universität Eichstätt-Ingolstadt
5	Friedrich-Alexander-Universität Erlangen-Nürnberg
6	Ludwig-Maximilians-Universität München
7	Technische Universität München
8	Universität der Bundeswehr München
9	Hochschule für Politik München
10	Universität Passau
11	Universität Regensburg
12	Bayerische Julius-Maximilians-Universität Würzburg
13	Philosophisch-theologische Hochschulen
14	Philosophisch-Theologische Hochschule der Salesianer Don Boscos Benediktbeuern
15	Hochschule für Philosophie München
16	Augustana-Hochschule in Neuendettelsau
Art Academies	
1	Akademie der Bildenden Künste München
2	Hochschule für Fernsehen und Film München
3	Hochschule für Musik und Theater München
4	Akademie der Bildenden Künste Nürnberg
5	Hochschule für Musik Nürnberg-Augsburg
6	Hochschule für Musik Würzburg
7	Hochschule und Institut für evangelische Kirchenmusik Bayreuth
8	Hochschule für katholische Kirchenmusik und Musikpädagogik Regensburg
Universities of Applied Sciences	
1	Fachhochschule Amberg-Weiden
2	Fachhochschule Ansbach
3	Fachhochschule Aschaffenburg
4	Fachhochschule Augsburg
5	Fachhochschule Coburg
6	Fachhochschule Deggendorf
7	Fachhochschule Hof
8	Fachhochschule Ingolstadt
9	Fachhochschule Kempten
10	Fachhochschule Landshut
11	Fachhochschule München
12	Fachhochschule Neu-Ulm
13	Georg-Simon-Ohm-Fachhochschule Nürnberg
14	Fachhochschule Regensburg
15	Fachhochschule Rosenheim
16	Fachhochschule Weihenstephan
17	Fachhochschule Würzburg-Schweinfurt
18	Fachhochschule Schloss Hohenfels – Staatlich anerkannte private Hochschule für Fachtherapien im Gesundheitswesen
19	Fachhochschule für angewandtes Management in Erding (staatlich anerkannte private Hochschule)
20	Munich Business School (staatlich anerkannte private Hochschule) Private Fachhochschule Döpfer – Fachbereich Physiotherapie und Ergotherapie in
21	Schwandorf
22	Evangelische Fachhochschule Nürnberg
23	Katholische Stiftungsfachhochschule München

Universities of Applied Sciences for Administration	
1	Fachhochschule für öffentliche Verwaltung und Rechtspflege in Bayern:
2	Fachbereich Polizei in Fürstenfeldbruck
3	Fachbereich Finanzwesen in Herrsching
4	Fachbereich Allgemeine Innere Verwaltung in Hof
5	Fachbereich Archiv- und Bibliothekswesen in München
6	Fachbereich Rechtspflege in Starnberg
7	Fachbereich Sozialverwaltung in Wasserburg a.Inn
8	Zentralverwaltung in München

Source: own research

Figure 3: Number of local units in Bavaria

Industry (WZ 2003)	N: enterprise-size classes (enterprises with employees)								total	
	0-5	6-9	10-19	20-49	50-99	100-199	200-499	500 and more	n	clear sample (abs.)** (%)
Agriculture, forestry, fishery (01-05)	7966	677	464	173	38	5 *	*		9325	37 (3)
Mining, energy, water (10-14, 40-41)	827	178	264	206	84	40	22	8	1633	34 (3)
Manufacturing business (15-37)	21414	5246	4865	3751	1623	1033	694	337	38984	300 (24)
Construction business (45)	22000	4714	3670	1634	383	140	54	11	32606	89 (7)
Trade (50-52)	48410	8901	6863	3931	1224	469	208	55	70061	161 (13)
Traffic and telecommunication (60-64)	10355	2033	1839	1125	373	171	89	26	16018	41 (3)
Credit business and insurance industry (65-67)	7370	984	786	547	253	164	105	47	10259	52 (4)
Service companies working for companies (70-74)	39542	5012	4204	2426	897	423	217	58	52779	149 (12)
Public administration, defence, social insurance (75)	1873	899	1216	1164	477	213	156	45	6043	81 (7)
Upbringing, education (80)	5412	1955	1721	651	193	74	25	13	10044	39 (3)
Health, welfare (85)	22742	5039	2318	1336	940	412	210	92	33089	122 (10)
Non-Profit-Organisations, other services (55, 90-99)	42919	4426	2942	1562	443	160	75	39	52566	21 (2) 102 (8)
No classification possible	280	2	2	4	1				289	
Bavaria total	231110	40066	31154	18510	6929	3304	1883	740	333696	1228 (100)
Northern Bavaria	91172	17118	13251	7887	3017	1424	804	310	134983	544 (44)
Southern Bavaria	139938	22948	17903	10623	3912	1880	1079	430	198713	684 (56)
Panel clear sample (abs.)**	194 (16)	174 (14)	159 (13)	182 (15)	125 (10)	106 (9)	128 (10)	160 (13)		1228

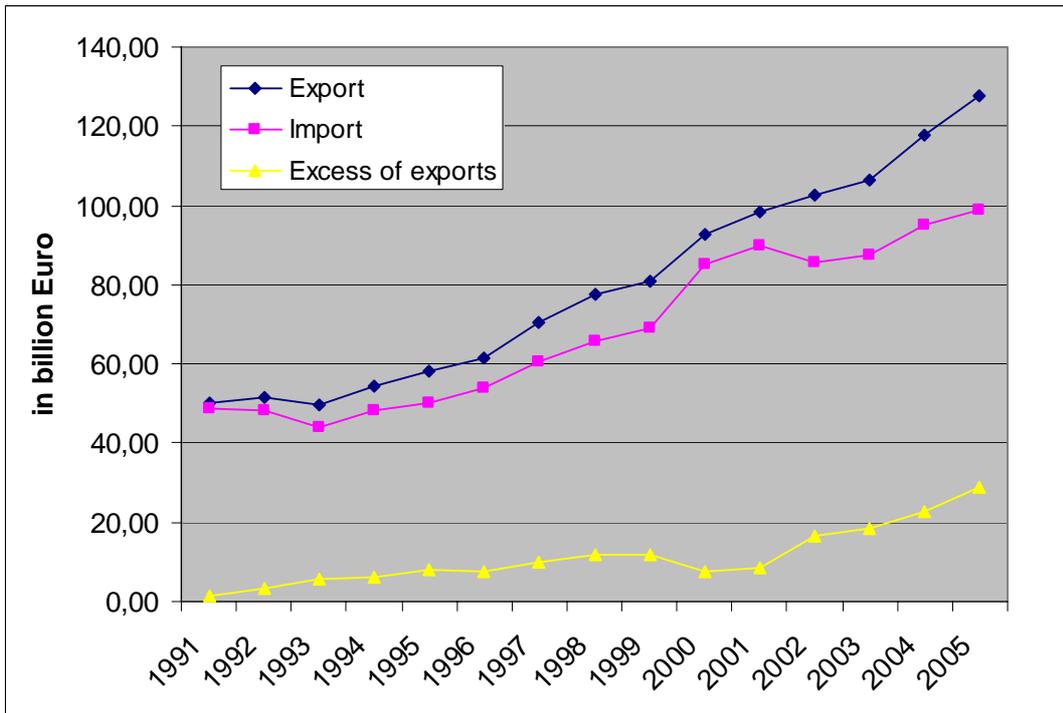
* Numbers <3 and correspondent cells are not filled out because of data protection

** Number of usable interviews for the categories which are given in the respective cells, in brackets the respective percentage allocation

Source N: Bundesagentur für Arbeit 2006

Source: INIFES 2006, p. 5.

Figure 4: Exports and Imports of Bavaria



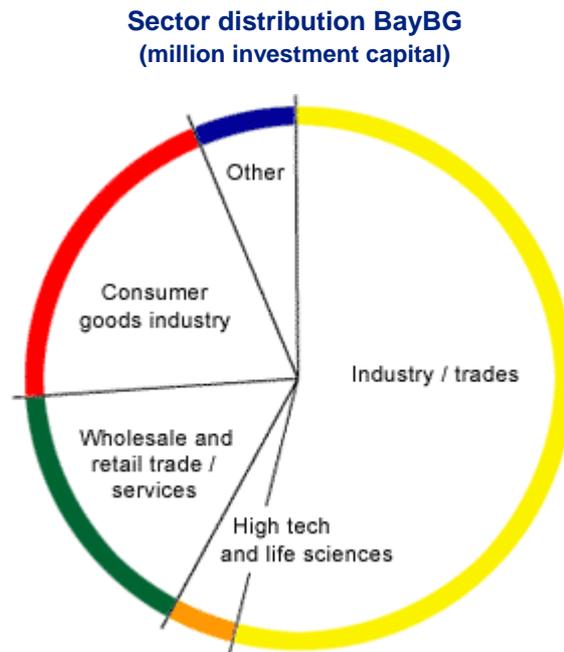
Source: Bavaria's Foreign Trade 2005, p.3

Figure 5: Bavaria's exports by groups of goods

Groups of Goods	2004 in mill.	2005 in mill.	(+ to 2004 in %
	Euro	Euro	
Food industry	4822	5300	+ 9,9
Raw materials	647	664	+ 2,6
Semi-finished goods	3903	4594	+ 17,7
Textiles, clothing	2305	2264	- 1,8
Chemicals and pharmaceutical products, plastics	9022	9670	+ 7,2
Iron and metal goods	4219	4570	+ 8,3
Machines	21185	22576	+ 6,6
Electrical products	13416	14519	+ 8,2
Vehicles	36136	41281	+ 14,2
Precision engineering products	3452	3653	+ 5,8
Paper, paper- and printing-products	2652	3033	+ 14,4
Other	16276	15682	- 3,6
Sum total	118035	127806	+ 8,3

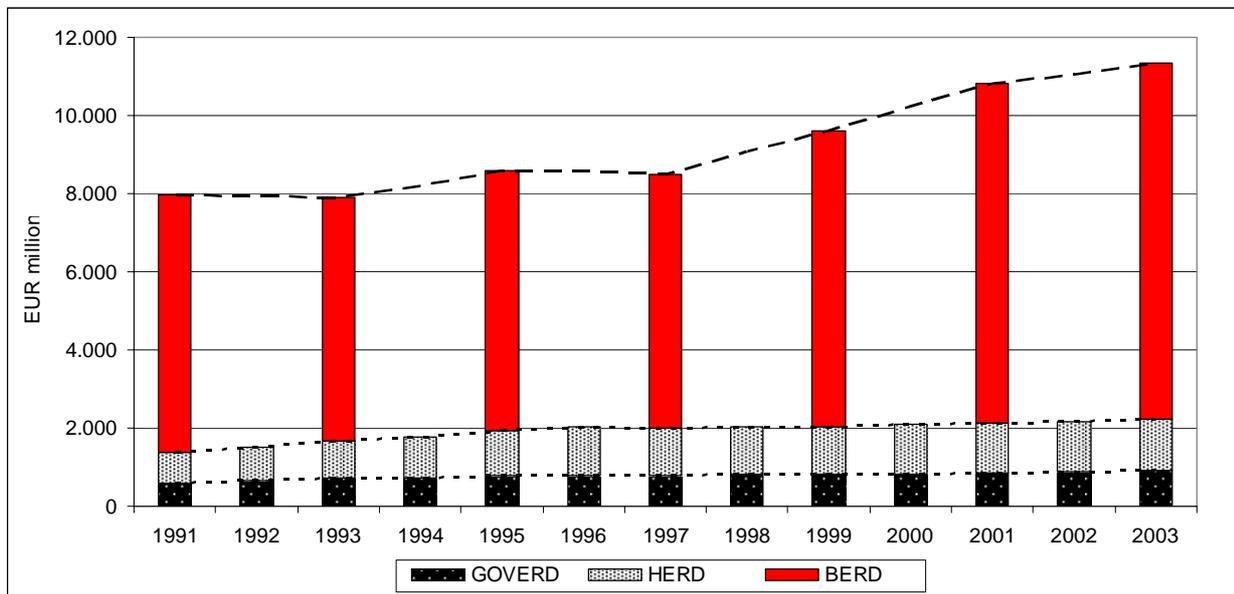
Source: Bavaria's Foreign Trade

Figure 6: Sector investments of BayBG²⁷



Source: Geschäftsbericht BayBG

Figure 7: Development of GOVERD/HERD and BERD in Bavaria 1991-2003



Source: Eurostat, own diagram

Additional information is displayed in the text. Online sources are quoted at the bottom of each page.

Annex 4: RTD policies

National Level Policies:

²⁷ <http://www.baybg.de/>

Title of the measure or initiative: "BioRegio Munich" (BMBF Programme BioRegio)
<p>Objectives: The major objective of the BioRegio Contest (which started in 1997) was to stimulate firm foundations and the location of foreign biotechnology companies in Germany, to accelerate growth in existing biotechnology companies and to ensure the supply of sufficient seed and venture capital to improve the competitive situation of Germany in biotechnology.</p>
<p>Policy Area: Networking, co-location and clustering measure</p>
<p>Main instruments and structure: BioRegio can be described as a policy-led attempt to initiate sub-national innovation systems in the field of Biotechnology. In a competition procedure three regions with appropriate research potential were selected: Munich, the Rhine-Neckar Triangle (Heidelberg, Ludwigshafen, Mannheim) and the Rhineland Region (Cologne, Aachen, Wuppertal, Düsseldorf). Over a five-year period from 1997 until 2001 each of these model regions, which were selected from 17 applicants, and "Jena", which received a special award, received privileged access to special project funding from the Federal Ministry of Education and Research (BMBF) totalling € 90 million. These "starting funds" enabled the regions to attract considerably higher private and public funding. The regions and the advantage of spatial (and organizational) proximity between industry, research and venture capitalists were made the starting point for network generation in and between the regions and international biotechnology research, testing and production.</p>
<p>Main beneficiaries /target group: Researcher from industry and academia, young biotech companies, biotech start-ups.</p>
<p>Achievements or failures: Due to the BioRegio Contest and its leverage, the BioRegio Munich is the top Biotech region in Germany – in terms of employees (the Berlin region has more Biotech companies but less employees). Since BioRegio, the Munich region could attract considerable Biotech related investments from abroad as well as from other parts for Germany. One of the reasons for selecting Munich as "winner region" were the favourable pre-conditions for the commercialisation of biotechnology in this region: the concentration of high-class research institutions – both in the public as well as private sector is <i>the</i> location factor No.1. Complementary to the BioRegio-funding, the Bavarian government also supported the Biotech sector extensively.</p>

Regional Level Policies:

Title of the measure or initiative: "Bavarian Technology Support Programme" (Bay TP)
Objectives: On the regional level, financial R&D support for the private sector is conducted within the Bavarian Technology Support Program (BayTP). BayTP supports innovative and technological risky development projects until the completion of a prototype. BayTP is <i>the</i> central measure of the Bavarian government for the commercial sector. BayTP pursues the following objectives: <ul style="list-style-type: none">- support of the development of technological new products and services,- facilitate the application of modern technologies in products and production.
Policy Area: Financial R&D measures for the private sector
Main instruments and structure: Bay TP consists of two sub-programmes: "Development Projects" are projects aiming at new products or processes (e.g. pre-prototypes, prototypes). "Applied Projects" are projects aiming at the adoption of new technologies which were not developed by the respective company. Support is carried out in the form of project funding. "Development Projects" are awarded with grants and loans, "Applied Projects" are awarded with loans. Depending on the size of the company and the proposed project, 15-25% of the total costs can be funded. The local banks, innovation advisory agencies and district governments are responsible for the application procedure. Bavaria's development bank (LfA) is in charge of the operational audit of the proposal and decides about the allocation of loans. The decision about the allocation of grants is with the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology.
Main beneficiaries /target group: Medium-sized enterprises of the commercial sector with less than 400 employees located in Bavaria (sub-programme 1: "Development Projects"); SMEs (sub-programme 2: "Applied Projects")
Achievements or failures: Since the implementation of the program in 1980, approximately 400 projects were supported with grants amounting to 68 million €. In addition, 400 projects were supported with soft loans amounting to 170 million € (BMWVT 2003: 12). From 2000-2004, the awarded grants amounted to 35,3 million €, the awarded loans amounted to 53,7 million €. The total costs of the project applied for funding amounted to 178,4 million € (Mittelstandsbericht 2005). With the Bavarian Technology Support Programme, the Bavarian government was among the first German regions (or <i>Bundesland</i>) which implemented its own technology support instrument. Over the years, the administrative elements of the programme have been improved and the budget increased. Apart from the technical aspects of the programme administration, one of the "success factors" of this particular measure is certainly the high "absorptive capacity" of the Bavarian firms – in terms of technology development and innovation.