

RIP-WATCH

ANALYSIS OF THE REGIONAL DIMENSIONS OF INVESTMENT IN RESEARCH

CASE STUDY REGIONAL REPORT: VÄSTSVERIGE (SWEDEN)

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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). A stated aim 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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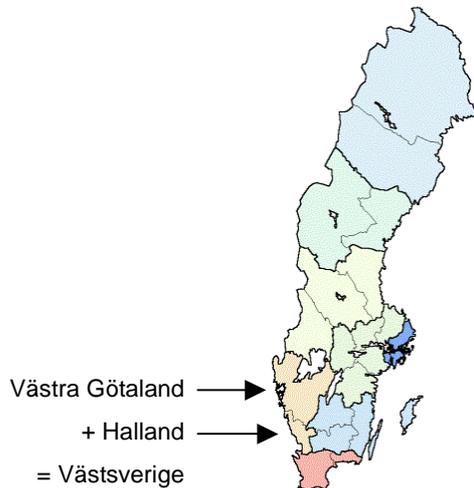
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Abbreviations

BERD	Expenditure on R&D in the business enterprise sector
EPO	European Patent Office
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Expenditure on R&D
GRP	Gross Regional Product
HEI	Higher Education Institution
HERD	Expenditure on R&D in the Higher Education sector
ISIC	International Standard Industrial Classification
NACE	Nomenclature générale des Activités économiques dans les Communautés Européenes
NIS	National Innovation System
PNP	Private Non Profit
PPP	Public Private Partnership
RIS	Regional Innovation System
SII	Summary Innovation Index

1 Introduction

Västsvrige (West Sweden) is located on Sweden's west coast and faces the North Sea (see figure). It borders on Norway to the north and, by sea, onto Denmark to the west and south. Thanks to its location, Västsvrige has a heritage of trade by both sea and land.



Västsvrige is a region of great contrasts. Its obvious centre is the cosmopolitan and industrialised city of Göteborg (Gothenburg), Sweden's second city; at the opposite extreme are vast and remote forests and open expanses of farmland, both of which are sparsely populated. Västsvrige's total area is 28 727 km² and its population – slowly rising – is 1,814,323 (December 31, 2005, Statistics Sweden), meaning that 20% of Sweden's population lives on 6.4% of the land. The majority of the population lives along the coast and about a third in the greater Göteborg region.

With 20% of the nation's workforce (head count: 872 000; 2003, Statistics Sweden), Västsvrige accounts for 19% of Sweden's GDP (€52 billion; 2003, Statistics Sweden), which translates into 134% of the EU25's average per capita GDP (2003), a figure that essentially has remained constant over the last decade (Eurostat). Although Västsvrige's Gross Regional Product (GRP) grew by 64% over the ten-year period from 1993-2003, the growth rate is declining (Statistics Sweden). The dominant components of GRP are manufacturing (20%: NACE D), real estate, renting and business activities (17%: NACE K), wholesale and retail trade (10%: NACE G) and health and social work (9%: NACE N) (Statistics Sweden). R&D expenditure (€3.1 billion) is 29% of the national figure and regional BERD (€2.7 billion) is 35% of national BERD, while regional HERD accounts for 17% of national HERD (2003, Eurostat). The high relative R&D expenditure of the region and the very high relative R&D expenditure by industry illustrates that, in essence, Västsvrige is the nation's industrial heartland. In contrast, despite large areas of forests and farmland, as well as a long coastline, agriculture, hunting, forestry and fishing (NACE A-B) account for a mere 1% of GRP. Although rising from a 4.3% low-point in 2001, unemployment is, at 6.8%, below national (7.5%) and EU25 (9%) levels (2005, Eurostat).

Västsvrige is one of eight NUTS 2 regions in Sweden and is composed of the two NUTS 3 regions Västra Götalands län and Hallands län. These two regions are somewhat uneasy bedfellows, given the differences between them. With an area of 23,941 km² and a population of 1 528 455, Västra Götaland dwarfs Halland, which has an area of 4,786 km² and a population of 285 868 (December 31, 2005, Statistics Sweden), while Halland's GRP is a mere 16% of Västra Götaland's (2004, Statistics Sweden). Moreover, the two NUTS 3 regions have separate governance systems, their own policies, and their inhabitants rarely identify themselves with the region of Västsvrige. In fact, politicians of all colours in Halland appear to agree that they would rather not be lumped together with Västra Götaland (nor with Skåne to the south, which has also been suggested). Thus, in reality Västsvrige is more of a statistical artefact than a functional region.

2 Regional knowledge base

2.1 Description of the regional knowledge base

In general, the level of education in Sweden is high and this is true also for Västsverige. However, as in many other parts of the country there are large differences within the region with a clustering of the knowledge base around the larger cities. In Västsverige there are six HEIs, two of which have university status, while the remaining four are university colleges, meaning that they cannot grant doctorates. The two universities are located in Göteborg, while the university colleges are located in Halmstad (capital of the NUTS 3 region Halland) and in the smaller cities of Borås, Skövde and Trollhättan. There are five research institutes in Västsverige, including both public and private non-profit (PNP) research institutes; with one exception they are located in greater Göteborg. Västsverige also hosts branch offices of research institutes headquartered elsewhere in Sweden. A clear strength of Västsverige's knowledge infrastructure is its combination of broad competence and international excellence in a number of research areas¹.

2.1.1 Knowledge creation capacity

2.1.1.1 Knowledge infrastructure

In 2005, Västsverige had 74,000 students representing 19% of the entire student population in Sweden. The number of students has increased gradually from 29,000 in 1977 (Statistics Sweden), apart from a few years when the increase was more notable, either due to recession (e.g. in the early 1990s, which made it especially hard for young people and immigrants to find a job), demographic changes, with an expanding cohort of young people at the beginning of the century, and finally with an expansion of the higher education sector at the beginning of the century (the government set the goal that 50% of students finishing upper secondary school should start higher education within five years). The region's share of graduate students has been more or less constant at 17% over the period 1999–2004 (Eurostat). In 2005 the six HEIs had a teaching and research staff of 4 200, corresponding to 19% of the national figure.

The region's largest HEI is Göteborg University with approximately 35,500 students and a teaching and research staff of 2,300 (2005, Statistics Sweden). The number of students has gradually increased from 22,500 in 1977. The university has nine faculties covering the areas of health, science, arts, fine and applied arts, social science, business, economics, law, education, and IT.

The Chalmers University of Technology, with 10,000 students and a teaching and research staff of 760 in 2005, is also located in Göteborg. The number of students has grown from 5,500 students at the end of the 1970s and it is now Sweden's third largest engineering university. The university offers a wide range of degrees in science and engineering, including applied mechanics, applied physics, architecture, chemical and biological engineering, civil and environmental engineering, computer science and engineering, energy and environment, fundamental physics, materials and manufacturing technology, mathematical sciences, micro-technology and nano-science, product and production development, and space science, shipping and marine technology, signals and systems, and technology management and economics. The university is an independent foundation and is one of three universities in Sweden that is not state-owned.

Among the region's university colleges, University College of Borås (located in Borås) is the largest with 8,500 students and a research and teaching staff of 340 (2005, Statistics Sweden). The university college offers degrees within the following schools: Swedish School of Library

¹ Regional konkurrenskraft och sysselsättning, operationellt program Västsverige, 2007-2013, Västra Götalandsregionen och region Halland, 2006.

and Information Studies, School of Business and Informatics, School of Engineering, School of Education and Behavioural Sciences, School of Textiles and School of Health Sciences. Second largest is Halmstad University² with 7,800 students and a research and teaching staff of 260 (2005, Statistics Sweden). The university college has four schools: School of Business and Engineering, School of Information Science, Computer and Electrical Engineering, School of Social and Health Sciences and the Department of Teacher Education. University West³ is currently located in Trollhättan and Uddevalla, but plans to concentrate its activities in Trollhättan in 2007/2008. It is the second smallest of the university colleges with 6,200 students and 260 researchers and teachers (2005, Statistics Sweden). The university college is divided into four departments: Department for Economics and Informatics, Department of Social and Behavioural Studies, Department of Technology, Mathematics and Computer Science and Department of Nursing, Health and Culture. The University of Skövde⁴ is the smallest HEI in Västsverige with 5 800 students and a research and teaching staff of 230 (2005, Statistics Sweden). The university college's aim is to develop two research profiles within ICTs and bioscience. Operations are organised within three schools: the School of Humanities and Informatics, the School of Technology and Society and the School of Life Sciences.

While the region's two universities can trace their ancestry back to the 19th century, the four university colleges are much more recent additions stemming from the political goal that everyone should have the possibility to pursue tertiary education. Thus, the university colleges in Borås, Halmstad and Skövde were founded in 1977 in the context of a wider university reform that increased the number of HEIs in Sweden by replacing and upgrading parts of secondary schools and training activities to university colleges, while University West was founded in 1990. The expansion of the HEI sector was at the time seen as a strategic means of achieving the goals of the government's regional policy⁵.

In the post-war period, Swedish policy for research institutes was well structured and viewed positively. It resulted in the foundation of SIK (Swedish Institute for Food and Biotechnology) and TEFO (Institute for Textile Research) near Chalmers University of Technology in 1942–1945 and of IVF (Institute for Industrial Research) in 1964⁶. In total, Västsverige now hosts five research institutes, two of which are public and three are private non-profit organisations. The Borås-based public research institute, SP (Technical Research Institute of Sweden), of which SIK is a part, reports to the Ministry of Enterprise, Energy and Communications. SP is Sweden's largest research institute with a turnover of more than €80 million and a staff of about 850, more than half of whom are engineers or scientists and of whom 90 have a scientific degree. The institute's activities cover a broad range of scientific areas such as measurement technology, energy, construction and buildings, electronics and ICTs, fire and protection, materials technology, transport and vehicles, wood technology and construction, and food and biotechnology. The other public research institute, Imego, was founded in 1998 and has a turnover of €6.5 million and a staff of 40; it is located on the campus of Chalmers University of Technology. Imego, which reports to the Ministry of Education, Research and Culture, focuses on micro- and nano-scale sensor systems and commercial application of these systems. IVF is a private non-profit research institute engaged in various industrial technologies and is headquartered in Mölndal just south of Göteborg. IVF has a staff of 100, 75 of whom are engaged in R&D, and a turnover of €11 million (2005). IFP Research – the successor of TEFO and PGI (Plastics and Rubber Institute; founded in 1977) – is another private non-profit research institute and specialises in fibres, textiles, polymers and composites. IFP Research is co-located with IVF and has a staff of 40 and a turnover of €4.3 million (2005). SIQ (Institute for Quality Control) is a non-profit institute whose main task is to contribute to high quality development within all parts of society. SIQ is located in Göteborg and has a staff of 13.

² The full translation from Swedish would be the "Halmstad University College".

³ The full translation from Swedish would be the "University College West".

⁴ The full translation from Swedish would be the "University College of Skövde".

⁵ Regional tillväxt – för arbete och välfärd, government bill 1997/98:62.

⁶ S. Sörlin, En ny instituttssektor, 2006.

While the region's research institutes, along with their counterparts throughout Sweden, generally prospered towards the end of the 20th century, they fell on hard times in the first few years of the new century as a result of significantly reduced public funding and a general insecurity regarding their role in the NIS. While this led to significant layoffs, the institutes' situation has improved again over the last couple of years with reinstated and even increased base funding, coupled to restructuring of the entire institute sector, which has led to four of the region's institutes having merged into two different national institute groupings. SP, including SIK and other previously independent institutes from other parts of the country, constitutes one group, while IVF and IFP Research (together with five additional previously independent institutes) belong to the Stockholm-based Swerea group that serves the materials and manufacturing industries. Swedish institutes are nevertheless still at a comparative disadvantage in international terms, since they only receive 8%⁷ of their turnover in base funding (2005) compared to 20-40% for their counterparts in many other nations⁸. The institute sector is thus underdeveloped from an international perspective.

The region's most respected university is Chalmers University of Technology (number 169 on Webometrics' world ranking (and 50 on its European ranking) and number 147 on The Times Higher Education Supplement World ranking), but Göteborg University is also well respected (number 219 on Webometrics' world ranking (and 73 on its European ranking). Both universities are rated in the 201-300 bracket in Shanghai Jiao Tong University's world ranking and in the 79-122 bracket in its European ranking. In contrast, the region's university colleges are little known outside the region. On the same note, the institute system is too small and still too fragmented to make much of an impression outside the country.

2.1.1.2 R&D expenditure and personnel

At the national level the Swedish government annually invests some €2.7 billion in R&D and six semi-public research foundations contribute another €0.18 billion (2006, Statistics Sweden). Estimates by researchers of the contributions from municipalities and county councils vary significantly and range up to €0.8 billion – mainly in health care and social services – but official statistics do not encompass this contribution⁹. Of the Swedish government's direct R&D investment, 56% goes to curiosity-driven research and 42% to mission-oriented R&D (20% to defence-related R&D, 22% to non-defence-related R&D). The clear majority of the investment in curiosity-driven research (€1.2 billion) is transferred directly to universities and university colleges and the remainder is channelled through three research councils. 22% of the investment in mission-oriented R&D that is not directly defence-related and is managed by a range of sectoral agencies, of which the Swedish Governmental Agency for Innovation Systems (VINNOVA) is the most important, allocating 6% of total government investment in R&D. VINNOVA's mission is to promote sustainable growth by funding R&D and developing effective innovation systems. In 1996, public investments in R&D corresponded to more than 1% of GDP, but the share decreased to around 0.75% in 1999; the share then increased again and has been more or less constant at around 0.95% of GDP in the period 2001-2006, but is expected to drop again in 2007. BERD increased from 2.3% of GDP in 1995 and peaked at 3.4% in 2001 and was back to 3.1% in 2005 (Statistics Sweden).

Västsverige's GERD is 29% of the national figure, but the region's BERD accounts for as much as 35% of the national total, while HERD is 17% and GOVERD is 2% (2003, Eurostat). Over the period 1997–2003 Västsverige's BERD increased by 73%. While Västsverige's share of the country's funding from RTD Framework Programmes is fully commensurate with the region's share of GDP (19%, 2000-2005), industry accounts for 30% (of funds to Swedish industry), institutes 29% (of funds to Swedish institutes) and universities 14% (of funds to Swedish universities) (VINNOVA). Employment in R&D is increasing both in the region and in its industry, and

⁷ S. Sörlin, *En ny institutssektor*, 2006.

⁸ E. Arnold et al., *The Role of Industrial Research Institutes in the National Innovation System*, 2006.

⁹ Trend Chart, Sweden, 2006.

the region's share of national employment in R&D in industry (31%, equivalent to a head count of 16 000 in 2003) is also increasing (Eurostat). Between 1993 and 2003, employment in R&D in industry increased by 63% in Västsverige, compared to 30% in Sweden and 17% in EU25 (Eurostat).

Given the region's automotive cluster, with three of the nation's four main vehicle manufacturers (see Chapter 3), the range of national collaborative R&D programmes to support the vehicle industry plays a significant role and a substantial portion of this funding naturally ends up in Västsverige. Such programmes, which have been in place in their present form since 1994, typically fund researchers in universities and research institutes, but require substantial R&D investments from industry (typically 50% or 67%) – usually contributed in kind. In 1994, the first of these programmes was launched with an annual budget of €6.5 million, half of which was funded by the government; in 2006, the budget for a range of non-fuels automotive R&D programmes had increased to approximately €125 million p.a., about a third of which comes from the government. Although smaller, similar collaborative R&D programmes facilitating knowledge diffusion between R&D providers and industry also exist for other sectors where Västsverige's industry is strong, e.g. biomedicine, aerospace and IT/telecoms.

EPO patent applications steadily increased both nationally and in the region up until 2000 when they peaked at over 350 patent applications per million inhabitants. However, since then applications have plummeted to less than half that number and in 2003 were back at 1990 levels, a trend that is explained by a dramatic change in patenting policies among major businesses. However, looking at patent applications in Mechanical engineering (IPC Section F), a sector to which much of Västsverige's industry base belongs, one finds that the regional decline since 2000 is less severe than for the country as a whole. Moreover, since the early nineties the region has had more mechanical engineering patent applications per capita than the national average; in 2003 Västsverige thus outperformed the national average by 64% (Eurostat). Sweden shows a relative specialisation in the fields of clinical medicine, health science, biomedical science, pharmacology and basic life sciences. Less pronounced –but still important– areas are food and agriculture, environmental science, civil engineering and materials science. The country shows a relatively high citation impact in clinical medicine and pharmacology¹⁰. With its biomedical cluster in greater Göteborg, including two internationally competitive universities active in the field, there is reason to assume that Västsverige would exhibit a similar pattern. In general, Sweden scores high in international comparisons in terms of publications per capita¹¹.

2.1.2 Knowledge diffusion capacity of the region

The region's knowledge diffusion capacity is largely concentrated in greater Göteborg. Thus, in Göteborg there are five science and technology parks and incubators with close connections to Göteborg University and Chalmers University of Technology: Chalmers Innovation, Lindholmen Science Park, Sahlgrenska Science Park, Chalmers Science Park and Framtidens företag (Companies of the Future) (Swedish Incubators & Science Parks). The science parks and incubators offer space to technology intensive companies and services that shorten the time to market for newly created technology-based companies. Four of the parks/incubators have a thematic focus: Emerging technologies and company development (Chalmers Innovation), Intelligent Vehicle and Transport Systems (Lindholmen Science Park), Biomedical R&D (Sahlgrenska Science Park) and Technology Intelligence and Applied R&D (Chalmers Science Park), while Framtidens företag is an incubator open to companies regardless of the type of business idea. The thematic science parks correspond well to the region's industrial specialisation, but all five also provide support of a more general character. In 1995, Göteborg University founded a holding company, as part of a national policy initiative, which funds and helps develop new enterprises based on the university's research results. So far, the holding company

¹⁰ Third European Report on Science and Technology Indicators, European Commission, 2003.

¹¹ Third European Report on Science and Technology Indicators, European Commission, 2003.

has contributed to more than 25 new enterprises and constitutes a mediator to venture capitalists.

The links between HEIs and industry are much less developed around the university colleges. Apart from the University College of Skövde, which has developed a science park, Gothia Science Park, and an incubator, the region's other university colleges appear not to have developed any real infrastructure for knowledge diffusion to industry. At these university colleges the interaction with industry is limited to continuing education, entrepreneurial education, including support of start-ups based on student's project ideas, and cooperation with industry in individual projects. However, there are also technology parks and incubators in Borås (Enspira), Trollhättan (Innovatum) and Skara (Liveum) (Swedish Incubators & Science Parks). Diffusion of knowledge from HEIs to industry and society is also supported through the universities' "third mission", which has developed from pure knowledge transfer (according to the university reform in 1977) to include cooperation with the surrounding society (according to the university reform in 1997)¹². However, the third task has not developed into an efficient means of cooperation between university and industry. In this context, the region's research institutes play an important role in supporting knowledge transfer from universities to industry and in particular to SMEs.

2.1.3 Knowledge absorption capacity of the region

The educational level of Västsverige's population closely follows the nation's; the fraction of students pursuing an upper secondary degree (ISCED level 3) is 22% (21% for Sweden; both fractions declined over the period 1998–2004) and the fraction pursuing a tertiary degree (ISCED levels 5-6; both fractions rose over the period 1998–2004) is 16% (18% for Sweden) (Eurostat). Västsverige's human resources in science and technology have been constant at 46% of the active population for the last decade (cf. 47% for the nation and 60% for Stockholm) (Eurostat). Sweden is the EU leader in lifelong learning with a score of 34% in 2003¹³ and Västsverige follows a similar pattern to the country as a whole (Statistics Sweden). There is consequently reason to believe that the knowledge absorption capacity of Västsverige's population is relatively good.

The knowledge absorption capacity of larger enterprises in the region, particularly in the dominant clusters, is generally quite good since they have a tradition of in-house R&D. While the ability of these companies to absorb externally generated knowledge may be quite good, they have – with the exception of biotechnology – not always wanted to collaborate closely with universities and research institutes. Nevertheless, national collaborative R&D programmes have gradually changed their attitude and collaboration between R&D providers and industry is getting closer, e.g. within the automotive cluster. While there is a large number of SMEs in the region, most engage in little or no R&D activities and many have no ambition to grow and expand, partly due to the owners being relatively old, on average, and having a low average level of education. The SMEs that do engage in R&D often do so supported by the region's research institutes.

2.2 Policy context

2.2.1 Governance structure and actors

Overall, the Swedish governance system is reasonably decentralised, meaning that regional and local authorities have significant autonomy. Västsverige consists of the two national regions (counties) Västra Götalands län and Hallands län, which in turn comprise 55 (49 + 6) local municipalities. In view of its size Västra Götaland is divided into four sub-regions, which also

¹² Högskoleverket, Högskolan samverkar, 2004.

¹³ European Innovation Scoreboard 2004, Comparative Analysis of Innovation Performance, SEC(2004) 1475, European Commission, 2004.

possess a certain degree of autonomy on an intermediate level. Neither municipalities nor counties have any legislative authority, but they determine one component each in the overall personal income tax rate and they define policies in the framework of national legislation. The counties are responsible for regional development, which in the Swedish governance system does not include direct RTDI policy formulation and funding. RTDI policy is formulated by the national government, supported by a Research Policy Council (RPC), an Innovation Policy Council (IPC) and the Institute for Growth Policy Studies (ITPS), but none of these bodies has any formal authority, meaning that they are reduced to advisory functions. In certain strategically important industry sectors (recently aerospace, metallurgy, automotive manufacturing, forestry, pharmaceuticals and IT/telecoms), industry has been invited to help formulate national strategies and eventually research programmes. RTDI funding is also managed on a national level. Having said that, some regional R&D funding outside of national policies does indeed exist, but it is not tracked by statistics (nationally or regionally) meaning that its importance is very difficult to assess.

Although RTDI policy formulation and funding are essentially national concerns, the regions are expected to formulate policies in many other fields and may, for example, implement instruments to stimulate innovation in various forms, including for example, by supporting and funding innovation infrastructure. The framework within which the regions may operate is largely set in the National Strategy for Regional Competitiveness, Entrepreneurship and Employment¹⁴, in which the government has merged the Strategic Reference Framework for the Structural Funds with its national regional development policy. The National Strategy provides the framework for 21 Regional Development Strategies (RUP) – one for each county – which are to be implemented in 21 Regional Growth Programmes (RTP). According to the National Strategy, the regional growth programmes should aim to stimulate sustainable regional development and support industrial development. The National Strategy also calls for Structural Funds Programmes for Sweden's eight NUTS 2 regions, of which Västsverige (i.e. Västra Götalands län and Hallands län) is one. The county councils are formally charged with developing the Regional Development Strategies and Regional Growth Programmes, which for Västsverige, is done in parallel for Västra Götalands län and Hallands län. The Regional Strategies and Programmes are partly developed through a bottom-up approach in which local municipalities and individual citizens may have their say. In contrast, development of the Regional Structural Funds Programme for Västsverige¹⁵ was a joint effort by the two county councils, but the Programme clearly shows that much of the preparatory work nevertheless must have been carried out along two parallel tracks.

2.2.2 Policy objectives

The mid-1970s represented a break with past RTDI policy. Established post-war innovation systems were rapidly dismantled as government-controlled markets were opened up to competition, meaning that the PPPs that defined much of industrial R&D in the post-war period were broken up. Simultaneously, a plethora of new university colleges were established as a result of university reform. A dramatic change in RTDI policy came about with a 1975 policy statement that high-quality undergraduate education requires engagement in high-quality research, which was further boosted by the rapid growth in student numbers. In 1980, a government enquiry established that “the universities were to be society's research institute”; in this respect, the enquiry revisited a previously formulated doctrine adopted by parliament in 1979 (although the sentiment dates back even further). During the 1980s and 1990s, sectoral R&D was strongly reoriented in favour of universities and university colleges. Universities and university colleges became the beneficiaries of a dramatic shift in funding priorities at the expense of research in-

¹⁴ Nationell strategi för regional konkurrenskraft, entreprenörskap och sysselsättning, 2007-2013, Ministry of Enterprise, Energy and Communications, 2006.

¹⁵ Regional konkurrenskraft och sysselsättning, operationellt program Västsverige, 2007-2013, Västra Götalandsregionen och region Halland, 2006.

stitutes. In the period 1982–2005, base funding for the university sector increased by more than a factor of three, while over the same period the institute sector's base funding was halved¹⁶.

Following the presentation in 2004 of Sweden's first innovation policy, national research policy is effectively a partial implementation of innovation policy. The innovation policy White Paper Innovative Sweden¹⁷ outlines four prioritised areas to encourage innovation. While pointing to general needs and areas that need to be addressed, the White Paper stops short of proposing concrete measures. In contrast, the 2005 research policy bill on Research for a Better Life¹⁸ states that the overall goal of research policy is for Sweden to be a leading research nation. It then goes on to set a range of priorities:

- Additional funding to be allocated to three high-priority research fields in the period 2005–2008: Medicine (€43 million increase), Technology (€38 million increase) and Environment and sustainable development (€23 million increase)
- Funding to be provided to internationally competitive centres of excellence (€32 million increase 2006–2008)
- Additional funding to be provided to enable more researchers to be trained and to offer them improved career prospects (€56 million increase 2005–2008, of which 13% is earmarked for Västsverige's universities and university colleges)
- Transfer of knowledge between academia and industry to be boosted through:
 - Improved efficiency of university holding companies, including capitalising them (€6.5 million increase 2005–2008)
 - Collaborative state-industry R&D programmes (€13 million increase 2005–2008)
 - Long-term funding for research institutes (€12 million increase 2005–2008)
 - Measures to facilitate SME access to research (€1.1 million increase 2005–2008)

The research policy bill consolidates policy developments that have been underway for quite some time. Neither the ambition for Sweden to be a world-class research nation nor the concentration of public funds to a few select research fields represents new developments. The belief in excellence in research and in the linear model dates back to the 1950s¹⁹, while the doctrine that the universities should be the main suppliers of publicly funded research was initially formulated in the early 1940s²⁰. However, it was only in the 1990s that it began to be admitted in policy discussions that the universities have not managed to live up to their third mission (collaboration with society and transfer of knowledge) and that technology transfer in general – and to SMEs in particular – needs to be strengthened. The belief in the linear model is still the cornerstone of R&D policy and the belated acknowledgement that innovation processes need to be supported for society to reap the full benefits of investments in R&D entered the policy debate in earnest in the 1990s and were more openly acknowledged in the aforementioned White Paper in 2004. While the 2005 research policy bill indicates a slight policy shift in favour of both mission-oriented R&D and the institute sector, the emphasis is still clearly on curiosity-driven R&D and the university sector. It is possible and perhaps even likely that some of the more recent gradual policy reorientations have been influenced by the development of the Lisbon agenda.

On the regional level, the main policy declarations can be found in the Regional Structural Funds Programme for Västsverige and in the respective Regional Development Strategies and Regional Growth Programmes for the two counties. While these policy declarations have their

¹⁶ S. Sörlin, En ny instituttssektor, 2006.

¹⁷ Innovative Sweden, Government White Paper, Ds 2004:36.

¹⁸ Research for a Better Life, Government bill 2004/05:80.

¹⁹ O. Edqvist, Den svenska forskningspolitikens tre världar, in Det nya forskningslandskapet, U. Sandström (ed.), skrifter 5, SISTER, Stockholm, 2002.

²⁰ H. Sandén and U. Sandström, Forskningsinstituten: Det glesa landskapet, in Det nya forskningslandskapet, U. Sandström (ed.), skrifter 5, SISTER, Stockholm, 2002.

origin in national initiatives, they are in all important respects regional products – but of course formulated within the framework on national strategy documents.

During the previous programming period, the structural funds programmes focused on maintaining job opportunities and creation of new jobs as a means of supporting structural and social change in the regions. Several measures focused on meeting relatively basic needs in education, innovation and knowledge in order to support regional development, rather than to support and complement the national innovation and knowledge economy. For the present programming period, the government has merged the strategic reference framework with its national regional development policy to achieve a more holistic approach. The strategic priorities of the Regional Structural Funds Programme for Västsverige 2007–2013²¹ are:

- Entrepreneurship, new businesses and seed funding
- Increased knowledge base, innovations, clusters and innovations systems
- Competence development, lifelong learning, collaboration between industry and education
- Pluralism, integration, attractiveness and culture as drivers for sustainable development

While the operational target areas are:

- Entrepreneurship and innovative businesses
- Collaboration initiatives and innovative environments
- Sustainable city development

The Regional Development Strategies do not include any policies directly targeting RTD. However, they both concern themselves with policies to directly and indirectly promote innovation-friendly environments. Västra Götaland – A Good Life²² stakes out five focus areas, which should all consider the cohesive region, equality, integration and internationalisation, if development is to be sustainable from the economic, social and environmental points of view:

- Vigorous and sustainable trade and industry
- A leading position in competence and knowledge development
- Infrastructure and high standard communications
- A leading cultural region
- Good health

The Regional Development Strategy Halland – bästa livsplatsen²³ provides three strategic foci:

- Realising favourable living environments
- Building businesses and knowledge by stimulating entrepreneurship, innovation and growth and by striking a balance between industry and education
- Exploiting its favourable location between two larger growth areas (Västra Götaland and Skåne) and its proximity to continental Europe by striking strategic alliances, developing leadership and reinforcing Halland's image

2.2.3 Policy instruments

The so-called Swedish paradox (referring to the observation that Sweden's high investments in R&D do not seem to be paying off sufficiently in terms of economic growth) has placed innovation-friendly policies and measures high on agendas both nationally and regionally. The attention to innovation friendliness and exploitation aspects was further increased with the "Innova-

²¹ Regional konkurrenskraft och sysselsättning, operationellt program Västsverige, 2007-2013, Västra Götalandsregionen och region Halland, 2006.

²² Vision Västra Götaland – A Good Life, Region Västra Götaland, 2005.

²³ Halland – bästa livsplatsen, Region Halland, 2005.

tive Sweden” white paper. Several of the ideas raised in the white paper were addressed in the most recent research policy bill and others through assignments to government agencies, as discussed below.

Improve R&D governance capacity: The National Strategy for Regional Competitiveness, Entrepreneurship and Employment of 2006 stated that regional growth programmes should be made a permanent feature in the future as a means to achieve a holistic and coordinated approach to regional development in each region.

Creation of an innovation friendly environment: The two dominant operational target areas of the Regional Structural Funds Programme for Västsverige largely focus on innovation friendliness. Examples of activities within the target area *Entrepreneurship and innovative businesses* (ERDF funding: €26 million for the period 2007–2013; total: €72 million) are improving business support systems and advisory services, supporting incubators and providing seed funding, e.g. in the form of JEREMIE funds. Activities in the target area *Collaboration initiatives and innovative environments* (ERDF funding: €25 million; total: €63 million) aim to build on clusters where the region has comparative advantages. (It is noteworthy that several of these clusters are also at the same time the targets of national industry sector collaborative R&D programmes.) These activities aim to support network and cluster initiatives and other activities bringing together industry, R&D providers and society, as well as developing physical infrastructure in terms of arenas for collaboration, competence centres etc. Within the target area *Sustainable city development* (ERDF funding: €10 million; total: €25 million) activities are mainly aimed at addressing economic and ethnic imbalances, but stimulation of entrepreneurship at local level is one instrument with which to address these imbalances. Overall, ERDF provides €64 million for Västsverige in the period 2007–2013; this funding is budgeted to gradually increase throughout the period.

The Regional Growth Programmes for Västra Götaland²⁴ and Halland²⁵ have in common that they strive to promote a favourable business environment, knowledge development and growth, and to enhance citizens’ quality of life. On the same note, several of the operative goals have a lot in common. It is noteworthy that Halland recognises and seeks to exploit the proximity to its larger neighbour to the north. The financial resources for Västra Götaland’s Regional Growth Programme are €66 million p.a., of which €26 million are of local and regional public origin, €5.5 million are EU funds and €20 million are of private origin. For Halland, the corresponding resources are €19 million p.a., of which €2.3 million are of local public origin, €1.6 million are EU funds and €2.7 million are of private origin.

Development of human capital: One of the main priorities of the most recent research policy bill is to provide substantial additional funding to enable more researchers to be qualified and to offer them improved career prospects (€56 million increase 2005–2008, of which 13% is earmarked for Västsverige’s universities and university colleges), particularly in view of the fact that some 45% of teaching and research staff at Swedish universities are due to retire within the next 15 years. The research policy bill’s increased funding to three priority areas (€104 million increase 2006–2008) and to internationally competitive centres of excellence (€32 million increase 2006–2008) will also result in substantial numbers of doctoral degrees, a good deal of which are likely to be awarded from the region’s two universities. One semi-public research foundation provides funding to develop research environments in newly established regional universities and university colleges, and a handful of semi-public research foundations provide funding to graduate schools, both more traditional university-based ones and those targeting part-time graduate students in industry and research institutes. Both the Regional Growth Programmes mentioned above support activities for knowledge development and lifelong learning.

²⁴ Det gemensamma Västra Götaland – hållbar tillväxt för ökad attraktivitet och konkurrenskraft, Tillväxtprogram för Västra Götaland 2004-2007.

²⁵ Regionalt tillväxtprogram för Halland 2004-2007, Region Halland, 2003.

Networking, co-location and clustering measures: Several of Västsverige's industrial clusters are the targets of collaborative R&D programmes in national industry sector, as outlined in the aforementioned research policy bill. On the same note, the region's universities are strong in the high-priority research fields highlighted in the same bill. The Regional Structural Funds Programme outlines several initiatives to support incubators, provide seed funding, develop networks and clusters between industry, R&D providers and society, and to aid the development of physical infrastructure in terms of arenas for collaboration, competence centres, etc. Both Regional Growth Programmes aim to support and strengthen industrial clusters already identified.

Knowledge and technology transfer to industry: One of the main priorities of the most recent research policy bill is to stimulate transfer of knowledge between academia and industry (particularly in the light of the Swedish paradox) through:

- Support for university holding companies, including providing them with additional capital (€6.5 million increase 2005–2008).
- Support for a new generation of industry sector collaborative R&D programmes (€13 million increase 2005–2008).
- Increased and long-term funding for research institutes (€12 million increase 2005–2008)
- A new instrument to provide SMEs with financial resources to carry out research. Unusually for Sweden, these grants go to SME applicants and not to R&D providers (as is the norm) (€1.1 million increase 2005–2008).

Both the Regional Structural Funds Programme and the Regional Growth Programmes have a range of activities to support knowledge and technology transfer.

Research collaboration between public research organisations and the private sector: Sweden has a tradition of collaborative R&D programmes; the majority of the funding provided by VINNOVA and some of the funding from the semi-public research foundations goes to such programmes. Industry runs collaborative R&D programmes targeting the aerospace, metallurgy, automotive, forestry, pharmaceuticals and IT/telecom sectors developed based on dialogues between the state and industry, thus closely matching perceived needs. The difference between sectoral programmes and most of VINNOVA's other programmes is that the former have their origins in political developments, meaning that VINNOVA is deprived of much of its freedom in programme formulation. From Västsverige's point of view, a range of extensive R&D programmes targeting the automotive industry to enhance its competitiveness vis-à-vis foreign competitors (and sister companies of Sweden's now foreign-owned automobile manufacturers) is of particular relevance considering the automotive cluster's dominant position in the regional economy. These programmes commenced in 1994 and both the number of programmes and their overall budget have since grown rapidly (cf. Section 2.1.1.2). Unusual for Sweden, these programmes are managed by industry and merely administered by VINNOVA (which for other industry branches also manages R&D programmes). Moreover, in the dominant automotive R&D programmes, the four vehicle manufacturers and the members of the suppliers association are the recipients of R&D grants, which may then be distributed to the R&D supplier of their choice (usually within academia). Some of these programmes are currently the subjects of a government enquiry, but it is taken for granted that the programmes will continue, albeit possibly somewhat modified. While the automotive programmes clearly dominate, Västsverige is also the beneficiary of several of the other industry sector R&D programmes.

Both the Regional Structural Funds Programme and the Regional Growth Programmes have activities to facilitate collaboration between R&D performers and industry, but do not directly fund R&D.

Support for public research: Of the government's €2.7 billion direct annual R&D investment, 56% goes to curiosity-driven research and 42% to mission-oriented R&D (20% to defence-

related R&D, 22% to non-defence-related R&D). The majority of the investment in curiosity-driven research (€1.2 billion) is transferred directly to universities and university colleges and the remainder is funnelled through three research councils for allocation to projects selected purely on scientific merit. Thus, direct support for universities and university colleges is the main R&D policy instrument. By contrast, the base funding to the research institutes amounted to €8.5 million in 2005. The most recent research policy bill provides increased funding totalling over €250 million for the period 2005–2008, of which €56 million goes directly to universities and university colleges compared to the €12 million increase in funding for research institutes. The research policy bill also provides additional support for university holding companies, including providing them with additional capital (€6.5 million increase for 2005–2008).

Financial R&D measures for the private sector: The predominant form of support for mission-oriented collaborative R&D is for government to fund R&D performers directly on the condition that industry contributes at least an equal amount (either in cash or in kind) to the project. One important exception is that of some of the R&D programmes targeting the automotive industry – hence very important for Västsvrige–, where industry receives a cash payment that it then often – but not always – uses to buy R&D services from universities and research institutes. Another notable exception is the new programme mentioned above to support R&D in SMEs, where the SME receives a cash payment to use as it sees fit. With a few exceptions, R&D priorities are in essence determined through a top-down approach. One exception is that of sectoral R&D programmes defined based on dialogues between the state and industry. Another exception is the aforementioned programme to support R&D in SMEs, where there are no predetermined topics. On a national level, the government provides several routes for capital and equity guarantees (cf. Chapter 3).

The main instrument groupings on the national level (e.g. research policy bills) are, in descending order of resources allocated, base funding for universities and university colleges, the research councils' instruments for curiosity-driven projects selected purely on scientific merit, mission-oriented collaborative R&D programmes (of which the sectoral R&D programmes are a subset) and technology-transfer and exploitation measures. Of these instrument groupings, measures to facilitate technology transfer, exploitation and innovation friendliness have been emphasised much more in recent years, particularly in the 2005 research policy bill, whereas the others are longstanding features of research policy. On the regional level there are a plethora of activities to support the creation of innovation-friendly environments, largely stemming from Regional Structural Funds and Regional Growth Programmes.

RTD Framework Programmes contribute €152 million p.a. to national R&D funding, of which €29 million p.a. goes to Västsvrige (average for 2000-2005; annual variations are large). In Västsvrige, industry receives 40% of the Framework funds, institutes 10% and universities 42%. SMEs' share of the industry total in Västsvrige is 43% (VINNOVA).

Exhibit 1: RTD policy mix affecting the region

Policy Areas ²⁶	Policy objectives and instruments at National* level affecting the region	Policy objectives and instruments at Regional* level
Improving R&D governance	Regional growth programmes were made a permanent feature in 2006	Regional growth programmes provide a means for a holistic and coordinated approach to regional development in each region
Creation of an innovation friendly environment	The "Innovative Sweden" White Paper sets the stage for activities related to innovation-friendliness for years to come	A plethora of instruments to promote innovation-friendliness are provided by the Regional Structural Funds Programme and the Regional Growth Programmes
Development of human capital	The "Research for a Better Life" research policy bill provides substantial additional funding to enable more researchers to graduate and to offer them improved career prospects Semi-public research foundations provide funding to research environments in newly established regional universities and to graduate schools	The Regional Growth Programmes support activities for knowledge development and lifelong learning
Networking, co-location and clustering measures	The "Research for a Better Life" research policy bill targets collaborative sectoral R&D programmes and high-priority research fields in which the region's industry and universities have a comparative advantage	The Regional Growth Programmes aim to support and strengthen already identified and existing industrial clusters
Knowledge and technology transfer to enterprises	The "Research for a Better Life" research policy bill outlines a concerted effort to improve and stimulate transfer of knowledge between academia and industry, including increased support to university holding companies, collaborative R&D programmes, research institutes and SMEs to provide them with financial resources to access R&D	The Regional Growth Programmes have activities in support of knowledge and technology transfer
Research collaboration of public research organisations with private sector	The "Research for a Better Life" research policy bill continues Sweden's tradition of collaborative R&D programmes and additionally outlines six industry sector collaborative R&D programmes	The Regional Growth Programmes have activities to facilitate collaboration between R&D performers and industry
Support of public research	44% of the government's direct R&D funding goes to universities and university colleges, both through base support and through open calls. The "Research for a Better Life" research policy bill prioritises research fields in which the region's universities have a comparative advantage	The Regional Growth Programmes have activities to facilitate collaboration between R&D performers and industry
Financial R&D measures for the private	The collaborative R&D programmes targeting the automobile industry are to a significant degree tailored to the re-	The Regional Structural Funds Programme provides

²⁶ 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 Trend Chart has developed its own policy mix taxonomy.

Policy Areas ²⁶	Policy objectives and instruments at National* level affecting the region	Policy objectives and instruments at Regional* level
sector	<p>region's automotive cluster.</p> <p>The "Research for a Better Life" research policy bill introduces an instrument to provide SMEs with financial resources to carry out R&D.</p> <p>Seed and venture capital is provided by several public organisation with local offices</p>	seed funding

[* 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

Västsverige's knowledge-creation capacity is very good, with two internationally competitive universities, four university colleges and five research institutes. The total student population in Västsverige is 74,000, of whom 45,500 study at the region's two universities. Moreover, numbers are expected to gradually increase. After prospering towards the end of the 1990s, the region's research institutes fell on hard times and shrunk during the first few years of the new century, but are now starting to prosper again as a result of favourable policy reorientations and renewed funding. The consolidation of the research institute sector into four large national groups will continue; one of the groups is based in the region (Borås).

Västsverige's GERD is 29% of the national figure, but the region's BERD accounts for as much as 35% of the national total (see Graph 1), while HERD is 17%. Over the period 1997–2003 Västsverige's BERD increased by 73%. Employment in R&D is increasing both in the region and in its industry, and the region's share of the nation's employment in R&D (31%) is also increasing (see Graph 1). Between 1993 and 2003, employment in R&D in industry increased by 63% in Västsverige, compared to 30% in Sweden. Regional GERD and BERD, as well as employment in R&D, are expected to continue to increase provided that the dominant automotive cluster continues to prosper. There is, however, an imbalance in that the region's BERD is 35% of the national figure, while the corresponding share for HERD is only 17% (see Graph 1). At 0.2% of GERD, the region's GOVERD is negligible. The region produces more patent applications per capita than the national average, largely due to a strong contribution from mechanical engineering (IPC Section F) (see Graph 1).

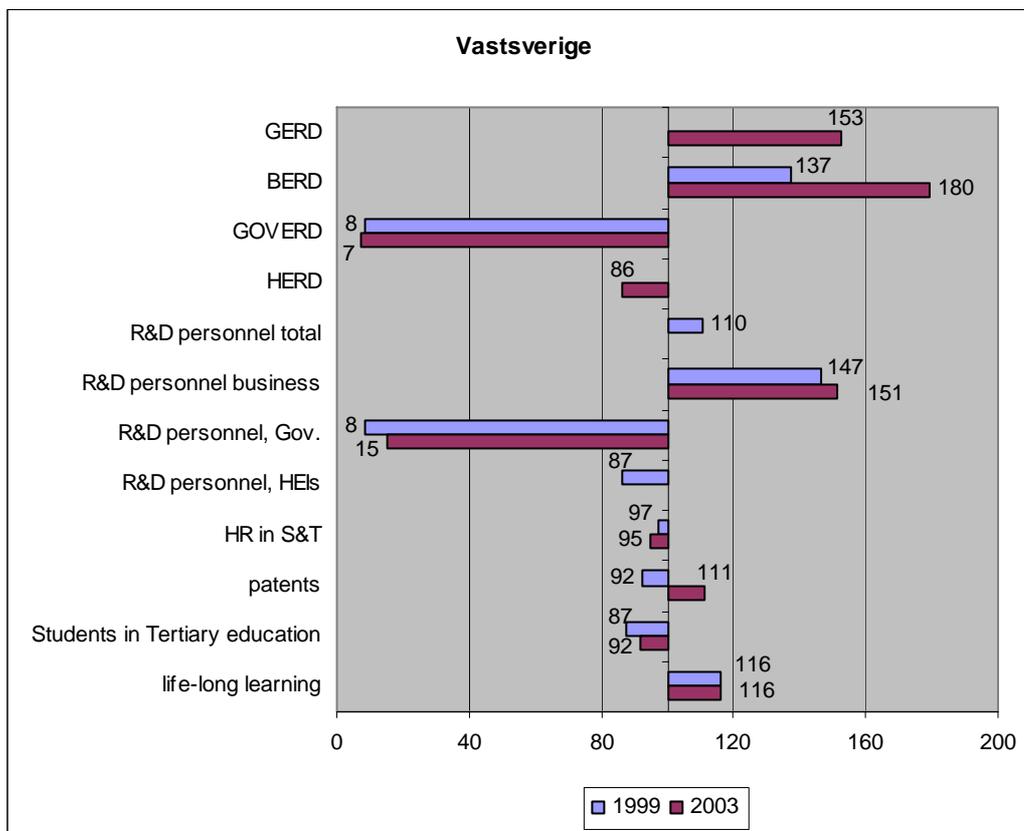
The region's knowledge diffusion capacity is largely concentrated in greater Göteborg and there are five science and technology parks and incubators near the two universities. The links between the university colleges and industry are less well developed, but these also have technology parks and incubators nearby. The region's research institutes play an important role in knowledge diffusion from universities to industry and in particular to SMEs, as do collaborative R&D programmes (which tend to attract larger enterprises).

Västsverige's population is fairly well educated and the region's human resources in science and technology and participation in lifelong learning are very good. The knowledge absorption capacity of larger enterprises in the region, particularly in the dominant clusters, is generally quite good, while a large number of SMEs in the region engage in little or no R&D.

Sweden's top priorities in RTDI policy (not in order of importance) are to:

- Maintain world-class quality in education and research
- Focus public R&D investments to a limited number of areas
- Ensure a smooth generation shift among researchers
- Eliminate the Swedish paradox

Graph 1: Comparison of Västsverige's knowledge base with that of Sweden as a whole



The first priority in this list is clearly the top priority and has been since the 1950s. Also the second priority, namely to concentrate public investments to a limited number of areas where Swedish preconditions are best, represents a continuation of previous policy bills. The third priority reflects the fact that some 45% of teaching and research staff at Swedish universities and university colleges are due to retire within the next 15 years. The final priority is by far the most challenging and reflects a generally, albeit reluctantly, accepted deficiency of the Swedish NIS that urgently needs to be addressed. One reason for the paradox may, arguably, be sought in the belief in the linear model of research and the fact that the universities are seen as the main providers of both curiosity-driven and mission-oriented research. At least the second of these presumptions has come to be questioned and the Innovative Sweden white paper and the Research for a Better Life research policy bill paid considerable attention to technology transfer and exploitation, as well as research institutes' role in these processes. While maintaining the standpoint that the universities are to remain the primary source of publicly funded research, there is a realisation that they need support in fulfilling the third task. Thus, a 2001 government bill awarded all universities the right to establish holding companies to facilitate exploitation of their research results. The 2005 research policy bill offered funding to improve the efficiency of university holding companies, including capitalising them. During the 1970s to 1990s there was no overall strategy for the research institute sector. A change came about in a 2001 government bill, which stated that the research institutes are important in supporting competence development in industry and as intermediaries between academic research and industrial applications. The 2005 research policy bill reinstated some of the institutes' funding which had previously been cut. The six sectoral collaborative R&D programmes may be seen as a recognition that the linear model is not the only way forward. Recent national policy developments thus indicate a certain insight into bottlenecks in the NIS and a will to address them. It is still unclear whether this partial reinstatement of the institute sector will continue under the conservative government that took office in 2006 (after a long period in which the social democrats were in power). To a large extent, regional policies are concentrated on com-

plementing national efforts to facilitate innovation processes and exploitation of R&D results in regional industry.

3 Regional economic structure

3.1 Description of the economic structure

3.1.1 The characteristics of the productive structure of the region's economy

Västsverige is Sweden's second most economically important region and contributes 19% of the nation's GDP (€52 billion; 2003), translating into 134% of the average EU25 per capita GDP (2003), a figure that essentially has been constant over the last decade (Eurostat). By comparison, the NUTS 2 region of Stockholm accounts for 29%, Östra Mellansverige for 14% and Sydsverige for 13% (2004, Statistics Sweden). Although Västsverige's GRP grew steadily from 1993 to 2003 (rising by 64%) the growth rate declined over the same period (Statistics Sweden).

The dominant sectors of the regional economy are manufacturing (20% of GRP 2004: NACE D), real estate, renting and business activities (17%: NACE K), wholesale and retail trade (10%: NACE G) and health and social work (9%: NACE N). Despite the large areas of forests and farmland, as well as a long coastline, agriculture, hunting, forestry and fishing (NACE A-B) account for a mere 1% of GRP (Statistics Sweden). In the period 1995–2003, value added increased in all sectors; manufacturing (NACE D) grew by 45%, real estate, renting and business activities (NACE K) by 60%, wholesale and retail trade (NACE G) by 39% and health and social work (NACE N) by 69% (Statistics Sweden). In 2003, gross fixed capital formation was the highest for real estate, renting and business activities (NACE K), followed by manufacturing (NACE D), transport, storage and communication (NACE I), wholesale and retail trade (NACE G) and health and social work (NACE N). However, growth in fixed capital formation in the period 1995–2003 provides a different sequence; strongest growth is exhibited by real estate, renting and business activities (136%), construction (NACE F: 118%), agriculture, hunting, forestry and fishing (NACE A-B: 86%), transport, storage and communication (NACE I: 59%), wholesale and retail trade by (56%), manufacturing (35%) and health and social work (17%) (Statistics Sweden).

As described in Chapter 2, Västsverige's GERD is 29% of the national figure and BERD accounts for as much as 35% of the national figure (cf. its 19% share of national GDP). Moreover, in the period 1997–2003 Västsverige's BERD increased by 73%. Employment in R&D is increasing both in the region as a whole and in industry and the share of the nation's R&D employment, 31% in 2003, is also increasing (Eurostat). The high relative figures in terms of regional GERD, BERD, Framework funding and R&D employment in industry illustrate that Västsverige's industry is very R&D intensive and, when considered together with the dominance of manufacturing (NACE D) in the regional economy, a picture of the region as the country's industrial heartland emerges. However, the dominance of manufacturing (NACE D) is declining from a peak in 2000 in terms of its share of GRP, while real estate, renting and business activities (NACE K) and health and social work (NACE N) are gaining in importance (Statistics Sweden). SMEs' share of the industry total framework R&D funds received is 43% in Västsverige and 61% nationally, suggesting both a dominance of large R&D intensive enterprises and a relatively small share of R&D intensive SMEs in Västsverige (VINNOVA).

Sweden is the EU25's top performer in its summary innovation index (SII), but is losing momentum. In particular, the dramatic drop in patent applications per capita mentioned in Section 2.1.1.2 will negatively influence Sweden's performance in future surveys. The development of Sweden's SII has nevertheless been very strong in the period 1996–2003. Since the three sectors exhibiting the highest average innovation performance (of the limited number of sectors

studied) are electrical and optical equipment, chemicals and chemical products and transport equipment²⁷, it seems reasonable to assume that Västsverige's level of innovation is also quite high since all these sectors (particularly the latter) are very strong in the region. Another indication pointing in the same direction is that Västsverige outscores Sweden in many of the indicators that make up the composite indices.

Västsverige is home to 21% of the nation's workforce (head count: 872 000; 2003) and the fraction is slowly increasing; absolute numbers have increased annually by over 2% from a low-point in 1998 (Statistics Sweden). Also, in terms of employment, manufacturing dominates (19% of workforce 2004: NACE D), followed by labour-intensive health and social work (17%: NACE N), wholesale and retail trade (14%: NACE G) and real estate, renting and business activities (11%: NACE K) (Statistics Sweden). In Västra Götaland, 5.9% of the population works for the automotive industry; in Halland, the corresponding figure is 1%. By the same token, 45% of all employees in the Swedish automotive industry work in Västra Götaland; for Halland, the corresponding figure is 1%²⁸. Most notable is the diminishing importance since 1998 of the medium high-technology manufacturing sector, including in particular the region's dominant automotive cluster, and the corresponding increase for all kinds of services, particularly knowledge-intensive services (Statistics Sweden), which may partly be explained by outsourcing.

Although rising from a low-point of 4.3% in 2001, unemployment is, at 6.8%, below the national (7.5%) and EU25 (9%) averages. In Sweden, unemployment is only lower in the regions of Småland med öarna (5.9%) and Stockholm (6.7%) (2005, Eurostat). Growth in productivity (as calculated by dividing value added by employment) in the region overall, as well as for the dominant sectors (NACE D, K, G and N), follows the overall national development with dips into negative growth in 2001 (2001–2002 for NACE D), but otherwise improvements were continuous over the period 1995–2003 (Eurostat, Statistics Sweden). The strongest growth is exhibited in health and social work (52% in the period 1995–2003: NACE N) followed by manufacturing (43%: NACE D), wholesale and retail trade (31%: NACE G) and real estate, renting and business activities (11%: NACE K), which may explain part of the decline in employment mentioned in the previous section. Very strong financial reports from industry in recent years (not yet included in the overall statistics) as well as prognoses for 2007, coupled with a general trend towards reduced labour intensity suggest that this positive trend may continue for some time²⁹.

3.1.2 Systemic characteristics of the region

Västsverige's automotive cluster is of immense importance to the region. The three vehicle manufacturers – the Volvo Group, Volvo Car and Saab Automobile – together with their regional suppliers, strongly dominate much of the region's business life. The automotive industry in Västra Götaland has more than 50,000 employees in approximately 200 companies with more than 20 employees (Business Region Göteborg) and the sector accounted for 49% of Västra Götaland's exports in 2003³⁰. 28% of all firms in the Swedish automotive industry are located in Västra Götaland; for Halland, the corresponding figure is 3%³¹. The automotive cluster is the cluster with the strongest growth as measured in export value (137% 1997–2003)³². The

²⁷ European Innovation Scoreboard 2004, Comparative Analysis of Innovation Performance, SEC(2004) 1475, European Commission, 2004.

²⁸ Nationella och regionala klusterprofiler. Företag inom fordonsindustrin i Sverige, Arbetsmaterial, 2006.

²⁹ Konjunkturbarometer för Västsverige hösten 2006 och våren 2007, Statistics Sweden, December 2006.

³⁰ Västsvenska näringslivets handelskontakter – en studie av exportflöden med fokus på EU:s nya medlemsländer, Business Region Göteborg, 2005.

³¹ Nationella och regionala klusterprofiler. Företag inom fordonsindustrin i Sverige, Arbetsmaterial, 2006.

³² Västsvenska näringslivets handelskontakter – en studie av exportflöden med fokus på EU:s nya medlemsländer, Business Region Göteborg, 2005.

automotive cluster invests heavily and to an increasing extent in R&D and collaborates closely with universities and research institutes. As discussed in the previous section, there is little doubt that the automotive cluster is the main contributor to the region's impressive BERD and the transport equipment sector is rated as the third most innovative industry sector³³. Since 1994, the automotive industry has been the target of public R&D support through a range of national collaborative R&D programmes (cf. Section 2.1.1.2). In the dominant automotive R&D programmes, Sweden's four vehicle manufacturers (the ones mentioned above plus Scania on the east coast) and the Scandinavian Automobile Suppliers receive R&D grants, which they then distribute to the R&D provider of their choice (usually within Swedish academia). These R&D programmes not only facilitate knowledge diffusion between R&D providers and industry, but also between vehicle manufacturers and between vehicle manufacturers and suppliers, meaning that competing enterprises collaborate within the same project, thereby learning from each other. It is worth noting that most of the programmes' non-industry R&D is carried out by graduate students with the explicit intent of supplying industry with qualified personnel. Moreover, within these programmes Västsverige's automotive cluster collaborates with R&D providers from all over Sweden, although there is naturally a bias towards regional providers.

Other important clusters, in terms of their share of Västra Götaland's exports in 2003, are petrochemicals (share: 10%; growth in export value 1997–2003: 27%) which, as mentioned in the previous section, is rated as the second most innovative industry sector; ICTs (share: 3.4%; growth: 10%), which is rated as the most innovative industry sector³⁴; timber (share: 2.7%; growth: 9%); food (share: 2.0%; growth: 46%); and, biomedical products (share: 1.7%; growth: 121%). Other clusters include textiles, entertainment and environmental technology. The biomedical cluster, which employs 8,000 people³⁵, is particularly R&D intensive as it tends to focus on R&D rather than production, and accounts for a smaller share of GRP and exports than might be expected. An example is the cluster's leading actor AstraZeneca; half of its products originate in R&D carried out in greater Göteborg, but most manufacturing takes place outside Västsverige. Some of these clusters contribute a substantial share of the nation's total exports within the respective NACE grouping, e.g. automotive (69%), petrochemicals (27%), food (18%) and timber (13%)³⁶.

A slightly different listing of clusters, which does not provide any rating of their relative importance, states that Västra Götaland and Halland have in common regional strengths in terms of health technology, tourism, food, environmental technology and logistics. In addition to these, Västra Götaland prioritises biomedicine, petrochemistry, automotive manufacturing, IT, textiles and wood, while Halland additionally prioritises trade and paper/print/media³⁷.

Most of the clusters mentioned above are – just like the automotive cluster – beneficiaries of national collaborative R&D programmes; in particular, there are notable recent programmes targeting the areas of forestry, pharmaceuticals and IT/telecoms. These programmes also act as network builders both between industry and R&D providers and within the respective categories.

There are several internationally competitive research environments corresponding to the region's clusters, both within universities and research institutes. In many cases, effective direct

³³ European Innovation Scoreboard 2004, Comparative Analysis of Innovation Performance, SEC(2004) 1475, European Commission, 2004.

³⁴ European Innovation Scoreboard 2004, Comparative Analysis of Innovation Performance, SEC(2004) 1475, European Commission, 2004.

³⁵ Regional konkurrenskraft och sysselsättning, Operationellt program, Västsverige, 2007-2013, 2006-10-31.

³⁶ Västsvenska näringslivets handelskontakter – en studie av exportflöden med fokus på EU:s nya medlemsländer, Business Region Göteborg, 2005.

³⁷ Regional konkurrenskraft och sysselsättning, Operationellt program, Västsverige, 2007-2013, 2006-10-31.

supplier-customer relationships exist between universities and industry, e.g. in the automotive and biomedical clusters, and between research institutes and industry, e.g. in the automotive, ICT, food, environmental technology and textiles clusters. The region's research institutes often play a key role in technology transfer between universities and industry, as do university technology parks and incubators. An example of one role of research institutes is the membership programmes run by most of the institutes, where enterprises – to a large extent (but not exclusively) SMEs – jointly fund pre-competitive collective R&D carried out by the institute. Such programmes act as technology transfer instruments and network builders. The importance of such institute-based collective R&D varies greatly depending on the sector, but has, for example, proved very important for the region's textile cluster around Borås.

3.1.3 The regional economy in the international context

Openly available data on the importance of FDI in Västsverige are scarce. In 2005, there were 3,700 foreign-owned establishments in Västsverige that employed 122,000 people³⁸, corresponding to 24% of the total workforce, which is slightly above the national average of 21% (2004, Statistics Sweden). In 2003, foreign-owned establishments in Västsverige accounted for 34% of industry revenues in the region, which is slightly above the national average of 31%³⁹. Half of all employees in the private sector work for international companies⁴⁰. It is noteworthy that Västra Götaland's three largest private companies⁴¹, Volvo Car (16,625 employees), Saab Automobile (5,275 employees) and Lear Corporation Sweden (3,925 employees) are foreign-owned (by Ford, General Motors and the Lear Corporation, respectively) (2005, Statistics Sweden) and all belong to the automotive cluster. Thus, the importance of FDI in Västra Götaland's automotive cluster is massive.

As mentioned in the previous section, the automotive cluster accounted for 49% of Västra Götaland's exports in 2003, petrochemicals 10%; ICT 3.4%; wood 2.7%; food 2.0% and biomedical products 1.7%. The clusters showing the strongest growth in export value in the period 1997-2003 were automotive (137%), biomedical (121%), food (46%) and petrochemicals (27%). The region's three major ports are Göteborg, Uddevalla and Varberg, where the former by far is the largest in the Nordic countries and accounts for almost a third of Swedish foreign trade (Port of Göteborg).

3.1.4 The local financial market

Industrifonden ("The Industry Fund") is a foundation set up by the government in 1979 to promote innovative Swedish companies by investing equity capital or granting loans, but it receives no recurring government funding and makes all investments on a commercial basis. The fund focuses on the industry and clean technology sectors, ICTs and life sciences. Over the period 2005/2006 it invested approximately €33 million nationwide. In 2006, Industrifonden opened a branch office in Göteborg. By the end of 2006, it had six investments in excess of €1.1 million (SEK10 million) in companies in Västsverige, four in industry and one each in ICTs and life sciences. Industrifonden is also co-owner of Innovationsbron (see Section 3.2.2).

The Swedish Private Equity & Venture Capital Association (SVCA) has 15 members in Västsverige. In 2005, €39 million in venture capital was invested in Västsverige, equivalent to 17% of the overall venture capital investments in Sweden (cf. the region's 19% share of GDP). From 2004 to 2005, venture capital investments in Västsverige increased by 37% in terms of amount invested and 26% in terms of number of investments. Based on data for the first three quarters of 2006, a

³⁸ Utlandsägda företag 2005, Swedish Institute for Growth Policy Studies, 2006.

³⁹ Strukturstudie av näringslivet i Sverige 2003, Swedish Institute for Growth Policy Studies, 2006.

⁴⁰ Regional konkurrenskraft och sysselsättning, operationellt program Västsverige, 2007-2013, Västra Götalandsregionen och region Halland, 2006.

⁴¹ Except the remainder of the Volvo group, which in 1999 sold its automobile division to Ford, is considered as one single company, in which case it is the second largest private employer in the region.

substantial continued growth in invested amount appears likely, although the number of investments is likely to be lower than in the preceding year (SVCA). There are four formal business angel networks in Västsverige, but no statistics on amounts invested are available (SVCA).

3.2 Policy context

3.2.1 Policy objectives

In the 1970s, the political goal for everyone to have the opportunity to pursue tertiary education led to growth in student numbers at the established universities and the creation of new university colleges. This expansion continues with increased student populations and conversion of some of the university colleges to universities, although not yet in Västsverige. The policy statement that high-quality undergraduate education requires high-quality research referred to earlier had a dramatic effect on HERD (cf. Section 2.2.2). In the area between education and R&D policy, the policy establishing that the universities are to be the main providers of publicly funded R&D has also positively influenced HERD at the expense of funding for research institutes, although this development has in the last couple of years been slightly reversed in favour of the research institutes (cf. Section 2.2.2). The “Innovative Sweden” White Paper outlines several sub-priorities outside the R&D domain, including seizing the opportunities presented by globalisation, using the public sector as an engine for sustainable growth, promoting public procurement of innovations and stimulating entrepreneurship. Defence materiel procurement programmes partly aim to procure innovative technologies. The objective of monetary policy is to maintain price stability, which the Sveriges Riksbank (Bank of Sweden) has interpreted as a low, stable rate of inflation of around 2%. Another key function of the Riksbank is to promote a safe and efficient payment system.

All of the operational target areas of the Regional Structural Funds Programme for Västsverige discussed in Section 2.2 contain non-RTD policies with obvious emphasis on stimulating entrepreneurship, innovation and sustainable development. On the same note, the Regional Development Strategies for both Västra Götaland and Halland almost in their entirety target non-RTD policies to directly and indirectly promote innovation-friendly environments, a favourable business environment, knowledge development and growth, as well as quality of life for their citizens. The financial resources for Västra Götaland’s Regional Growth Programme are approximately €66 million per annum 2004–2007, of which approximately €26 million are of local and regional public origin and approximately €20 million are of private origin. For Halland, the corresponding resources are approximately €19 million p.a., of which approximately €2.3 million are of local and regional public origin and approximately €2.7 million are of private origin.

3.2.2 Policy instruments

Sweden no longer has any R&D tax incentives (which it had prior to 1982), but there have been a couple of recent changes in the tax code that may lead indirectly to increased R&D investments. Since 2001, foreign experts, executives, scientists and researchers may only have to pay tax on 75% of their income during their first three years in Sweden, provided the employer’s application to the tax authority is approved. The (national) inheritance tax was abolished in 2005, partly in an attempt to facilitate succession in unlisted companies (usually SMEs) and to encourage them to take a longer-term view, possibly including R&D investments and growth ambitions. At the end of March 2007 the new government which took office in 2006 stated that it will live up to its election promise to retroactively abolish the (national) wealth tax in 2007. It is expected that this will lead to enhanced access to venture capital and thus eventually boost growth, particularly among SMEs.

Arguably the strongest policy interactions with regards to R&D policy come from tax and labour policies. High social costs and inflexible labour legislation mean high labour costs. Moreover, high-calibre international recruitment is made difficult by high and progressive income taxes

(despite the time-limited tax incentive for foreigners) and by the high cost of living, which is also due to tax legislation to a large extent (and to some extent to labour legislation). Such conditions translate into distinct comparative disadvantages for Sweden, meaning that many MNCs relocate R&D activities to other countries, while smaller companies may not invest in R&D at all. On a similar note, would-be entrepreneurs are often deprived of sufficient incentives to take risks, both in terms of setting up a company and in pursuing its growth. On the one hand, this is due to the level of income taxes and on the other hand it is due to the fact that profits on investments in one's own company are taxed at a higher rate than investments in publicly listed companies (there are limitations as to the share of profits that may be taxed as dividends and how much must be taxed as wages (at a higher rate)). The new government has indicated that it plans to address this issue, which has its origin in a law from 1990, but this has yet to happen. It should be noted that the issues above have arisen despite Sweden's having a relatively low corporation tax rate (28%).

Deregulation of the national electricity market in 1996 did not lead to the envisaged degree of competition and has thus not led to decreasing prices as intended, but rather the opposite. The very high electricity prices have recently (autumn 2006) made companies in energy-intensive industries, such as paper and pulp, cancel or postpone major investments or even close down plants, which has had a negative impact on corollary R&D investments. Major reasons for the increase in electricity prices are the supplier oligopoly and inadequate supply, partly as a result of the premature closing of two nuclear reactors (for political reasons) and partly due to increased energy taxes, both of which have their origins in environmental policy. On the other hand, the current situation may also inspire further investments in R&D in environmentally friendly technologies, which is a key goal of environmental policy.

The previous government began a process of developing a national strategy for public procurement of innovations in order to boost industry R&D investments and national competitiveness. Following the 2006 change of government, it is unclear whether this initiative will be continued.

Entrepreneurship programmes have been set up to disseminate best practice methods to influence attitudes towards entrepreneurship in primary and secondary schools. There are also supplementary activities directed towards universities, including development of entrepreneurship courses, and continuing education of business advisors.

There is a large number of publicly funded actors that aim to support entrepreneurs. The Swedish Agency for Economic and Regional Growth (NUTEK) promotes entrepreneurship, supports business development and aids in regional development. During 2005 and 2006, NUTEK provided SMEs with approximately €14 million to support product and service development⁴².

Innovationsbron (The Innovation Bridge) is a national organisation that aims to commercialise research-related ideas through business development and incubators as well as by providing seed funding. It has seven regional offices, one of which is in western Sweden, but its geographical responsibility is larger than the region of Västsverige. Innovationsbron's national budget for 2006 for direct funding and engagement in newly started companies amounted to approximately €11 million.

ALMI Företagspartner (ALMI) is another national organisation, which aims to stimulate growth and development for SMEs and innovators, provides venture capital and offers advice on business development. ALMI has one regional office in Västra Götaland and one in Halland. While the government retains 51% ownership in the regional offices, the remainder is owned by regional and local public organisations. In 2005, ALMI invested approximately €7 million nationwide.

⁴² Riskkapitalbolagens aktiviteter och annan finansiering i tidiga skeden, tredje kvartalet, R 2006:25, NUTEK, 2006.

In terms of financial support, verification, pre-seed funding and seed funding is provided by VINNOVA, Innovationsbron, ALMI, business angels and some university holding companies, among others. Equity in the start-up phase is provided by venture capital companies, business angels, Industrifonden and to some extent by Innovationsbron and university holding companies.

The Regional Structural Funds Programme and the Regional Development Strategies consider a wide range of instruments, including support for regional foresight activities, advisory services for entrepreneurs, development of new and support of existing incubators and support for networks and technology test beds.

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

Policy Areas	Policies complementary to RTD instruments affecting policy area*	Effects on R&D capacity of the region
Improving R&D governance	Support for regional foresight activities	Formulation of regional strategies
Creation of an innovation friendly environment	Advisory services for entrepreneurs Development of new and support of existing incubators	Positive impact on demand for R&D services (in-house or externally) Creation of benevolent environments for R&D and innovation
Development of human capital	Increased enrolment at universities and university colleges Entrepreneurship programmes in primary and secondary schools, and universities	Increased supply of educated people Creating a positive attitude towards entrepreneurship, with corollary effects on demand for R&D services
Networking, co-location and clustering measures	Support of networks and technology test beds	Positive impact on growth prospects for entrepreneur-led enterprises
Knowledge and technology transfer to enterprises	Financial support to university holding companies ⁴³ (national)	Positive impact on technology transfer from academia
Research collaboration of public research organisations with private sector	None	None
Support for public research	Regulatory changes for university holding companies ⁴⁴ (national)	Positive impact on technology transfer from academia
Financial R&D measures for the private sector	Several national agencies with local offices in western Sweden provide seed and venture capital, as well as equity (national)	Positive impact on growth prospects for entrepreneur-led enterprises

*Examples of such policies are fiscal, industrial, regional, educational, labour, trade and competition policies.

3.3 Conclusions

Västsverige clearly has some very notable strengths, including several internationally competitive manufacturing industry clusters, a vigorous service sector, low unemployment (cf. Graph 2) and the Nordic countries' largest and most dynamic logistics centre. Industry is supported by internationally competitive universities and high-quality research providers in both academia and institutes. Data indicate that the region's industry is very R&D intensive. The automotive cluster – effectively the epitome of Västsverige – massively dominates the region's industry, which is illustrated by the column for employment in medium high technology manufacturing in Graph 2; the decline in employment between 1999 and 2003 was mainly due to productivity improve-

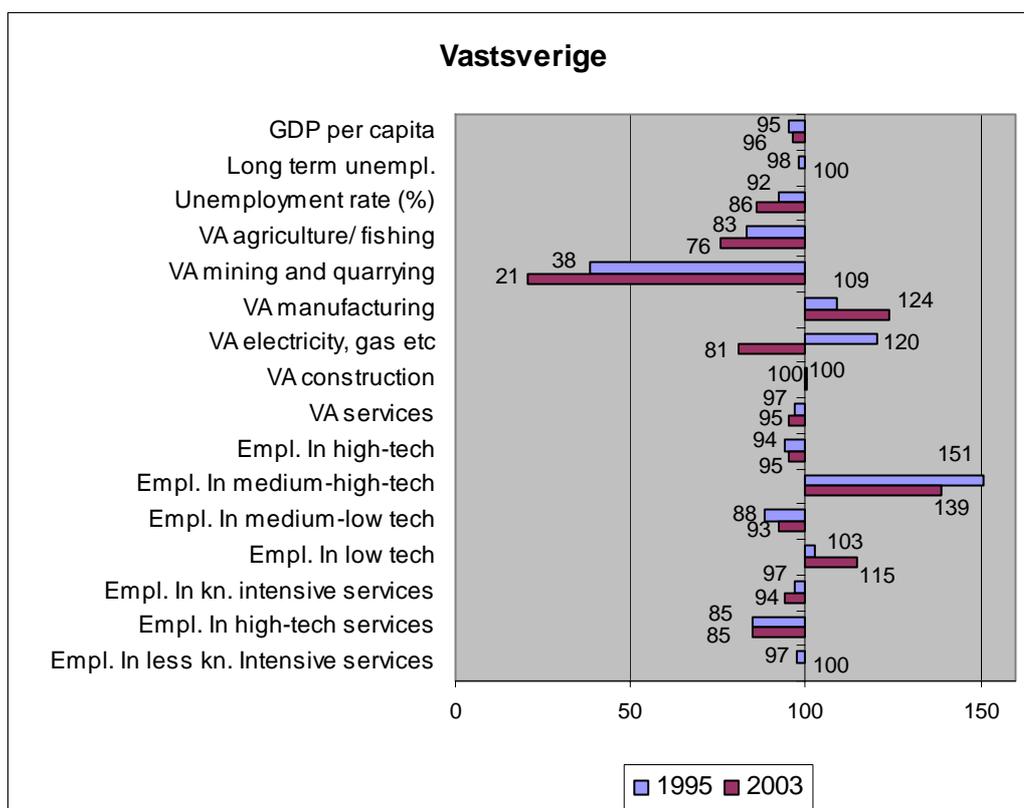
⁴³ These are in the Swedish context considered part of research policy and are therefore discussed in Chapter 2.

⁴⁴ These are in the Swedish context considered part of research policy and are therefore discussed in Chapter 2.

ments. The column for value added in manufacturing clearly shows Västsverige to be Sweden's industrial heartland. The sectors exhibiting notable decreases in value added (see Graph 2) are of little overall importance to the region; agriculture/fishing (NACE A-B) accounts for 1% of GRP, mining (NACE C) 0.1% and electricity and gas 2% (NACE E), meaning that they do little to tarnish the overall picture.

From a developmental point of view, Västsverige is highly diverse with sharp contrasts. In several inland municipalities both the economy and the number of inhabitants is declining, while at the same time most of the coastal municipalities, and in particular those around greater Göteborg, are prospering. From this perspective, it is remarkable that the region is close to the national GDP per capita (see Graph 2). While there is a large number of SMEs in the region, most engage in little or no R&D. One of the region's greatest assets – the automobile cluster – may also be seen as a potential liability due to its massive regional dominance. The region's three largest private employers – all belonging to the automotive cluster – are foreign-owned and constitute small units within US-owned automotive giants that have no emotional ties to the region. With high labour costs and inflexible labour legislation, coupled with fierce international competition, globalisation poses particular challenges to the automotive cluster. The "ship yard crisis" of the 1970s, when the region's previously vibrant ship building cluster all but vanished in a few years in the face of fierce competition from Asian ship yards with low wages and flexible labour conditions, is still fresh in the memory of many in the region.

Graph 2: Comparison of Västsverige's economic structure with the economic structure of Sweden as a whole.



Note: long term unemployment, unemployment rate and employment in high tech 1999, 2003.

There is little doubt that R&D is a cornerstone in much of the region's development, past, present and future, as is evidenced by the concentration of BERD in the region. The automotive cluster invests heavily in R&D and collaborates closely with universities and research institutes, mainly in the region. The national collaborative R&D programmes to support the automotive industry that have been in existence since 1994 have probably led to some additional private

R&D investments, but their effect should not be overly exaggerated. The automotive cluster is vibrant enough in its own right to pursue massive R&D efforts even without public support. Equally important in this context is probably the universities' production of qualified young graduates (most of the university R&D within the programmes is carried out by graduate students) for the industry to employ for in-house R&D efforts. Having said that, industry of course benefits from and exploits publicly funded R&D results, whether produced in collaboration with universities and institutes or not, but the extent to which public R&D investments spur additional industry investments in R&D or affect growth is likely to be limited. However, there are strong indications and ample anecdotal evidence from industry that the national R&D programmes have enhanced the international competitiveness of Västsverige's automotive enterprises and tier-1 suppliers. Representatives of both Volvo Car and Saab maintain that the collective research efforts together with internationally competitive R&D providers and the fact that the Swedish government co-finances R&D are strong arguments within Ford and General Motors when determining which corporate R&D projects – if any – are to be carried out in their Swedish subsidiaries. Being such corporate centres of excellence are seen by industry pundits as a necessary prerequisite to ensuring that Sweden will continue to have an automotive industry in the future – which of course is the main goal of the national R&D programmes.

The region's second fastest-growing cluster is the biomedical cluster. This has also been the target of national collaborative R&D programmes for a number of years and is particularly R&D intensive. Most of the region's other industry clusters, including petrochemicals, ICTs, food and wood, have also been – and still are – recipients similar national collaborative R&D programmes. There is no reason to doubt that also these programmes have had benign effects on the development of the region's clusters.

A range of initiatives to stimulate entrepreneurship and promote innovation-friendly environments are bound to pay off eventually, and thus also have a positive impact on R&D intensity. In fact, several recent surveys have shown a marked increase in young people's interest in eventually starting their own companies. The upcoming national policy to promote public procurement of innovative technologies should have a positive impact as well; indeed, Sweden has a history of successful technology procurement, mainly within energy-related technologies, meaning that implementation of a national strategy would have relevant experiences to build upon. On the negative side is the (national) tax legislation, which deprives many potential entrepreneurs of sufficient incentives to pursue their ideas, while Swedish-based MNCs increasingly often relocate their R&D to countries with lower costs and more flexible labour legislation. This is likely to be one reason why Sweden's BERD (as proportion of GDP) has been decreasing from a peak in 2001, although Västsverige's BERD (as a proportion of GRP) increased throughout the period 1999–2003. Deregulation of the electricity market has inadvertently led to increased electricity costs, which has made companies in energy-intensive sectors postpone or cancel substantial investments, with corollary effects on R&D investments. Sweden has no R&D tax incentives.

4 Conclusions

4.1 Assessment of the RIS

With two internationally competitive universities, four university colleges and five research institutes Västsverige's knowledge creation capacity is excellent. All the universities and university colleges have some form of science and technology park and incubator nearby, but this system has evolved furthest around the universities in Göteborg. The region's research institute sector is small and under-funded and the institutes thus have some difficulty fulfilling their role in the regional investment system (RIS). However, their financial situation has improved recently and is expected to continue to do so. The region's knowledge absorption capacity, which is nearly identical to the country's as a whole, is very good. Sweden is the EU leader in lifelong learning. Västsverige's population is well educated and the region's human resources in science and technology account for 42,5% of the active population according to Eurostat in 2006.

Västsverige has several internationally competitive manufacturing industry clusters. The automotive cluster massively dominates the region's industry. However, the automotive cluster is also a potential liability given its regional dominance and the fact that the region's three largest private employers – all part of the automotive cluster – are foreign-owned. While there are a large number of SMEs in the region, most engage in little or no R&D and many have no ambition to grow and expand.

Overall, there is a good match between the needs of the region's industry and its knowledge creation capacity. This is particularly clear in the automotive and biomedical sectors, where both universities and industry excel. The automotive cluster is furthermore a good example of vigorous vertical collaboration and a notable share of the vehicle manufacturer's supplier base is located in the region. There is also some degree of horizontal collaboration between nominally competing enterprises through collaborative R&D programmes. The role of the research institutes in the innovation system is both as creators and diffusers of knowledge. While university-industry collaboration mainly takes place with larger enterprises with good absorption capacity, institutes to a significant extent work with SMEs that generally have limited absorption capacity. The institutes normally deal with more applied problems than the universities, thus addressing industry needs more directly. Most of the research institutes have their own form of collaborative R&D programmes that also facilitate horizontal and vertical collaboration. Particularly in sectors that receive less attention from policy makers and the media than, for example, the automotive and biomedical sectors, the research institutes play important roles; examples include the food and textile sectors.

While there is a good topical match between the needs of the region's industry and the region's knowledge creation capacity, there is likely to be an imbalance between supply and demand. The region's share of national BERD is 35%, but the corresponding share of HERD is only 17%. The region's share of HERD also seems low when compared to its share of GDP (19%) and the total workforce (21%),. On the other hand, it is probably unrealistic for the regional knowledge creation capacity to completely satisfy the needs of enterprises competing in a global economy. In this context it is important to recall that the region's two automobile manufacturers, Volvo Car and Saab, are fully owned subsidiaries of Ford and General Motors, respectively, meaning that much of their knowledge supply is imported from elsewhere in the respective groups.

Västsverige's GRP has grown steadily since 1993 and essentially at the same rate as GDP. In contrast, the region's BERD as a fraction of GRP has increased from 3.9% in 1997 to 5.3% in 2003, which is out of step with Sweden as a whole, where BERD as a fraction of GDP peaked at 3.4% in 2001 and was down to 3.1% in 2003. Also employment in R&D in industry increased more rapidly in Västsverige in the period 1993–2003 than nationally. These differences probably reflect the R&D needs of the region's industry rather than systemic inefficiencies.

The university system keeps production of human capital on par with GRP; the increase in the number of students enrolled increased at a rate commensurate with GRP over the period 1993–2004, while the number of doctorates awarded did not increase quite as rapidly as GRP over the period 1999–2004. Since BERD is rising faster than GRP, the output of graduates may perhaps appear to be insufficient. Following a period of growth in the 1990s, the institute sector has reduced its personnel since 2000 due to severe budget cuts.

Exhibit 3: Strengths and weaknesses of the regional innovation system

	Strengths	Weaknesses
Knowledge creation capacity	Two internationally competitive universities and six regional university colleges Five professional research institutes	The region's share of national HERD is only half its share of BERD (17% vs. 35%)
Knowledge diffusion capacity	Five professional research institutes Nine science parks and incubators	Inefficient collaboration and knowledge diffusion between R&D providers and industry
Knowledge absorption capacity	Lifelong learning and human resources in science and technology are strong Larger enterprises, e.g. in the automotive and biotechnology clusters, are intensely engaged in in-house R&D, meaning that they have good absorption capacity. They are also increasingly employing research graduates	Most SMEs engage in little or no R&D
Interactions of main actors	The larger enterprises, particularly within the automotive and biotechnology clusters, have a tradition of collaborating with universities and research institutes. Collaborative R&D programmes are leading to increased B2B interaction	Collaboration between universities and research institutes is insufficient
RTD governance capacity	The region's politicians are committed to supporting industry development and innovation-friendly measures	Swedish RTDI policy is set at the national level, meaning there is limited regional autonomy in RTDI
Knowledge vs. economic specialisation	The region's universities and research institutes are specialised in fields that well match the needs of the region's industrial clusters	Given that the region's share of national HERD is only half the region's share of BERD, the region's knowledge creation capacity cannot fully satisfy the needs of the region's industry
Economic Structure	Highly competitive industry clusters, particularly the automotive and biotechnology clusters	Vulnerability due to the massive dominance of the automotive cluster, which to a large extent is foreign-owned
Access to seed and venture capital	Several potential sources of public support	Fragmented and under-funded public support system The region's share of VC investments is smaller than would be expected considering the region's strong and R&D intensive industry

Since Swedish RTDI policy is set at the national level, there is limited regional autonomy in terms of RTDI policy and investments. The existing regional autonomy is basically limited to innovation-friendly measures in the context of Regional Structural Funds and Regional Growth

Programmes. The financial mechanisms available in the region (compared to the country as a whole) are in most cases insufficient with regards to the region's GRP.

The region's dominant industrial clusters invest heavily in R&D from sheer necessity as without constant R&D efforts they would stand no chance in the global marketplace. The impact of public investments in R&D targeting these clusters is believed to be important, albeit limited; the enterprises constituting these clusters would have made the most of their R&D investments anyway. However, the marginal – perhaps even catalytic – effects of public investments in R&D on industry's competitiveness should not be underestimated. This may be particularly evident in the output of graduates available to industry. Moreover, the region's politicians' commitment to supporting industry development and innovation-friendly measures is likely to be a strong signal to industry.

However, the notion of a RIS in Västsverige is largely artificial. Västra Götaland and Halland are not integrated into one region by any stretch of the imagination and it is therefore questionable whether they can be said to share an innovation system. Moreover, it can also be questioned whether Västra Götaland has a unique RIS; greater Göteborg certainly has a vigorous innovation system, but much of the county is a virtual backwater in terms of RTDI.

4.2 Assessment of policies

The most recent research policy bill, the Regional Structural Funds Programme and the Regional Growth Programmes, all aim to exploit and build upon scientific fields and industry sectors that are already internationally competitive. The main weaknesses of the NIS – also reflected in the RIS – are, arguably, a result of a belief in the linear model of research and in the doctrine that universities should be the main providers of publicly funded research. While the linear model and the research doctrine remain cornerstones of research policy, the political will to address the weaknesses of the NIS emerged during the 1990s and in earnest during the last few years, but it is uncertain to what extent the conservative government that took office in 2006 will continue the previous government's policies. It is clear that these weaknesses were recognised when drafting the current Regional Structural Funds and Regional Growth Programmes.

The overall objective of research policy is for Sweden to be a leading research nation, but much more powerful than additional public R&D investments to achieve this, would be to address the current tax and labour legislation disincentives to R&D investments. In contrast, the recent abolition of inheritance tax and the upcoming abolition of capital tax are expected to positively influence some aspects the NIS (and the RIS) as outlined in Exhibit 4. The cornerstones of research policy mentioned (i.e. the belief in the linear model of research and the presumption that universities can best meet society's research needs) conflicts with innovation policy's goal of exploitation of R&D results, since – according to most pundits – both these presumptions have outlived themselves.

Employment issues, mainly in the form of sustainable growth, are clearly at the top of the new conservative government's list of priorities, closely followed by entrepreneurship and enterprise. Research is indeed also prioritised, but the division of responsibilities for research and innovation between the Ministry of Education, Research and Culture and the Ministry of Industry, Employment and Communications, respectively, is unfortunate. In the past, this division has been an obstacle to coherent policy formulation and implementation.

The national collaborative industry sector R&D programmes developed in order to ensure continued prosperity for both industry and society are very powerful. These programmes have proven successful in their endeavour to strengthen the international competitiveness of selected industry sectors, and indirectly in boosting investments in R&D. A series of such programmes targeting the automotive industry particularly favours Västsverige's automotive cluster (see also Annex 4).

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

<i>[S&Ws from Exhibit 3]</i>	Effective approaches <i>[only measures which appear to have a significant contribution to facing the S&Ws are presented]</i>	Failures <i>[only measures which appear to have a significant negative effect or failed to address effectively the S&Ws]</i>
Strengths		
Two internationally competitive universities	Additional government funding	
Five professional research institutes	Clear policy statement on the role of institutes in the NIS Restructuring of the institute system Reinstated and slightly increased base funding	Nonexistent policy on the role of institutes in the NIS (previously) Dramatic reductions in base and project funding (previously)
Large enterprises with good absorption capacity	Collaborative R&D programmes to foster B2B interaction and stimulate R&D investments Education of research personnel (for enterprises to employ)	
Highly competitive industry clusters	Collaborative R&D programmes to foster B2B interaction and stimulate R&D investments	Tax and labour legislation discourage R&D investments in Sweden
Weaknesses		
Inefficient collaboration and knowledge diffusion between R&D providers and industry	Collaborative R&D programmes Improved conditions for university holding companies, including capitalisation	Dramatic reductions in base and project funding for research institutes (previously)
Most SMEs engage in little or no R&D activities	New instrument to provide SMEs with the funds to carry out or buy R&D Abolition of inheritance tax will facilitate generation shifts in SMEs and will encourage R&D and growth (effect to be confirmed)	Dramatic reductions in base and project funding for research institutes (previously)
Vulnerability due to massive dominance of the automotive cluster	Dedication of collaborative R&D programmes to sectors important for the region Diversification into sectors other than the automotive industry	Tax and labour legislation discourage R&D investments in Sweden
Access to seed and venture capital	Abolition of capital tax will increase supply of capital that has fled the country (effect to be confirmed)	Lack of coordination of public support system

4.3 Policy challenges

Overall, the RIS faces much the same policy challenges as the NIS, namely inadequate collaboration between industry and R&D providers, insufficient commercialisation of R&D and too few new business start-ups.

While collaboration between industry and R&D providers in the region's dominating clusters is currently fairly good, there are still improvements to be made to further enhance collaboration. (Generic structural challenge).

Outside the region's main clusters, collaboration between industry and R&D providers is nowhere near as good as within the clusters, in particular when it comes to SMEs. In the quest to involve SMEs in R&D, important policy changes have either been implemented or are due to be implemented (cf. Section 4.2), but a lot remains to be done. In this context, the fragile position

of the research institutes deserves careful attention, since they are often SMEs' only realistic means of accessing qualified R&D services. (Generic catch-up challenge).

The challenges in terms of commercialisation and new businesses require a change in the public mindset regarding entrepreneurship, additional seed and venture capital and improved financial incentives for entrepreneurs. The first is underway (cf. Section 3.3), but efforts must continue. A potentially important contribution to the second may come from the upcoming abolition of capital tax, but additional public funds and coordination of the different public actors in the field are, in the long run, likely to be good investments as well. Policy measures to provide adequate financial incentives for entrepreneurs (cf. Section 3.2.2) have been absent so far (with the exception of the abolition of the inheritance tax) and are sorely needed. Additionally, some form of tax incentive for R&D investments, at least for SMEs, would certainly enhance BERD and would over time likely be a good investment. (Generic structural challenge).

Västsverige's "ship yard crisis" in the 1970s offers a sufficiently recent example of what could happen if changing global realities do not quickly lead to well-considered industry adaptation. The region's present massive dependency on the automotive cluster needs to be addressed from at least two perspectives. On the one hand, both industry and the RIS must continuously adapt to increasingly fierce global competition and an ever-more important component in this quest for competitiveness is without a doubt increased investments in R&D and in the regional knowledge base, e.g. to meet new automobile emission requirements introduced by the EC. On the other hand, the region ought to reduce its dependency on the automotive cluster and use its resources wisely to simultaneously develop other sectors and clusters. (Specific structural challenge).

Västsverige's current competitiveness may seem enviable to many other regions. However, to stay ahead, the region needs to address a series of tough challenges. The region's actors produce sound and internationally competitive R&D. The challenge is how to exploit it. A dilemma in this context is that the responsibility for many such potential measures traditionally rests with the national authorities (Generic structural challenge).

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Annex 1: Definition of policy mix typology

- **Improve innovation and 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 in support of R&D investments and innovation. This could include changes in the organisation of decision making, national and regional foresight, measures for improvement of evaluation etc.
- **Creation of an innovation and entrepreneurial 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. In this category the following measures are included:
 - Promotion of an entrepreneurial and innovation culture in the private sector by undertaking awareness initiatives and by changing regulations and disincentives which discourage entrepreneurship;
 - Regulation and initiatives addressing the 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 of spin-offs and New Technology Based Firms (NTBFs). Direct support includes public financial schemes such as pre-seed and first stage capital, while indirect measures include funding of incubators, training related to entrepreneurship, etc.
- **Development of human capital:** This category includes measures aiming at the upgrading of 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 remedying deficiencies in innovation systems by promoting cooperation, networking and interaction. Measures promoting co-location of industrial and scientific organisations (e.g. innovation poles), funding for clusters infrastructure and activities with technological and innovation orientation and support of innovation networking (e.g. information exchange clubs) are some of possible interventions under this category.
- **Knowledge and technology transfer to industry:** This category includes policies supporting directly or indirectly knowledge and technology transfer from universities and public research organisations and commercialisation of public research results. Direct support includes aid schemes for utilising technology-related services or for implementing technology transfer projects from 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 private sector:** Measures supporting collaborative research projects and development of common (for use by private and public sector) research infrastructures are included.
- **Support of public research:** Measures under this category include:
 - public investments in research infrastructure and direct funding of public R&D e.g. setting up new infrastructures, 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 Summary 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

Summary 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

Summary 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 (EUR million): Share (%) of sectors to total
 - Agriculture/ fishing
 - Mining and quarrying
 - Manufacturing
 - Electricity, gas and water supply
 - Construction
 - Services (excl. extra-territorial organizations 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

Table 1 HEIs and research institutes in Västsverige. Source: organisations' web sites

Universities	
Göteborg University Staff 2005: 2 343	<ul style="list-style-type: none"> • Sahlgrenska Academy (health science) • Faculty of Science • Faculty of Arts • Faculty of Fine and Applied Arts • Faculty of Social Science • School of Business, Economics and Law • Faculty of Education • IT university • Education and Research Board for Teacher Training
Chalmers University of Technology Staff 2005: 759	<ul style="list-style-type: none"> • Applied Mechanics • Applied Physics • Architecture • Chemical and Biological Engineering • Civil and Environmental Engineering • Computer Science and Engineering • Energy and Environment • Fundamental Physics • Materials and Manufacturing Technology • Mathematical Sciences • Micro technology and Nano-science • Product and Production Development • Radio and Space Science • Shipping and Marine Technology • Signals and Systems • Technology Management and Economics
University West (university college) Staff 2005: 260	<ul style="list-style-type: none"> • Department for Economics and Informatics • Department of Social and Behavioural Studies • Department of Technology, Mathematics and Computer Science • Department of Nursing, Health and Culture
University College of Borås Staff 2005: 338	<ul style="list-style-type: none"> • Swedish School of Library and Information Studies • School of Business and Informatics • School of Engineering • School of Education and Behavioural Sciences • School of Textiles • School of Health Sciences
Halmstad University (university college) Staff 2005: 257	<ul style="list-style-type: none"> • School of Business and Engineering • School of Information Science, Computer and Electrical Engineering • School of Social and Health Sciences • Department of Teacher Education
University of Skövde (university college) Staff 2005: 227	<ul style="list-style-type: none"> • School of Humanities and Informatics • School of Technology and Society • School of Life Sciences
Research institutes	
Imego Staff 2005: 40	<ul style="list-style-type: none"> • Sensors • Microelectronics
SP Staff 2005: 850	<ul style="list-style-type: none"> • Measurement technology • Energy • Construction and buildings • Electronics and ICT • Fire and Protection • Materials technology • Transport and vehicles • Wood technology and construction • Food and biotechnology
IFP Research Staff 2005: 40	<ul style="list-style-type: none"> • Fibres • Polymers • Composites
IVF Staff 2005: 100	<ul style="list-style-type: none"> • Generic and applied industrial technologies
SIQ Staff 2005: 13	<ul style="list-style-type: none"> • Quality control systems

Table 2 Number of enrolled students in HEIs [headcount]. Source: Statistics Sweden.

	1977/78	1980/81	1985/86	1990/91	1995/96	2000/01	2005/06
Sweden. total	177 405	187 851	185 003	203 177	285 713	329 970	389 096
Västsverige. total	28 872	32 204	32 048	33 555	50 891	61 737	74 006
Göteborg University	22 551	23 614	21 929	21 397	29 512	30 534	35 576
Chalmers University of Technology	4 625	5 086	6 704	6 932	8 211	8 940	10 048
University College Borås	1 549	2 176	2 103	1 859	3 967	6 674	8 466
University College Halmstad	117	560	622	1 478	4 183	6 057	7 773
University College Skövde	30	768	690	1 183	2 717	4 237	5 878
University College West				706	2 301	5 295	6 265

Table 3 Human resources in science and technology [% of active population], students with education of ISCED level [% of all students]. Source: Eurostat.

	1998	2000	2002	2004	2006
Sweden					
Human Resources in Science and Technology	46,0%	49,4%	46,5%	47,9%	48,9%
Upper secondary education (ISCED level 3)	25,9%	23,8%	22,8%	21,3%	
Tertiary education (ISCED levels 5-6)	12,2%	14,3%	15,7%	17,5%	
Västsverige					
Human Resources in S&T	43,0%	50,1%	45,2%	46,2%	46,0%
Upper secondary education (ISCED level 3)	24,9%	24,0%	27,5%	21,6%	
Tertiary education (ISCED levels 5-6)	17,9%	12,3%	17,0%	15,9%	

Table 4 Unemployment [%]. Source: Eurostat.

	1999	2000	2001	2002	2003	2004	2005
Sverige	7,6%	5,4%	4,8%	5,1%	5,7%	6,5%	7,5%
Västsverige	7,0%	5,1%	4,3%	4,8%	4,9%	6,1%	6,8%

Table 5 EPO patent applications [applications per million inhabitants]. Source: Eurostat.

	1991	1993	1995	1997	1999	2000	2001	2003
Sweden, total	139	165	213	299	334	367	323	137
Mech. Eng. (IPC Section F)	20	21	23	25	26	32	31	15
Västsverige, total	124	169	196	292	309	358	343	152
Mech. Eng. (IPC Section F)	20	22	32	37	32	42	46	25

Table 6 GOVERD and BERD as fraction of GDP [%]. Source: Statistics Sweden.

	1995	1997	1999	2001	2003	2005	2007
GOVERD/GDP		0,93%	0,73%	0,93%	1,0%	0,95%	0,92%
BERD/GDP	2,3%	2,6%	2,7%	3,4%	3,1%	3,1%	

Correspondent calculations. GDP for 2007 estimated from extrapolation of data for 2004 and 2005.

Table 7 Number of employees in R&D per sector [headcount]. Source: Eurostat.

	1993	1995	1997	1999	2001	2003
Sweden, total		97 955	104 322	107 521	110 291	110 737
Business enterprise sector	40 371		49 323	49 823	53 484	52 346
Government sector		5 360	5 192	5 085	5 239	5 521
Higher education sector		44 182	49 643	52 480	51 465	52 500
Private non-profit sector			163	133	103	370
Västsverige, total	16 400	19 953	22 236	23 200		
Business enterprise sector	9 795	11 978	13 410	14 248	16 110	15 998
Government sector	233	102	109	95		141
Higher education sector	6 372	7 873	8 717	8 857	9 618	
Private non-profit sector						

Table 8 R&D expenditure per sector [€million]. Source: Eurostat.

	1997	1999	2001	2003
Sweden, total	7 735	8 608	10 511	10 642
Business enterprise sector	5 797	6 466	8 118	7 886
Government sector	274	289	297	371
Higher education sector	1 658	1 842	2 085	2 344
Private non-profit sector	6	10	10	41
Västsverige, total				3 135
Business enterprise sector	1 585	1 685	2 445	2 737
Government sector		5		6
Higher education sector				392
Private non-profit sector				

Table 9 GDP and GRP by NACE [€million]. Source: Statistics Sweden.

	1993	1995	1997	1999	2001	2003
Sweden, total	170 778	191 729	220 125	238 127	247 382	269 217
NACE A-B	3 798	4 512	4 547	4 318	4 113	4 248
NACE C	482	607	652	544	511	643
NACE D	27 441	37 199	41 766	45 395	44 599	46 352
NACE E	5 070	5 297	5 845	5 237	5 820	6 476
NACE F	7 560	7 398	7 770	8 437	9 460	10 213
NACE G	15 342	18 677	20 469	22 640	22 739	24 949
NACE H	2 023	2 222	2 705	3 231	3 412	3 595
NACE I	12 365	13 532	16 314	17 860	17 770	19 238
NACE J	8 998	7 368	10 674	10 050	9 023	8 714
NACE K	25 400	29 769	34 676	39 193	44 699	48 643
NACE L	10 264	9 847	11 394	11 893	11 838	12 984
NACE M	8 135	8 714	10 327	11 452	11 869	13 887
NACE N	14 437	15 425	18 212	19 918	22 018	25 671
NACE O, part of P	5 300	5 984	7 322	8 048	8 696	9 869
Not classified	24 161	25 179	27 452	29 911	30 816	33 733
Västsverige, total	31 761	36 296	40 859	45 338	47 525	52 045
NACE A-B	556	708	716	602	619	621
NACE C	43	44	27	45	33	26
NACE D	5 767	7 632	9 134	10 508	11 042	11 064
NACE E	1 044	1 203	843	828	705	1 007
NACE F	1 419	1 401	1 429	1 592	1 790	1 977
NACE G	3 087	3 773	4 155	4 510	4 688	5 215
NACE H	364	406	498	606	639	709
NACE I	2 340	2 624	3 101	3 271	3 282	3 555
NACE J	1 131	1 020	1 313	1 150	981	984
NACE K	4 852	5 637	6 384	7 337	8 102	9 019
NACE L	1 514	1 476	1 680	1 826	1 874	2 124
NACE M	1 523	1 668	1 882	2 152	2 304	2 712
NACE N	2 640	2 848	3 273	3 836	4 083	4 811
NACE O, part of P	873	986	1 200	1 260	1 357	1 578
Not classified	4 607	4 870	5 224	5 815	6 025	6 642

Table 10 Number of employees by NACE [headcount*1 000]. Source: Statistics Sweden.

	1993	1995	1997	1999	2001	2003
Sweden, total	4 077,6	4 102,9	4 015,3	4 163,3	4 345,0	4 336,5
NACE A-B	138,2	131,5	116,5	112,1	107,9	101,2
NACE C	8,7	9,1	8,6	8,1	7,5	8,0
NACE D	703,6	745,1	734,4	744,6	753,6	714,0
NACE E	34,1	32,4	32,4	32,8	30,1	34,2
NACE F	224,2	213,7	201,4	214,9	235,8	234,2
NACE G	526,7	528,2	517,1	539,7	548,7	548,9
NACE H	104,0	106,5	105,1	109,8	121,3	119,3
NACE I	285,1	279,8	273,5	286,3	296,0	286,1
NACE J	82,3	85,0	85,9	90,0	93,6	90,4
NACE K	329,6	359,9	366,7	421,6	509,0	507,0
NACE L	329,3	302,5	286,7	276,2	274,0	269,5
NACE M	398,1	370,7	356,3	367,1	378,9	411,9
NACE N	658,0	680,6	674,8	700,1	715,3	729,2
NACE O, part of P	255,7	257,9	255,9	260,0	273,3	282,6
Västsverige, total	786,9	798,9	778,8	809,4	862,8	871,9
NACE A-B	27,8	26,6	23,5	21,7	20,2	18,4
NACE C	0,3	0,3	0,3	0,2	0,1	
NACE D	157,7	168,2	163,8	170,3	177,1	170,9
NACE E	7,4	6,9	6,6	6,5	6,5	6,9
NACE F	43,2	41,9	38,2	41,9	45,4	46,2
NACE G	109,8	110,2	108,9	112,5	116,2	116,9
NACE H	20,0	20,8	19,9	20,6	23,7	24,1
NACE I	53,8	54,8	54,4	54,5	57,4	57,5
NACE J	13,0	12,6	12,2	12,2	12,8	12,0
NACE K	57,2	63,4	64,7	74,2	87,8	91,8
NACE L	53,0	49,4	46,3	44,0	47,4	48,2
NACE M	73,4	69,5	64,4	70,4	75,9	82,5
NACE N	126,7	131,6	132,7	137,6	145,1	146,6
NACE O, part of P	43,6	42,7	42,9	42,8	47,2	49,9

Table 11 Value added by NACE [€million]. Source: Eurostat.

	1995	1997	1999	2001	2003
Sweden, total	166 397	192 666	208 072	216 408	235 720
NACE A-B	4 509	4 548	4 316	4 111	4 254
NACE C	606	652	544	511	644
NACE D	37 172	41 773	45 375	44 576	46 409
NACE E	5 293	5 846	5 234	5 817	6 484
NACE F	7 393	7 771	8 434	9 455	10 226
NACE G	18 664	20 473	22 630	22 727	24 980
NACE H	2 220	2 706	3 230	3 410	3 600
NACE I	13 522	16 317	17 852	17 761	19 262
NACE J	7 362	10 676	10 045	9 019	8 724
NACE K	29 747	34 682	39 176	44 676	48 703
NACE L	9 809	11 357	11 837	11 787	12 946
NACE M	8 708	10 328	11 447	11 863	13 905
NACE N	15 414	18 216	19 909	22 007	25 703
NACE O	5 959	7 300	8 017	8 659	9 839
NACE P	20	23	27	32	43
Västsverige, total	31 403	35 640	39 505	41 478	45 459
NACE A-B	707	716	601	619	622
NACE C	44	27	45	33	26
NACE D	7 627	9 136	10 503	11 036	11 078
NACE E	1 203	843	828	705	1 008
NACE F	1 400	1 430	1 592	1 789	1 979
NACE G	3 770	4 155	4 508	4 686	5 222
NACE H	406	498	606	639	710
NACE I	2 622	3 102	3 269	3 281	3 559
NACE J	1 020	1 313	1 149	981	986
NACE K	5 633	6 385	7 334	8 097	9 031
NACE L	1 475	1 680	1 825	1 873	2 126
NACE M	1 666	1 882	2 151	2 303	2 715
NACE N	2 846	3 274	3 835	4 081	4 817
NACE O	986	1 200	1 259	1 354	1 580
NACE P	0	0	1	2	0

Table 12 Gross fixed capital formation [€million]. Source: Eurostat.

	1995	1997	1999	2001	2003
Sweden, total	30 139	34 074	40 464	42 493	42 791
NACE A-B	791	1 103	1 177	1 203	1 441
NACE C	211	312	250	224	171
NACE D	7 217	8 301	8 735	8 900	7 588
NACE E	1 481	1 931	1 874	1 788	2 146
NACE F	557	803	1 219	1 049	1 253
NACE G	2 091	2 432	3 125	2 953	2 961
NACE H	350	362	485	480	456
NACE I	4 388	4 800	6 427	6 912	6 672
NACE J	622	671	965	860	852
NACE K	6 193	7 484	9 300	11 089	11 794
NACE L	3 061	2 631	3 000	3 002	3 287
NACE M	1 108	1 098	1 261	1 305	1 226
NACE N	1 161	1 121	1 394	1 245	1 353
NACE O	908	1 027	1 254	1 483	1 592
NACE P	0	0	0	0	0
Västsverige, total	5 778	6 652	7 728	9 136	9 291
NACE A-B	143	201	249	217	266
NACE C	12	24	17	4	8
NACE D	1 587	1 909	2 033	2 472	2 138
NACE E	308	294	280	347	394
NACE F	107	162	283	181	233
NACE G	418	483	554	569	652
NACE H	62	56	85	100	75
NACE I	888	1 096	1 150	1 520	1 415
NACE J	97	103	152	132	137
NACE K	1 086	1 387	1 747	2 242	2 559
NACE L	471	358	513	576	650
NACE M	218	224	198	215	240
NACE N	222	172	256	284	261
NACE O	161	186	212	278	264
NACE P	0	0	0	0	0

Table 13 Main RTDI programmes.

Programme	Main objectives	Geographical level of implementation
Regional Structural Funds Programme	To promote entrepreneurship, innovative businesses, collaboration initiatives, innovative environments and sustainable city development	Regional measures with origin in national initiatives
Regional Growth Programmes for Västra Götaland and Halland	To promote favourable business environment, knowledge development and growth, and quality life for citizens	Regional measures
Defence materiel procurement programmes	To procure the best possible technologies for Swedish defence forces	National measures
Entrepreneurship programmes	Diffuse best practice methods to influence attitudes towards entrepreneurship in primary and secondary schools, and at university level	Regional measures
Collaborative industry sector R&D programmes	Enhancing national competitiveness and growth through R&D collaboration between industry and R&D providers. Targeting enterprises in the aerospace, automotive, forestry, IT/telecom, metallurgy, pharmaceutical sectors. Most of these programmes are of relevance to Västsverige, most notably the automotive programmes	National measures

Annex 4: RTD policies

Title of the measure or initiative: Collaborative industry sector R&D programmes
Objectives: Enhance key Swedish industry sectors' international competitiveness to ensure future prosperity and jobs.
Policy Area: Research collaboration of public research organisations with private sector.
<p>Main instruments and structure: Sweden has a tradition of collaborative R&D programmes, usually run by VINNOVA, the Swedish Energy Agency (STEM) and some by semi-public research foundations. These programmes typically fund 50% of the total budget of industry-academia projects, provided that industry partners contribute at least equally much in cash or in kind.</p> <p>The previous government commenced "industry dialogues" with representatives of key industry sectors, which led to national strategies (one for each sector) that to a significant degree were based on industry's perceived needs. VINNOVA was then assigned to develop these strategies together with industry representatives into six sector research programmes, where the main project form is the one described in the previous paragraph. An important difference between the sector programmes and most of VINNOVA's other programmes is that the former have their origin in political developments, meaning that VINNOVA is deprived most of its usual freedom in programme formulation.</p> <p>The automotive industry has a longer history of such arrangements than most other sectors. Programmes targeting the automotive industry commenced in 1994 and both the number of programmes and their overall budget have since grown rapidly. In 1994, the first of these programmes was launched with an annual budget of €6.5 million, half of which from the government; in 2006, the budget for a range of non-fuels R&D programmes had increased to approximately €125 million p.a., about a third of which from the government. Unusual for Sweden, some of these programmes are managed by industry and merely administered by VINNOVA (which for other industry branches also manages R&D programmes). Moreover, in the dominating automotive R&D programmes, the four vehicle manufacturers and the members of the suppliers association are the recipients of R&D grants, which may then be distributed to the R&D supplier of their choice (usually within academia). Some of programmes are currently the subjects of a government enquiry, but it is taken for granted that the programmes will continue, albeit possibly somewhat modified.</p>
Main beneficiaries/target group: Enterprises in the aerospace, automotive, forestry, IT/telecom, metallurgy and pharmaceuticals sectors. R&D performers collaborating with said sectors.
<p>Achievements or failures: Three of the automotive programmes that are managed by industry and where industry receives the grants are presently being evaluated and it is clear that the programmes by most accounts are a success. They have led to:</p> <ul style="list-style-type: none"> • Improved knowledge base in areas of strategic importance to the automotive industry • Improved personal networks. The programmes not only result in knowledge diffusion between R&D providers and industry, but also horizontally and vertically between potentially competing enterprises that collaborate in the same project, thus learning from each other • Enhanced international competitiveness for Swedish automotive enterprises and tier-1 suppliers. Representatives of both Volvo Car and Saab assert that the collective research efforts together with internationally competitive R&D providers and the fact that the Swedish

government co-finances the R&D indeed are strong arguments within Ford and General Motors when determining which corporate R&D projects – if any – are to be carried out in their Swedish subsidiaries. Volvo Car and Saab have group responsibilities for a range of strategic competencies, partly due to research carried out within the programmes

- Internationally competitive R&D environments in academia and research institutes have been established and/or further strengthened
- A large number of PhDs have graduated (most of the university R&D is carried out by graduate students) and the majority are employed in the Swedish automotive industry