

ERAWATCH Country Report 2009

Analysis of policy mixes to foster R&D investment
and to contribute to the ERA

Slovakia

Vladimír Baláž



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ERAWATCH COUNTRY REPORT 2009: Slovak Republic

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investment and to contribute to the ERA

ERAWATCH Network – The Institute for Forecasting of the Slovak
Academy of Sciences

Vladimír Baláž

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Executive Summary

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. This report aims at supporting the mutual learning process and the monitoring of Member States efforts. Its main objective is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The report builds on the analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

Basic facts on Slovak research system

The Slovak Republic is a small Member Country and has a small and underdeveloped R&D system. In the 1980s Slovakia had an extensive system of applied research institutes, high numbers of researchers and generous R&D spending. Slovakia underwent a thorough and painful economic and social transition during 1990s and early 2000s. An extensive and well-developed system of R&D and innovation governance disintegrated almost immediately after the collapse of central planning. Share of GERD in GDP fell from 3.88% to 0.49% and the head count of researchers fell from 34,600 to 19,400 in the period 1989-2007. In 2007 Slovakia (plus Romania, Bulgaria and Cyprus) ranked as the countries with the lowest R&D intensity (Eurostat 2009). Some 3% of the Slovak labour force worked as scientists or engineers in 2006. This share was also one of the lowest in Europe, where the EU27 average is 4.8%. The system of applied research has become dilapidated over time and basic research has increased in importance (the share of basic research in total R&D spending expanded from 21.2% in 1994 to 46.2% in 2007).

Evolution of the National Growth Strategy

For a fairly long time Slovak policy has not considered R&D a priority. Since mid 2000s political documents have mentioned such policies and addressed respective objectives. The Ministry of Education has been responsible for R&D policy-making. It prepared several policy analyses and plans (e.g. the 2002 [Concept of the State-Governed Scientific and Technical Policy up to the Year 2005](#), Technology Foresight, the 2007 [Long-term Objective of the State S&T Policy up to 2015](#)) and tried to implement these via instruments supported from the State Budget.

In political rhetoric the gap between challenges and objectives/priorities narrowed. Slovak government started institutional reform of the R&D system. A whole set of important laws were adopted in order to implement priorities stated by the 'Objective' (such as increases in GERD, establishing new modes of R&D funding, improvements in R&D infrastructure, improving cooperation between industry and academia). The government also considerably increased public funding of R&D. Structural Funds are considered key resource for development of knowledge-based society in Slovakia.

About one third of total assistance by Structural Funds is channelled via Operational Programmes 'Education' (OPE), 'Competitiveness and Economic Growth' (OPCEG) and 'Research and Development' in period 2007-2013 (OPRD).

Main components of the policy mix for increasing national R&D investment

Policy mix to foster R&D investment is set in the '[Long-term Objective of the State S&T Policy up to 2015](#)': Detailed policy measures, to be implemented by central government bodies in period 2008-2010, are contained in the '[Strategy implementing Long-term Objective up to 2010](#)'. The 'Objective' defines direct and indirect S&T policy tools and sets a clear target of 1.8% share by GERD in GDP by 2015. Some 2/3 of total GERD should be provided by business sector. European money should be another important resource for the Slovak R&D system. Expenditure on S&T should be given a special chapter in the State Budget Law.

Institutional support to Universities and Slovak Academy of Sciences (SAS), and project finance channelled via the State R&D programmes, grant by the Research and Development Agency and horizontal programmes remain major forms for direct assistance to R&D in Slovakia till 2015. Institutional funding is provided both via direct transfers from the State budget to the SAS and Universities, and via competitive [VEGA](#) grants (the VEGA agency provides grants for basic research). Direct transfers have traditionally been of higher importance than competitive grants in institutional funding. Indirect assistance may potentially involve tax incentives, but these must be consulted with the Ministry of Finance first. The 'Long-term Objective' envisages important changes in structure of public support to R&D. Institutional finance accounted for about one half of total support in 2007. By 2015 institutional support should decrease to one third, while the project finance should generate some two thirds of the total outlays on R&D by the State Budget.

Investment related priorities are specified in the 'Strategy Implementing Long-term Objective up to 2010 and refer to (a) Human resources, and (b) R&D infrastructure. These priorities respond to some long-term weaknesses of the Slovak R&D system, namely limited and ageing stock of human capital, poor research infrastructure and weak ties between the industry and academia sectors. Evidence on R&D spending by Eurostat indicated that some national targets in R&D investment (in business sector in particular) could prove overoptimistic. Importance of foreign resources, on the other hand, is likely to increase. Structural Funds and Framework Programmes should provide significant financial assistance to public research institutions and projects in particular.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Dual economy and low wages generate low supply of and low demand for R&D solutions.	Tackling this problem is outside of scope of explicit R&D policies. Barriers are likely to be removed by market forces and framework supportive policies. These developments can take years to materialise.
Limited sources of R&D funding.	Opportunity: Operational Programmes 'Research and Development', 'Competitiveness and Economic Growth' and 'Education' provide great volume of R&D funding. Risks: Significant increases in public support to R&D need not necessarily be reflected in corresponding investment by private sector. Increased public investment in human resources and R&D infrastructure may prove unsustainable, once Structural Funds assistance stops.
Limited attention paid to R&D issues in period 1990-2004; low understanding of importance by R&D for economic and social development.	Opportunity: Importance of R&D and innovation issues in government rhetoric increased. Slovak government also increased public outlays on R&D. Risks: Incumbent stock of human capital is low and ageing, and may not generate a critical mass needed for transition towards a knowledge-based economy. Brain-drain by young researchers remains a threat for development of highly skilled human resources in Slovakia.

Policy mix balance and national R&D investment objectives

The existence of a dual economy, low demand for R&D solutions and limited national financial assistance to R&D are major barriers to the implementation of national R&D investment goals. These problems refer to current development stage of the country. Implementation of research infrastructure policies is assisted significantly by European money, but results may take years to materialise. Major imbalances and policy risks include:

- rather excessive role of SMEs envisaged in research policies and neglect of cooperation with branches of MNCs established in Slovakia;
- potentially overoptimistic targets '1.8% share of GERD in GDP' and '2/3 share of business expenditure in GERD' by 2015;
- fragmentation of limited research resources to 12 thematic priorities.

ERA-related policies

There is no coherent policy mix related to the ERA in Slovakia. Importance of the ERA-related policies, however, increased in 2008 and 2009. Some ERA-related priorities and policies explicitly are referred to in the 2008-2010. Among these (a) support to participation of Slovak organisations in international research and development projects, particularly in the framework EU programmes, (b) establishing Central information portal supporting mobility by Slovak scientists within the ERA, and (c) implementation of European legislation on researcher mobility rank to most important.

Low levels of scientific outputs (in terms of publications, citations and patents), underfinanced research sector, underdeveloped national R&D infrastructure, and limited ageing stock of human capital in research sector are the main challenges for Slovak R&D-system in relation to ERA-development.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • Medium importance, no influx of foreign researchers is envisaged. Brain-drain by Slovak scientists seems a more important issue. 	<ul style="list-style-type: none"> • Full access by EU nationals to Slovak research market. Policies aimed at preventing and/or reversing brain drain in place.
Governance of research infrastructures	<ul style="list-style-type: none"> • High importance, great interest in participation in European research infrastructure. 	<ul style="list-style-type: none"> • Increased support to research exchange and mobility, co-financing successful applicants in FP projects.
Autonomy of research institutions	<ul style="list-style-type: none"> • Medium importance, there are no formal barriers for autonomy of research institutions. 	<ul style="list-style-type: none"> • Slovak Government discussed amendment of the Law on Higher Education. Criteria for establishing and operating HEU should be unified for public and private HEI and access by HEI established in the OECD Member Countries made easier.
Opening up of national research programmes	<ul style="list-style-type: none"> • Low importance and little experience with the issue. 	<ul style="list-style-type: none"> • Provisions on foreign researchers in the 172/2005 Law.

TABLE OF CONTENTS

Executive Summary.....	3
1 Introduction.....	8
2 Characteristics of the national research system and assessment of recent policy changes.....	9
2.1 Structure of the national research system and its governance.....	9
2.2 Summary of strengths and weaknesses of the research system	12
2.3 Analysis of recent policy changes since 2008.....	14
2.3.1 Resource mobilisation.....	14
2.3.2 Knowledge demand	16
2.3.3 Knowledge production.....	17
2.3.4 Knowledge circulation	18
2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment	19
3 National policy mixes towards R&D investment goals.....	20
3.1 Barriers in the research system for the achievement of R&D investment objectives	21
3.2 Policy objectives addressing R&D investment and barriers	22
3.3 Characteristics of the policy mix to foster R&D investment.....	23
3.3.1 Overall funding mechanisms.....	23
3.3.2 Policy Mix Routes.....	26
3.4 Progress towards national R&D investment targets.....	32
4 Contributions of national policies to the European Research Area.....	34
4.1 Towards a European labour market for researchers	35
4.1.1 Policies for opening up the national labour market for researchers.....	36
4.1.2 Policies enhancing the attractiveness of research careers in Europe	37
4.2 Governing research infrastructures	38
4.3 Research organisations	40
4.4 Opening up national research programmes.....	41
4.5 National ERA-related policies - a summary.....	41
5 Conclusions and open questions.....	42
5.1 Policy mix towards national R&D investment goals.....	42
5.2 ERA-related policies.....	42
References	44
List of Abbreviations	45

1 Introduction

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs.¹ This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. For the period 2008 to 2010, this focus is confirmed as main policy challenge and the need for more rapid progress towards establishing the European Research Area, including meeting the collective EU target of raising research investment to 3% of GDP, is emphasised.

A central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area (ERA). The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures which a research system has to cope with. The analysis of the ERA dimension still remained exploratory.

The country reports 2009 build and extend on this analysis by focusing on policy mixes. Research policies can be a lever for economic growth, if they are tailored to the needs of a knowledge-based economy suited to the country and appropriately coordinated with other knowledge triangle policies. The policy focus is threefold:

- An updated analysis and assessment of recent research policies
- An analysis and assessment of the evolution of national policy mixes towards Lisbon R&D investment goals. Particular attention is paid to policies fostering private R&D and addressing its barriers.
- An analysis and assessment of the contribution of national policies to the realisation of the ERA. Beyond contributing to national policy goals, which remains an important policy context, ERA-related policies can contribute to a better European level performance by fostering, in various ways, efficient resource allocation in Europe.

¹ COM(2007) 803 final, "INTEGRATED GUIDELINES FOR GROWTH AND JOBS (2008-2010)", http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Basic facts on Slovak research system

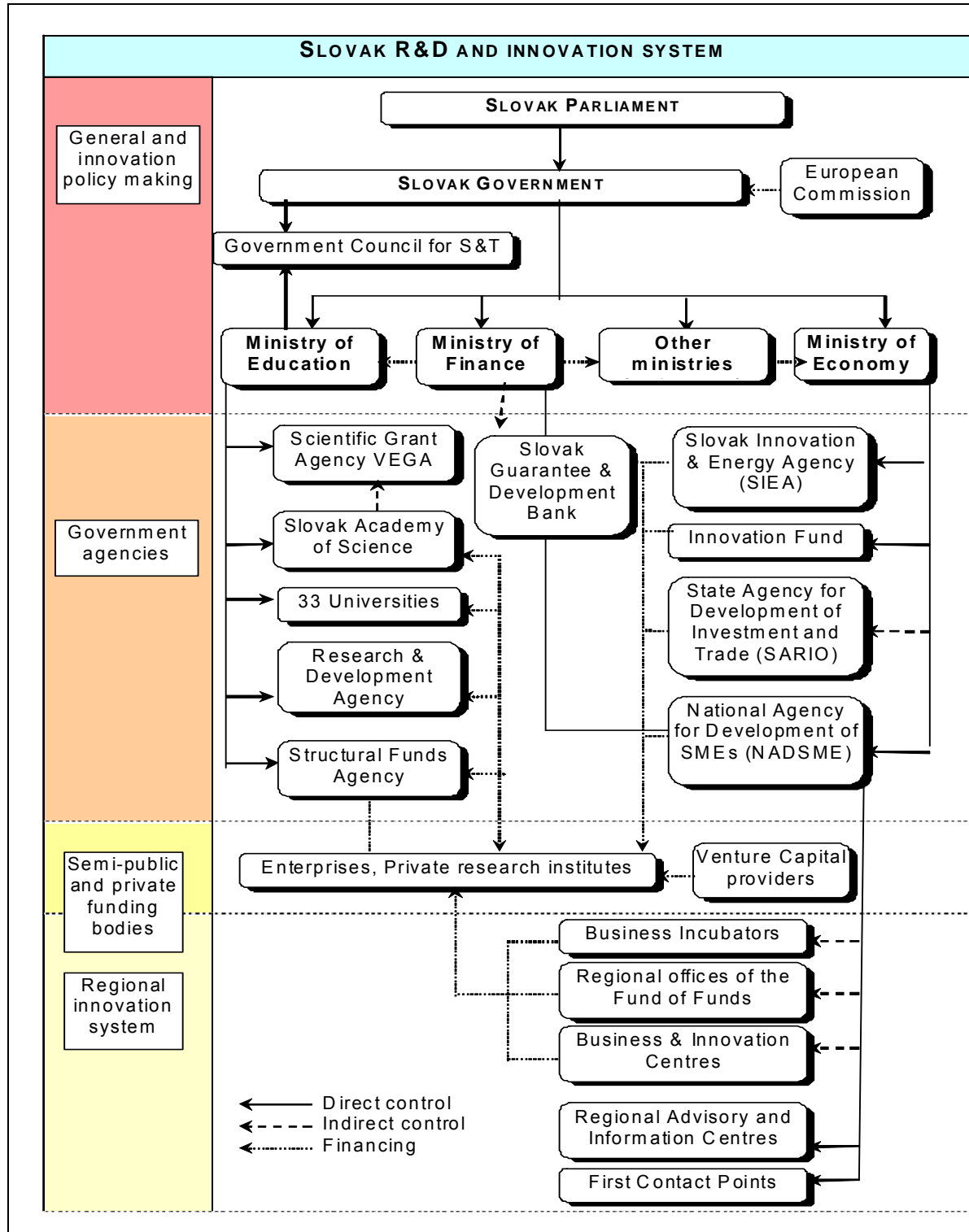
The Slovak Republic is a small Member Country and accounts for a small and underdeveloped R&D system. In 1980s Slovakia accounted for an extensive system of applied research institutes, high numbers of researchers and generous R&D spending. Slovakia underwent a thorough and painful economic and social transition during 1990s and early 2000s. An extensive and well-developed system of R&D and innovation governance disintegrated almost immediately after collapse of central planning. Gross expenditure on R&D as percent of GDP fell from 3.88% to 0.46%, and numbers of researchers in head counts from 34.6 thousands to 19.4 thousands in period 1989-2007. In 2007 Slovakia (plus Romania, Bulgaria and Cyprus) ranked among countries with the lowest R&D intensity (Eurostat 2009). Some 3% of the Slovak labour force worked as scientists or engineers in 2006. This share also was one of the lowest in the Europe and compared with the EU27 average of 4.8%. System of applied research dilapidated over time and basic research increased in importance (share of basic research in total R&D spending expanded from 21.2% in 1994 to 46.2% in 2007).

Main actors and institutions in research governance

The governance structure of the Slovak research system has been fairly stable over last decade. The Slovak [Ministry of Education](#) is responsible for policy- and decision-making in the field of science and technology and R&D (see Figure 1 below). National science and technology policy is prepared and coordinated by the Ministry of Education with the co-operation of other ministries, the [Slovak Academy of Sciences](#) (SAS), higher education institutions (HEI) and associations of employers, and industrial research organisations, respectively. The Ministry of Education also administers the most important body for coordination of science and technology policies (S&T) – [Slovak Republic Government Board for Science and Technology](#) (SRGBST). The Statutes of the SRGBST declare that "the Council is a permanent advisory body of the Slovak government in the field of state science and technology policies....It discusses and evaluates conceptual and strategic materials on S&T policies elaborated for the Slovak government, EU organisations or other international organisations". Another body for coordination of the S&T and innovation policy is the Commission for the Knowledge-based Society (CKBS). The body was established in December 2006 and is headed by the Deputy Prime Minister for the knowledge-based society, European affairs, minorities and human rights. Members of the Commission include Ministers of Education, Finance, Economy, Construction and Regional Development, Agriculture, Health and Labour, Social Affairs and Family, plus president of the Slovak Academy of Sciences. The CKBS is advisory and coordination body of the Slovak Government in matters of knowledge-based society and Structural Fund programmes related to these issues. Both the SRGBST and CKBS have relatively weak powers. Most important decisions in field S&T

policies (drafting legislations and budget) are made by ministries of Education and Finance.

Figure 1: Overview of the governance structure of the Slovakia's research system



Source: author

S&T policies significantly overlapped with the innovation policies in Slovakia. The SRGBST remains important also for making innovation policy as it involves great array of stakeholders from the R&D and from outside the R&D domain. In

organisational terms, R&D and innovation policy implementation became more separated after 2007. In 2007 the Ministries of Education and Economy (directed by different coalition member parties) drafted their own basic policy documents ('The Long-term Objective' and the 2007 Innovation Strategy) and established separate agencies for implementation of operational programmes.

Innovation policy measures are implemented by the [Ministry of Economy](#) and its agencies. In 2008 the Ministry of Economy prepared the Innovation Policy document and established the Slovak Innovation and Energy Agency (SIEA). This organisational division was prompted by introduction of the Operational Programme of Competitiveness and Economic Growth (OPCEG, implemented by the Ministry of Economy) and Operational Programmes Research and Development, and Education (OPRD and OPE, implemented by the Ministry of Education). The research policy measures are implemented by the Ministry of Education and its agencies, the RDA and VEGA implement measures supported by the State Budget and the Structural Funds Agency implements the Operational Programme Research and Development.

Two informal bodies provide for additional advice in field of science and technology. The [Rectors' Conference](#) is an informal body to advise the authorities on a wide range of issues, especially budgetary policy with respect to higher education institutions, and science policy. The [Association of Industrial Research Institutes](#) is an informal body of institute directors. It advises the authorities on issues of technology policy.

The institutional role of the regions in research governance

Slovakia used to be a centralised country and its first self-governing regions were created as late as in 2002. No special arrangements were made for research and development, science, technology and/or innovation policies on regional levels. These activities have traditionally been considered matters of central government. The university system is an explicitly national affair. Regional governments may establish and support regional R&D centres and/or technology parks, but they lack financial resources and, in the case of less developed regions, professionals. Bratislava is the major centre of R&D activities, and accounts for about one half of Slovak R&D personnel and R&D spending. R&D capacities in Bratislava, however, are mostly supported by the central government, and/or large enterprises.

Main research performer groups

The key research performers include:

- **The Slovak Academy of Sciences ([SAS](#))** is a research body providing the bulk of basic research in Slovakia. By end of 2007 the SAS had budget of €46.7 million and employed some 3304 people (1590 of which held a scientific degree and 611 were PhD students).
- **Higher Education Facilities.** There are 23 public and 10 non-state Universities and Higher Education Facilities in Slovakia (as of 2009). Share of public expenditure on the university system in GDP was about 0.63% in 2008. A great nominal increase is planned for 2009, to €748.425m. Impacts of global financial crunch on Slovak budget revenue, however, may alter this sum.

The key funding agencies include:

- The [VEGA](#) Grant Agency is a funding and advisory body for the Ministry of Education and the SAS. In 2007 (latest available data) the VEGA sponsored 2452

research grants with €11.257m (€4591 per project). The Culture and Education Grant Agency (KEGA) provides grants in humanities.

- **The Research and Development Agency (RDA)** provides for tendering and funding grants to public and private research bodies. The Agency's budget increased from €0.15m in 2001 to €29.34m 2008.

Total outlays on R&D were rather modest. Slovak GERD accounted for some €252.1m and generated about 0.49% of GDP in 2007. The government sector was main sponsor of research. Share of the government expenditure on R&D (by sector of source) in total GERD was 53.92% (including state subsidises to general university funds). Share of the business sector in R&D was 35.60% and share of the foreign resources 10.24%. The Universities and private non-profit sectors were quite unimportant sources of funds, as they generated 0.16% and 0.08% of the total GERD in Slovakia in 2007.

Most research was performed in the business sector (39.6% of total outlays on R&D), public research facilities (35.4%) and higher education facilities (25.0%). Private non-profit sector accounted for some 0.1% of total outlays.

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008 which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The Analytical Country Report for the specific country can be found in the [ERAWATCH web site](#).

Slovak research system experienced a wave of profound shocks in early 1990s, related to fragmentation and privatisation of key large enterprises, disintegration of applied research facilities, falling public spending on R&D and dilapidation of research infrastructure. These shocks were reflected in deep decreases in numbers of researchers and expenditure on R&D. Difficulties related to general problems of economic and social transition, and establishing an independent state (1993) shifted attention by political and economic elites away from the research and development. Science, technology and innovation were not considered development priorities till mid 2000s. Slovakia's membership in the EU provided an important impetus for reconsidering role of R&D in economy and society. Slovakia became eligible for Structural Funds assistance and had to develop policies related to fostering knowledge-based economy. There also was a change in strategic thinking by political and economic elites. Since mid 2000s it became clear that Slovakia's competitive edge on the world markets, low production costs (based on low wages and an advantageous exchange rate), were not tenable in long-term. The number of countries with similar characteristics has been increasing and Slovakia faced competition from some new Member States (Bulgaria, Romania) and countries outside the EU (China, India, Russia and Ukraine in particular).

The table below summarises the ways in which Slovakia can build on existing strengths in this process and which weaknesses remain relevant.

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	Government and broader public generally understand importance of R&D for long-term development, but actual demand for R&D results by companies is low.
	Securing long term investment in research	Government increased support to R&D, but business support fell and overall level of investment stagnates in relative terms.
	Dealing with barriers to private R&D investment	Slovakia has a dual economy. Domestic firms are too small to pursue R&D activities. Multinational companies perform their research outside Slovakia.
	Providing qualified human resources	Government adopted several initiatives to ensure the provision of a qualified human resource base for R&D.
Knowledge demand	Identifying the drivers of knowledge demand	Challenge posed by nature of dual economy and importance of middle- and low-tech industries in Slovakia is considerable.
	Co-ordination and channelling knowledge demands	Coordination bodies and mechanisms do exist, but are weak and account for limited efficiency.
	Monitoring of demand fulfilment	Evaluation culture is underdeveloped in Slovakia. Monitoring and evaluation practices are more concerned with formal topics of administrative and financial compliance, rather than goal attainment, impact assessment or even implementation efficiency.
Knowledge production	Ensuring quality and excellence of knowledge production	Relatively well-preserved system of basic research, but weak system of applied research.
	Ensuring exploitability of knowledge	Demand on commercial applications of research is limited.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Networking mechanisms for industry-academia cooperation are underdeveloped. Some of brokerage institutions (e.g. business angels) are almost completely lacking.
	Profiting from international knowledge	Slovak research teams participate in Framework Programmes, but extent of participation is modest. Branches of multinational companies, on the other hand, profit well from patents and research activities by their parent companies.
	Enhancing absorptive capacity of knowledge users	Domestic SMEs account for limited absorptive capacity. Technology transfers and introduction of quality management systems proved most efficient ways of knowledge absorption so far.

Poor research performance by a large degree relates to factors outside of remit of the research policy, namely long and difficult transition and dual economy. Slovak government had to concentrate on other policy areas as to create a stable macroeconomic background, establish business-friendly regulatory environment, to attract foreign investment and decrease unemployment and regional disparities. These policies were successful in their own terms and delivered high rates of economic growth. Research policies were not considered an important part of the general policy mix till 2005. Long-term neglect of the research issues had many negative consequences. Low spending on R&D probably was the key challenge of national research system. Slovakia accounted for relatively educated labour force, but failed to transit to R&D-intensive employment structure. Total numbers of R&D

personnel in full time equivalent, for example, stagnated between 15.2 and 15.4 thousands in period 2000-2007. Moreover, Slovak R&D personnel was ageing and becoming less mobile. Low funding of R&D facilities made careers in this sector unattractive for young and talented people. Pool of potential scientists shrank, and ties between the industry and academia sector weakened over time. Weak system of applied research in particular disabled cooperation between the industry and academia sectors and was reflected in poor commercial outputs of R&D base. Majority of technology effort was focused on knowledge absorption and diffusion rather than on knowledge generation and circulation.

Since 2004, Slovak governments have passed several important laws and regulations aimed at supporting R&D, technology and innovations. New funding and implementing agencies were established and research governance system somewhat strengthened. Governance structure, however, is not wholly supportive to coordination between the industry and academia sectors. Ministerial responsibilities for science and higher education are separate from those for innovation and the economy and so are activities by implementing agencies. The most important body for coordination of S&T and innovation policies, SRGBST, accounts for limited responsibilities and meets quite infrequently (three times in 2007, once in 2008).

Challenges faced by the Slovak research system are considerable. Public expenditure on R&D decreased from 0.43% of GDP to 0.25% of GDP in period 1993-2007. Business expenditure on R&D decreased from 0.94% of GDP to 0.16% of GDP in the same period. Low support to R&D contributed to significant downfall in extent and quality of research base. It may take more than a decade to rebuild the research system and develop strong linkages between the industry and academia sectors.

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

Government support to R&D increased both in terms of institutional and financial assistance in period 2008-2009. The updated National Reform Programme analysed weaknesses of the Slovak research systems, specified policy initiatives addressing major challenges and set clear goals and evaluation criteria for research policies (see box below).

Changes in National Reform Programme regarding the role of research in the broader economic growth strategy

The preamble of the 2008-2010 Slovak National Reform Programme (NRP) states several explicit objectives. These include: 'creating conditions for rapid and long-term sustainable economic growth, increases in social mobility, strengthening social cohesion, alleviation of demographic pressures and higher flexibility of the Slovak economy after joining the Eurozone'. Policies aiming at main research system weaknesses were specified and refer to targets in 'Institutional background for R&D'. The NRP correctly concentrates on reform of the public financial support to science and technology. Any major increases in public expenditure would probably make little sense in absence of institutional reform of research sector. Science and technology financing reform will be implemented. Government document titled 'The New Module of S&T Financing' will set principles for the state support to science and technology. In this document, the Government plans to increase the share of purpose-oriented grant financing of S&T and support particular projects, which are already partially financed from international or private entrepreneurial sources. The basic research will be supported without thematic limitations and based on the criteria of scientific excellence, and support in the field of applied research will be focused on a number of priority areas. These will be oriented to address the strategic challenges of the Slovak economy.

The 'Modernisation Programme Slovakia 21', an accompanying document to the NRP, contains Action Plans in four priority areas of the public policy: (a) R&D and Innovations, (b) Education, (c) Employment, and (d) Business Environment. The Programme sets that Slovakia would reallocate resources to education, R&D and innovation, and duly implement a coherent R&D and innovation strategy with a particular focus on the institutional reform of the public research sector and substantial improvement of business-research cooperation.

Research policies became better integrated with other related knowledge triangle policies. Slovak Ministries of Economy and Education published lists of the 2008 calls and national projects related to education, R&D and innovation. Calls are designed for participants fitting selection criteria, while national projects (NP) mostly refer to national infrastructure and human resource programmes, and are directly assigned to pre-selected participants from public sector. Support to knowledge-based economy accounted for spectacular increases in period 2008-2009, compare to previous years. Total assistance by Structural Funds to human resources, R&D and innovation was some €436m in planning period 2004-2006. Assistance to these fields should increase to some €3.5b in planning period 2007-2013.

The Slovak 2009 State Budget, in force since 1 January 2009, set much higher level of financial support to R&D in several key areas. The SAS, which carries out bulk of basic research, had its budget increased by 14.5%, to €63.633m and budget of the RDA, which supports applied research projects, increased by 35.8% to €39.832m. The State also should support OPRD by €171.79m. Combined total public support to R&D doubles to some €171.79m in 2009. Actual spending on R&D, however, may be impacted by financial crisis.

Table 2: Calls and national projects by Ministries of Education and Economy

	launched in 2008	planned for 2009
Operational Programme Education	8 calls + 7 NP, €38.9m	8 calls, €101m
Operational Programme Research and Development	4 calls + 2 NP, €260.1m	11 calls, €540m
Operational Programme Competitiveness and Economic Growth	6 calls, €222.1m	7 calls, €181.7m
Total assistance by Structural Funds	€621.1m	€822.7m

Source: webpages of Ministry of Education (www.minedu.sk) and Ministry of Economy (www.economy.gov.sk). Note: NP = National Project

Table 3: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	Importance of R&D for long-term development better understood and made more explicit in the NRP.
Securing long term investments in research	Support to R&D from Structural Funds and national public resources increased several times.
Dealing with uncertain returns and other barriers	Slovakia has a dual economy. Stage of development of the national economy is outside of remit of the explicit R&D policies.
Providing qualified human resources	The Ministry of Education launched several calls and national projects on human resources.

2.3.2 Knowledge demand

There are some 80 thousands small and medium enterprises (SMEs) in Slovakia. Most of these enterprises are based in regions outside of Bratislava and account for limited human, financial and technology resources. They also generate modest demand for R&D results, as they compete with low costs of inputs.

Central government ministries and agencies developed several processes aimed at identification of knowledge demand and monitoring and assessment of demand fulfilment:

Regular data collection and surveys by the Statistical Office of the Slovak Republic (SOSR). Research and development (R&D) surveys cover so called 'legal and natural persons' (companies and personal businesses) in which R&D is their main activity, as well as legal and natural persons whose main activity is different from R&D, but their R&D potential calculated to the full time equivalent (FTE) is equal at least to one man/year. R&D activities include basic research, applied research and experimental development. The information is provided via a standard questionnaire. R&D data collected by the SOSR cover human resources in R&D, R&D expenditure, patents and licences and regional breakdown of main R&D indicators. The SOSR also implements the Community Innovation Survey in Slovakia. The survey provides most representative and comprehensive data on intra- and extramural demand on R&D activities by Slovak businesses.

Surveys by the National Agency for Development of Small and Medium Enterprises (NADSME). Since 2000 the NADSME has been publishing annual reports on the 'State of Small and Medium Enterprises in the Slovak Republic'. The report contains some information on innovation and R&D resources by Slovak SMEs. The NADSME also produced several reports on innovative activities by Slovak

SMEs. These reports contain more details on R&D activities by SMEs. The NADSME surveys and reports aim at indentifying demand for innovation policy measures designed by the Ministry of Economy.

Monitoring, analytical and evaluation activities performed by the Section for Science and Technology of the Ministry of Education. Since 2005 the Section has produced Annual Report on R&D. The Annual Reports list (a) volumes of R&D resources, (b) R&D input/output indicators, (c) policy measures related of the public support to R&D developed by the Ministry of Education and other central government agencies, and (d) activities by Slovak R&D bodies in area of international cooperation in R&D (including FP and ERA). The Annual Reports provide details on programmes implemented by the [Research and Development Agency](#). Several programmes by RDA support R&D in SMEs and/or cooperation between academia and industry sectors. The 2005-2007 Annual Reports provided quite detailed lists of various financial flows related to the abovementioned policy measures, but did not try to compute their socio-economic impacts.

The Government considers weak knowledge demand by private sector a major problem for establishing knowledge-based economy in Slovakia and adopted several policy measures to cope with this challenge. ‘Building Regional Innovation Centres’ (RICs) is the most important initiative supporting knowledge demand in Slovakia. It is a flagship initiative of the 2007 Innovation Strategy and the 2008 Innovation policy. Main goal of this measure was set in the 2008 ‘Innovation Policy’ document. The measure (a) promotes implementing state and regional innovation policies; (b) supports regional innovation development; and (c) facilitates development of knowledge-based society. Activities supported via this measure should improve regional competitiveness and promote sustainable economic growth in industry and services. The RICs will generate capacity for development of innovations in SMEs. The measure also aims at improving links between the business sector, and applied industry research organisations and Universities. The RICs should create platforms for cooperation in field of innovations on regional, national and international levels. The measure also supports development of human resources for innovation development. First calls related to this measure are expected in 2009.

Table 4: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	The 2007 Innovation Strategy and the 2008 Innovation policy envisage establishment of the RICs in 2009.
Co-ordinating and channelling knowledge demands	RICs will become main coordination bodies in regional innovation systems.
Monitoring demand fulfilment	The updated 2008-2010 NRP set quantitative criteria for monitoring activities and performance by the RICs.

2.3.3 Knowledge production

Knowledge production in Slovakia concentrates into the public sector. Unlike in the EU15 countries, higher share of research activities is performed within the SAS (predominantly dealing with the basic research), while the Slovak higher education is less research-oriented and more focused on education. Low levels of excellence research and underdeveloped evaluation culture impact knowledge production in Slovakia. Slovakia lags behind the EU15 countries in production of scientific publications. In 2007 values of the relative citation index were 0.59 for Slovakia, 0.75 for the Czech Republic, 0.97 for Hungary, but 1.42 for Denmark (source: [The 2007 Annual Report on R&D](#)).

Several incumbent and planned policies address problem of low production of knowledge:

- The 172/2005 Law on Organisation of the State Support of R&D was amended in May 2008. It defines bodies eligible for the State Aid in field of production and transfer of knowledge between industry and academia sectors. Centres of Excellence were recognised as a specific type of S&T bodies.
- The government approved proposal that at least 30% of evaluators of the Slovak R&D grant schemes should be foreign.
- The 2008-2010 NRP set preparation of a document ‘Reform of the public financial support to science and technology’. Principles for the state support to S&T will be redefined. Excellence will be main criterion for support of the basic research. Strategic challenges and limited number of priorities should be criteria for support to applied research. The ‘Reform’ document will also define principles for creating and evaluation the National Programme for Support the S&T.

Table 5: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	The updated 2008-2010 NRP set clearer targets in the excellence research.
Ensuring exploitability of knowledge production	No significant changes.

2.3.4 Knowledge circulation

In 2008 and 2009 the Ministry of Education launched two important national projects supporting knowledge circulation in Slovakia:

National information system supporting research and development in Slovakia aims at ‘promoting transfer of technologies and improving collaboration networks (a) between SMEs, and (b) between SMEs on one hand and other enterprises and HEI, research centres and regional bodies on the other hand’. It also aims at (i) ‘removing barriers between industry and academia sectors’ and (ii) supporting popularisation of R&D results with broader public’. The support measure invests some €19.7m and implements Measures 2.2 and 4.2 of the OPRD. These refer to ‘increasing intensity of cooperation by R&D institutions with public and private sectors via transfer of knowledge and technologies and increasing rates of economic growth in Slovakia (Measure 2.2) and Bratislava Region (Measure 4.2)’. The Slovak Centre of Scientific and Technical Information (SCSTI) was directly selected an only recipient of the project. The SCSTI is the national information centre and specialized scientific library of the Slovak Republic. Activities supported by this measure include:

- analysis of current situation in collecting, processing and using electronic information resources for R&D in Slovak Universities and research institutes;
- coordinating selection and creating optimal portfolio of electronic information resources for R&D in Slovakia, regarding needs of users and 12 thematic priorities for development of society and economy;
- building efficient system of electronic information resources for needs of R&D via management and administration of e-resources;
- creating database of Slovak e-resources for R&D;

- enlarging and adding new functions to the Central Information Portal for R&D (CIPRD); the functions should (a) respect the EU standards and support efficient work with projects during their lifecycles; (b) connect to other information resources, including incumbent and future resources of the CIPRD.

Infrastructure for research and development – Data centre for research and development aims at ‘increasing ability by R&D organisations to cooperate with the EU and foreign organisations of R&D, and also with other private and public bodies via transfer of knowledge and technologies’. The SCSTI was directly selected the only recipient pre-selected in this project. The measure invests some €33.194m and supports following activities:

- building premises and technology equipment for main and back-up data centre, including construction works, connection links to the SANET (Slovak Academic Network) and necessary ICT infrastructure;
- design, purchase and implementation of hardware and software solutions, and data contexts of the R&D data centre, including an independent workplace for digitalisation of books and periodicals; the workplace will reside in the SCSTI;
- implementing modern communication infrastructure to data centre; the infrastructure will provide R&D workers with information exchange within Slovakia and with other countries;
- securing operations and maintenance of the infrastructure built; securing sustainability of the project via reconstruction of the ICT infrastructure in period of the project implementation.

Table 6: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	<ul style="list-style-type: none"> • Information System and Data Centre are important steps towards ability by R&D organisations to facilitate knowledge transfers with other private and public bodies.
Profiting from access to international knowledge	<ul style="list-style-type: none"> • Information System and Data Centre enable Slovak R&D organisations profiting from cooperation with the EU and foreign organisations of R&D.
Absorptive capacity of knowledge users	<ul style="list-style-type: none"> • Policy measures supported under the OPRD create better conditions for co-operation between the industry and academia sectors and enhance absorptive capacity of knowledge users.

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

Recent policy changes and documents adequately respond to the weaknesses in Slovak research and innovation systems. It is expected that excellence of the public research system is positively affected by the initiatives contained in the amended NRP and calls and national projects applied under the OPRD. The same expectations apply to initiatives applied under the 2008 Innovation policy,

implemented under the OPCEG, in field of building RICs, and connecting industry and academia organisations in Slovak regions.

Results of these policies, however, may be impacted by factors outside of scope of S&T and innovation policies (dual economy, low-cost, low-value added mode of competition by Slovak SMEs). Financial support to Slovak system of research and innovation by public and business sectors decreased considerably in period 1989-2007. Creation of efficient links between public research and private sector research institutes is likely to take years.

Table 7: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	<ul style="list-style-type: none"> Higher support to R&D from the State budget and Structural Funds will positively impact development of R&D sector. 	<ul style="list-style-type: none"> There is low absorption capacity for R&D investments in private sector in general and SMEs in particular.
Knowledge demand	<ul style="list-style-type: none"> Links between science and technology and innovation policies (including co-operation between public and private sectors may be strengthened via building RICs. 	<ul style="list-style-type: none"> The initiative may be met with low demand by industry; weak links between universities and external partners (mainly those from industry) could lead to mismatches between university research priorities and needs of the economy.
Knowledge production	<ul style="list-style-type: none"> Document 'Reform of the public financial support to science and technology' may improve excellence of the public research system; a new set of performance indicators, may increase role of socio-economic impacts of research. 	<ul style="list-style-type: none"> Support to all R&D disciplines may continue disregarding excellent disciplines, workplaces and national thematic R&D priorities; potential rigidity of the new evaluation system may disregard differences among individual research disciplines.
Knowledge circulation	<ul style="list-style-type: none"> New R&D infrastructure and RICs may improve linkages between industry and academia sectors and between Slovakia and advanced OECD members. 	<ul style="list-style-type: none"> Low demand and absorption capacity by knowledge users remain a challenge.

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP of which two thirds should come from private investment. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?

3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

Dual economy and low wage levels probably are major systemic barriers for the achievement of R&D investment objectives. There is both low supply of and insufficient demand for R&D solutions in Slovak economy.

Prior to 1989 the Slovak economy was organised into a relatively small number of divisional monopolies from 2000 to 80,000 employees. These monopolies had their own networks of well-equipped applied research institutes. Share of GERD in GDP was 3.88% in 1989. The collapse of central planning and introduction of the "shock therapy" model of economic and social transition was immediately reflected in the disintegration of the system amongst research agencies. The demand for traditional company-level research has declined in favour of technology imports. A dual economy was established in Slovakia in the late 1990s and early 2000s. Branches of multinational companies (MNCs) form one sector, typically with world-class technology imported from abroad and high productivity levels. Enterprises privatised and/or established by MNCs seldom retained research activities, as research was usually carried out in the MNCs' headquarters. Some 80 thousands of Slovak small and medium enterprises (SMEs) and few large companies owned by domestic investors form the second sector, typical with low productivity levels and low R&D intensity. Domestic SMEs had limited financial and intellectual resources and competed with low costs of labour rather than R&D inputs. Slovak SMEs considered returns from R&D investments uncertain and preferred competition by low costs of inputs. In 2007 share of Slovak GERD in GDP fell to 0.46%, and numbers of researchers in head counts dropped to 19.4 thousands. Slovakia's research sector ranked among the poorest within EU27.

The greatest challenges for investment in R&D have been generated by factors outside the remit of the explicit R&D policies. Challenges posed by low wages and organisational structure of the Slovak economy are more likely to be addressed by market forces and framework-supportive regulations than R&D policies. The 2007 average monthly labour costs in Slovakia were €842.3, some 21.5% of those in neighbouring Austria. There, however, was a clearly visible trend in rising wages (1997: €359.6), which undermined competitiveness based on low costs of inputs. Some multinationals (e.g. in shoe-making sector) have already started to move their productions farther to the Eastern Europe and Asia. There is a strong manufacturing sector and stock of human resources with considerable technical skills, which may contribute to increased interest by MNCs in R&D investments in Slovakia. A few research centres were established in the electrical engineering, electronics and metal processing industries. Rebirth of industrial research, of course, is likely to take years.

Demand-side support measures may include public procurement of top technologies. Bulk of demand for top technology solutions, however, is likely to be generated by market forces in general and rising wage levels in particular.

3.2 Policy objectives addressing R&D investment and barriers

For a fairly long time Slovak policy has not considered R&D a priority. Since mid 2000s political documents have mentioned such policies and addressed respective objectives. The Ministry of Education has been responsible for R&D policy-making. It prepared several policy analyses and plans (e.g. the 2002 Concept of the State-Governed Scientific and Technical Policy up to the Year 2005, Technology Foresight, the 2007 Long-term Objective of the State S&T Policy up to 2015) and tried to implement these via instruments supported from the State Budget.

In political rhetoric the gap between challenges and objectives/priorities narrowed. Slovak government started institutional reform of the R&D system. A whole set of important laws were adopted as to implement priorities stated by the 'Objective' (such as increases in GERD, establishing new modes of R&D funding, improvements in R&D infrastructure, improving cooperation between industry and academia). The government also considerably increased public funding of R&D. Structural Funds are considered key resource for development of knowledge-based society in Slovakia. About one third of total assistance by Structural Funds is channelled via OPRD, OPCEG and OPE in period 2007-2013.

These initiatives were met with limited success. Financial support to research system by public and business sectors fell considerably in period 1989-2007 and challenges for development of a knowledge-based economy are considerable. The 2008-2010 NRP identifies several system challenges for development of R&D and innovations. These include (a) low and decreasing share of GERD in GDP, (b) low shares of innovative enterprises and weak ties between the industry and academia sectors and (c) institutional reform of R&D system. The NRP points to the articulation of research policies with other knowledge triangle policies. The Annex 3 of the NRP lists information on institutional settings for implementation of the Lisbon Strategy and describes several Action Plans and structural indicators in various policy areas. The Action Plans identify rationale and goals of the respective policies, plus timeline of policies' implementation and evaluation indicators.

Recent R&D and innovation policy documents addressed some areas of R&D development neglected in the previous period. Policy mix adopted by Slovak government provided important incentives for increases in stock of human capital and improvement in R&D infrastructure. Research policies are better integrated with innovation and business related education policies now. The policy mix may, if not completely overcome, at least partly remove institutional barriers between universities, public research organisations and businesses to knowledge circulation. It also may foster inter-sectoral R&D cooperation and R&D personnel circulation and create mechanisms for strengthening links in knowledge transfer between academia and industry sectors.

Slovakia is pointing in the right direction but making slow progress towards the Lisbon targets. Realising the aim of fostering business R&D requires major institutional changes that are only likely to occur in the long-term.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

Policy mix to foster R&D investment is set in the 'Long-term Objective of the State S&T Policy up to 2015': Detailed policy measures, to be implemented by central government bodies in period 2008-2010, are contained in the '[Strategy implementing Long-term Objective up to 2010](#)'. The 'Objective' defines direct and indirect S&T policy tools and sets a clear target of 1.8% share by GERD in GDP by 2015. Some 2/3 of total GERD should be provided by business sector. European money should be another important resource for the Slovak R&D system. Expenditure on S&T should be given a special chapter in the State Budget Law. The 172/2005 Law states that the Objective's targets are implemented via the National R&D Programme (NRDP). The NRDP has a separate sub-chapter in the State Budget and provides institutional and project finance for Slovak R&D system.

Institutional support to HEI and SAS, and project finance channelled via the State R&D programmes, RDA grants and horizontal programmes remain major forms for direct assistance to R&D in Slovakia till 2015. Institutional funding is provided both via direct transfers from the State budget to the Slovak Academy of Sciences (SAS has its own separate chapter in the state budget) and Universities (from chapter of the Ministry of Education), and via competitive VEGA grants. Total state support to higher education was €358.2m in 2007. Expenditure on research performed by higher education facilities was €63.0m in the same year. About 18% of the HEI budgets were spent for research activities. Exact shares of research in total expenditure in HEI sector are difficult to compute. Data on total income of the HEI (including business and foreign resources) was not available.

Direct transfers have traditionally been of higher importance than competitive grants in institutional funding. Indirect assistance may potentially involve tax incentives, but these will have to be consulted with the Ministry of Finance first (specific mechanisms for tax incentives were under preparation in 2009). The Long-term Objective envisages important changes in structure of public support to R&D. Institutional finance accounted for about 70% of total support in 2007. By 2015 institutional support should decrease to one third, while the project finance should generate some two thirds of the total outlays on R&D by the State Budget.

Investment related priorities are specified in the 'Strategy Implementing Long-term Objective up to 2010' and refer to (a) Human resources, and (b) R&D infrastructure. These priorities respond to some long-term weaknesses of the Slovak R&D system, namely limited and ageing stock of human capital, poor research infrastructure, and weak ties between the industry and academia sectors.

3.3.1 Overall funding mechanisms

The Slovak national research system consists of a number of governmental, private and non-profit organisations controlled and/or supported by the ministries of Education and Economy. These two Ministries and their agencies generated an overwhelming majority of R&D funding in Slovakia. The RDA, VEGA and KEGA are directed by the Ministry of Education. The National Agency for Small and Medium

Enterprises (NADSME) and the SIEA are directed by the Ministry of Economy. Some R&D projects are supported also by other central government ministries.

Institutional funding is channelled via two separate modes:

- Bulk of institutional support is provided directly via block grants from the State budget divisions (ministries and other central authorities, e.g. Slovak Academy of Sciences).
- The VEGA Scientific Grant Agency and the KEGA Culture and Education Grant Agency award competitive grants to institutions of basic research. HEIs and Slovak Academy of Sciences (SAS) only are eligible for the VEGA grants.

Share of the VEGA and KEGA grants in total institutional funding was about 12-15% and accounted for no significant changes in period 2002-2007.

Project-based funding is provided either via several channels. General calls and seven thematic programmes managed by the RDA and the State R&D Programmes (SRDP) are co-financed by the Ministry of Education and private sector. Bilateral cooperation and international research cooperation (Framework Programmes in particular) are co-financed by the Ministry of Education and foreign participants. Project-based funding supports mostly applied research and development, and is based on competitive grants and peer review mechanisms. The 2007 Annual Report on R&D sets public support to project-based funding to €33.297m and private support to €6.528m. General and specific calls by the RDA, and the State R&D programmes were major sources of project-based funding in 2007. European resources provided about 13.5% of total project funding by public sector.

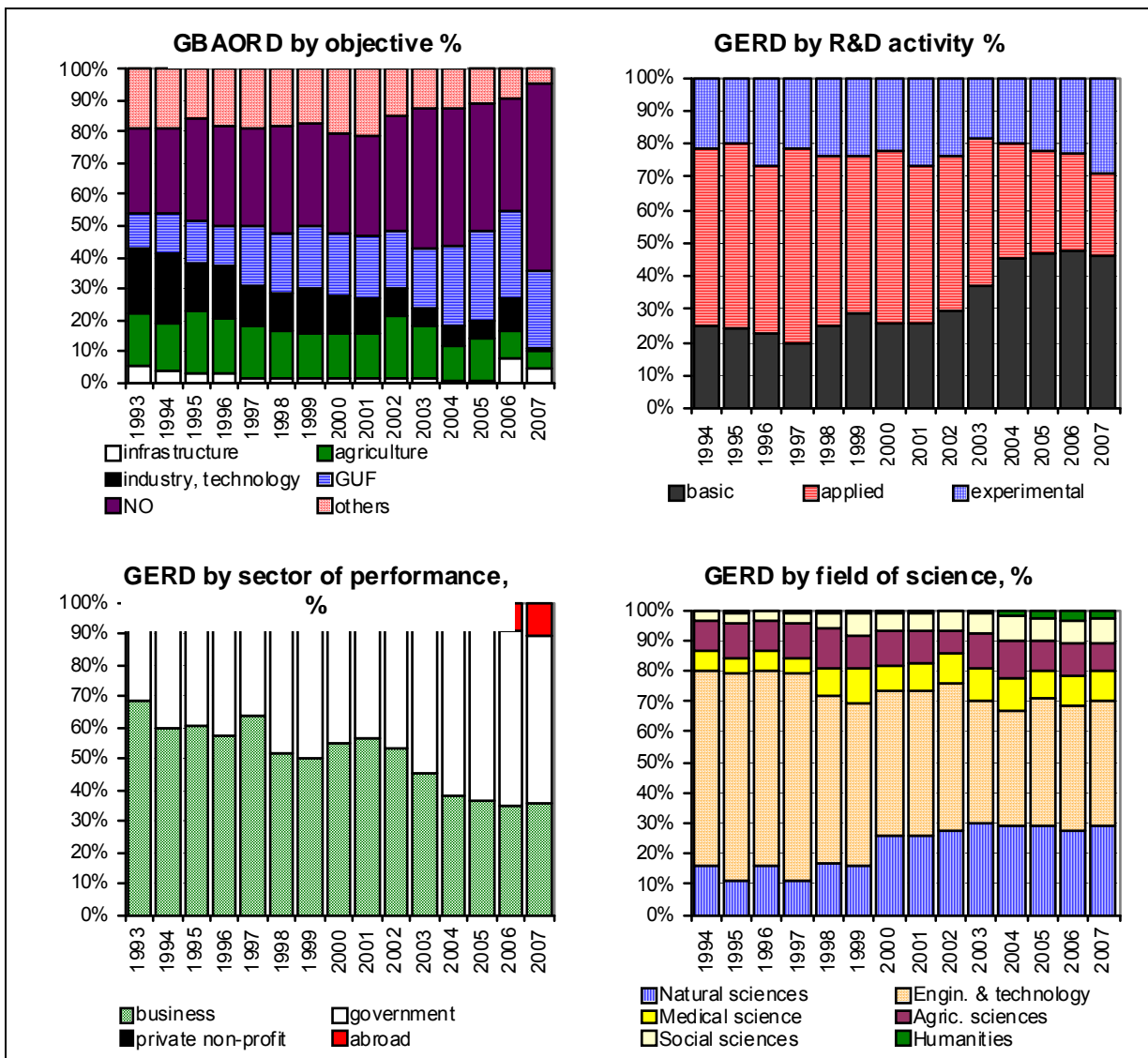
The Long-term Objective of the State S&T Policy up to 2015 stated that share of the institutional support was 70% and share of project support about 30% of total public support to R&D in 2007. The 'Objective' set a target for reversing these shares by 2015.

Funding patterns accounted for important, if not always positive changes in 1990s and 2000s.

In 1993 public institutions (including HEI) accounted for 31.4% and business sector 68.6% of GERD. In 2007 public institutions accounted for 54.0% and business sector for 35.6% of GERD (Figure 2). The shift in funding source structure was reflected in the shift in the type of research structure. The public sector (HEI and the SAS) became the main research agencies and basic research the main type of research. The share of basic research in total funding increased from 22.6% to 46.2% in the period 1994-2007. The share of applied research dropped from 49.4% to 24.5%, and the share of development rose from 19.5% to 29.2% in the same period. Business and public research sectors became increasingly less interconnected. In 2007 two single financial flows generated 79% of the total support to research: (a) transfers from central government to the Slovak Academy of Sciences and higher education facilities accounted for some 49% of the total GERD and (b) transfers from businesses to private research facilities generated some 29% of the total GERD. In late 1980s and early 1990s industry and agriculture were main priorities of Government funding and accounted for some 37.0% of total government budget appropriations and outlays on R&D (GBAORD, 1993). Research financed from general university funds (GUF) and non-oriented research (NO) generated some 37.3% of total expenditure. Heavy industries and machinery dominated the former centrally planned economy and this industry structure also was reflected in structure of GBAORD. In 1990s and 2000s, Slovak research system became fairly generic in

terms of socio-economic priorities. By 2007 the GUF and NO research accounted for some 81% of total GBAORD. The agricultural production and technology (6.04%), infrastructure and general planning of land-use (3.99%), and protection and improvement of human health (2.21%) accounted for other important themes. Structure of gross GBAORD was difficult to reconcile with development needs of the Slovak economy.

Figure 2: Trends in research funding in Slovakia



Source: Eurostat

The Long-term Objective of the State S&T Policy up to 2015 states that 'it is necessary to set substantive (thematic) priorities of research and development in the outlook by 2015' and names 12 thematic priorities. There are no details on funding flows by thematic priorities. Their importance can be guessed from channels of support. Agencies managed by the Ministry of Education and the SAS channelled about 80% of total public support for research in 2007. This share corresponded with 81% share of general university funds and non-oriented research in total GBAORD. Divisional ministries disbursed some 20% of total public support to research in the same year. Ministries of Health, Agriculture and Environment received some 80% of total funding outside projects and institutions supported by the Ministry of Education

and the Slovak Academy of Sciences (SAS). Ministry of Economy and its agencies concentrated on R&D projects supported by the Structural Funds.

Increasing shares of foreign resources for funding private research has been most interesting feature of trends in research funding in recent years. The Eurostat data on total intramural R&D expenditure by sectors of performance and source of funds reveal that the share of foreign funding in total GERD increased from 1.3% in 1993 to 10.2% in 2007. Surge in foreign finance has been related to:

- Slovakia's ability to tap the European resources and Structural Funds and Framework Programmes in particular;
- increasing business expenditure provided by the enterprises within the same group (cross-border intra-company transfers, including transfers between headquarters and branches of multinational companies).

3.3.2 Policy Mix Routes

The "Policy Mix Project" identified the following six 'routes' to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one 'route', the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system, etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

Two schemes aimed at establishment of new indigenous R&D performing firms.

The Research-Based Spin-Off and Incubator Scheme was administered by National Agency for Development of Small and Medium Enterprises (NADSME) in period 2001-2005. The scheme was aimed at implementation of policy mix for support of research-based spin-offs via seed capital investments, subsidising current production costs, advisory, consultation and administrative services, technical support and mentoring. The support was expected to foster generation of research outputs, patents and innovative products and services. Financing source of the scheme was the Ministry of Economy and budget set to €5.2m. The scheme was based on a Government Regulation No 669/2001 and co-financed by the PHARE – SR 9906 Programme. The scheme accounted for a limited success, as it coped both with lack of eligible applicants and limited resources subsidising current production costs.

In February 2007 the RDA prepared four new programmes aimed at development of knowledge-based society and transfer of knowledge between industry and academia sectors. Most important scheme, in terms of financial assistance, was the **Support to R&D in SMEs**. The programme is aimed at micro-enterprises, spin-offs and start-ups and supports feasibility studies, technology transfer and R&D project finance. Evaluation criteria for supported projects include intellectual value of the project and its economic impacts. €16.76m in period 2007-2010.

There was another policy measure that, in theory, should stimulate establishment of new indigenous R&D performing firms. The Business Incubators, Technology Parks and R&D Centres Scheme (BITPRDC, the SK 10 TrendChart measure) matched Measure 1.2 'Business Incubators, Technology Parks and R&D Centres' of the Priority I of the Sectoral Operational Plan for the Industry and Services (SOPIS). The business incubators, technology parks and R&D centres should be based by Slovak municipalities and co-operate with Universities. The support had form of the grant, which repaid real eligible costs occurred in the project. In period 2004-2006/8 the Scheme was planned to allocate some €41.25m (of which €30.94m was provided by the ERDF and €10.31m by Slovak Government and municipalities). The scheme was based on Slovak State Aid Law No 231/1999. In general, this policy measure was met with great interest by applicants. The public sector provided some 95% of total assistance. Industrial and technology parks were hoped to decrease high unemployment rates in some lagging behind Slovak regions. The policy measure ranked to most sophisticated among those supported by the Structural Funds. Applicants (Slovak municipalities) were asked to provide long list of formal documents related to property rights certificates, financial statements, employment statistics, environmental audits, etc. Smaller municipalities in particular sometimes were not able to prepare all these documents in time and quality required. The structure of contracted projects suggests that industrial parks and business incubators were more demanded and supported than R&D centres and/or technology incubators. The latter, however, are much more difficult to establish. The SOPIS, unfortunately, could address only Objective 1 Regions. Evaluation criteria favoured projects submitted by underdeveloped regions. This policy measure excluded Bratislava, where some 60% of total Slovak R&D capacities are concentrated. Small municipalities in peripheral regions hardly could apply for sophisticated projects in R&D centres and/or technology incubators.

Route 2: Stimulating greater R&D investment in R&D performing firms

Stimulating greater R&D investment in R&D performing firms was the most traditional area of action by Slovak government, when supporting private R&D investment. The logic behind this route is simple: pool of private R&D is limited to (privatised) industry research institutes and research units of (few) large domestic firms. Major initiatives in this field included:

Support of Industry Research and Pre-Competitive Development (SIRPCD, former TrendChart measure SK 08). The Scheme aimed at increases in competitiveness of Slovak products via industry research and pre-competitive development and developing closer networks between the user and facilitators of the industry research and pre-competitive development. The scheme matched Measure 1.3 'Support of business, innovations and applied research' of the Priority I of the SOPIS (Planning period 2004-2006/8). In period 2004-2006 the Scheme allocated some €22.10m (of which €7.73m was provided by the ERDF, €6.63m by Slovak Government and €7.73m by Slovak entrepreneurs). The Scheme was

administered by the SIEA and had several lots with varying budgets and was implemented in two modules. The 'de minimis' module supported smaller scale projects in introduction of quality management systems, certifications, intellectual property rights (IPR) registration and exploitation, and introduction of monitoring systems. Total costs of this scheme were €0.65m, average costs per project €0.02m. The State Aid module targeted larger scale projects in applied research. Industry research (private) institutes doing research in chemistry, machinery and manufacture of transport equipment were main recipients of the aid. Some 19 projects were supported with €5.6m.

Supporting innovative activities in enterprises scheme (the SK 13 TrendChart measure) is identical with the Measure 1.3 'Supporting innovative activities in enterprises' of the OPCEG. It implements Measure 3.3 'Supporting innovative activities in enterprises' of the Innovation Strategy and basically mirrors the abovementioned SIRPCD scheme in planning period 2007-2013. Some €154m are allocated to projects on applied research, IPR and organisational innovations.

The State R&D programmes (SRDP) involve participants from private and public sectors and are aimed at applied research and development. Ten SRDP allocated some €16.7m in period 2006-2009. Shares of private and public sectors were not available.

The abovementioned programmes have been designed for all kinds of firms. Applicants, however, usually must prove research experience and provide details about their R&D resources. Industry research institutes and large enterprises are best candidates for absorbing State Aid in area of R&D in Slovakia.

Route 3: Stimulating firms that do not perform R&D yet

There was no explicit research policy measure aimed at firms that had not performed R&D yet. Two major schemes supported technology transfers in SMEs:

- Support for Purchases of Innovative Technologies and Creation of Quality Management Systems Scheme (former TrendChart measure SK 02) was financed from the state budget and allocated some €3.0m in period 1999-2005.
- Assistance to SMEs Scheme (former TrendChart measure SK 09) matched Measure 1.1 'Assistance to SMEs' of the Priority I of the SOPIS and allocated some €44.20m, of which €15.74m was provided by the ERDF, €13.26m by Slovak Government and €15.47m by Slovak entrepreneurs.

Both schemes aimed at modernisation of the SMEs via transfer of new technologies and implementation of the quality management systems. Activities supported by these schemes reappear in the 'Innovation and technology transfers' scheme (Trendchart Measure SK 12) The Scheme is identical with the Measure 1.1 'Innovation and technology transfers' of the OPCEG. It implements Measure 3.1 'Innovation and technology transfers' of the Innovation Strategy and invests €241m in period 2008-2013.

The abovementioned schemes may have induced interest by Slovak SMEs in performing R&D activities, but evidence on the fact has been missing so far.

Route 4: Attracting R&D-performing firms from abroad

There are no explicit policies for attracting R&D-performing firms from abroad. Some framework-supportive policies are in place, which may increase interest by high-tech

firms to establish their research units in Slovakia. The Act on Investment Aid No. 561/2007 supports investments in (a) lagging behind regions and (b) preferred sectors of national economy. The total volume of investment incentive for each investment project is computed as combination of territorial and sectoral criteria match. Two forms of state assistance for individual projects are provided:

- (1) Indirect assistance: tax allowance and transfers of the state property to an investor;
- (2) Direct assistance: subsidises for employee education, subsidises for job creation and fixed investment subsidises.

The Act allows for provision of regional investment and employment aid for investment or expansion projects of industrial production, technology centres, strategic service centres, and complex tourism centres. The 'strategic services' category refers to 'services with a high added value facilitating employment of qualified experts in software development centres, expert solution centres, high-tech repair centres, customer support centres and headquarters of multinational corporations'. Eligible costs include tangible assets (land, buildings and equipment), intangible assets (patents, licences and other forms of intellectual property) and wages in newly created labour posts. Most foreign investors rely on the Slovak Investment and Trade Development Agency (SARIO), when negotiating the terms of investment assistance. The 561/2007 Act does not explicitly refer to provision for R&D, but it is expected that the strategic service centres could attract investors interested in doing applied research in Slovakia. In January 2009 the Slovak Ministry of Education drafted a law on research and development (R&D) stimuli, which defines the rules for state aid provided to businesses in the area of R&D. Two types of stimuli are envisaged: subsidises and tax allowances. Tax allowances, however, are subject to approval by the Ministry of Finance. All kinds of businesses may apply for stimuli. The provision of stimuli is subject to the creation of new or the extension of incumbent R&D workplaces for the period of at least five years. The maximum sum of the stimuli was set pursuant to Article 6 of Commission Regulation (EC) No 800/2008 declaring certain categories of aid compatible with the common market. The maximal total eligible costs per applicant were set to €1m for basic research projects and €3.5m for applied and experimental research projects. Eligible costs include wages, travel, material and energy costs, and costs of external services related to implementation of R&D projects. The proposal for the law on R&D stimuli was approved by the Slovak government and submitted to Slovak parliament.

Some foreign firms have already started to establish their R&D units in Slovakia, in the software industry in particular. Whether this trend was assisted more by the investment incentive regulations or market forces (good balance between labour costs and skills) is difficult to say.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The RDA launched the *Support to Cooperation between the Universities and Slovak Academy of Sciences, and businesses* in 2007. The programme is based on grants supporting planning, establishing and running centres of cooperation between SAS and HEI on one hand and businesses on the other hand. The project finance supports both costs of partnership creation and operation, and costs of basic research in centres established under this scheme. Evaluation criteria for supported projects include intellectual value of the project, its economic and social impacts, as

well as project's ability to bind Industry and Academia sectors, and centres' performance. The Scheme allocates €7.59m in period 2007-2010.

The **Innovation Voucher Scheme** is aimed at SMEs. The scheme is modelled on Dutch experience. The SME intending to introduce an innovation should be able to contact a Regional Innovation Centre (RIC) and/or University and ask for innovation solution. The solution is paid by the voucher. The vouchers should be issued in large quantities and have quite small nominal value (about €3000). The main purpose of the scheme is to get maximal numbers of SMEs in touch with innovation solution providers and stimulate extramural R&D services. Given low face value of the voucher, the scheme accounts for simple, fast and low-cost administration procedures. The Ministry of Economy and the SIEA are the scheme managers. The scheme is expected to start in 2009 or 2010, once the RICs are established. Introduction of the Scheme may be impacted by financial crisis in 2009.

Route 6: Increasing R&D in the public sector

Major policy measures aimed at increasing R&D in the public sector include (a) State R&D Programmes (SRDP), (b) general calls by the Research and Development Agency (RDA) and (c) thematic programmes by the RDA.

The RDA launched thematic programme **Support to creation and activities of Centres of Excellence** in 2007. The programme supports projects developed by centres of excellence in research and development. Evaluation criteria for supported projects include numbers of jobs for PhD students and post-docs, centres' infrastructure, ability to tap resources supported by the FP7 and Structural Funds, and dissemination activities, as well as numbers of publications, citations and patents. The Scheme allocates €8.82m in period 2007-2010.

Support to human potential in area of R&D and popularisation of science is another scheme launched by the RDA. The Scheme aims at following targets:

- Creating conducive environment for post-doctoral R&D workers;
- Supporting mobility between Industry and Academia sectors;
- Improving cooperation between Slovak and international R&D facilities;
- Improving education on R&D ethics.

Typical instruments aimed to achieving these targets include creation of 3-years job contracts for postdoctoral workers, re-integration grants for Slovak R&D workers employed at least 2 years abroad and grants for excellent mentors in PhD education. The Programme also plans to create a database of Slovak scientists working abroad. The Scheme was designed for period 2006-2010. Volume of financial assistance depends on RDA's resources in particular years. In 2009 the scheme allocates €6.64m.

Support to excellence research and human resources in R&D sector, and the new mechanism for the allocation of financial means for doctoral scholarships are also main themes of the updated NRP for 2008-2010.

The importance of education and innovation policies

Slovakia accounts for low share of innovative businesses. Relevant government documents (the 2007 Innovation Strategy and 2008 Innovation Policy, 2008-2010 NRP) identify weak linkages between the industry and academia sectors major barrier for development of innovations. The NRP for 2008-2010 states that the government will support 'the transfer of knowledge between academic and business sectors and contractual research for the needs of the public administration. The main implementation instrument for this measure will be the provision of financial means co-financed from structural funds through the OPRD and OPCEG...It will be necessary to renew the knowledge triangle based on intensive cooperation of research and development organizations, universities and the business environment for the successful operation of the knowledge-oriented society'. Building RICs is a key initiative in area of the knowledge triangle. New mechanism for allocating financial support to PhD fellowships is another important policy in this field. Financial assistance will be provided to full-time PhD students through research projects from the new grant scheme of the RDA. The scheme will allow for the financing of the scientific part of the doctoral study and increase the share of financing of doctoral scholarships from grants. The most active PhD students will acquire significantly higher scholarships by working on scientific projects.

Assessment of the importance of policy mix routes and their balance

Slovak system supporting R&D investment evolved in a path-dependent manner in which past practices shaped the options for future strategies and development.

Slovakia finance system has traditionally been dominated by banks. Attempts to create Anglo-Saxon-type capital markets (the Coupon Privatisation schemes) failed in 1990s and have not been repeated since that time. Defunct capital markets did not provide fertile environments for risk capital schemes. Market reforms introduced by liberal-minded market governments in 1998-2006 proved very successful in their own terms. They helped to attract significant amount of the foreign direct investment (FDI), generate high rates of economic growth and decrease unemployment rates. The reforms promoted business-friendly market environments based on flexible labour markets, flat income tax, and non-discriminatory support to foreign direct investment. Tax incentives for R&D intensive investors have been considered several times, but rejected for fear they would distort tax system, praised for simplicity and transparency. Defunct capital markets and flat tax environment explain why Slovak system supporting R&D investments relies almost exclusively on grants.

Two routes have dominated policies aimed at stimulation of R&D investment in Slovakia in 2000s: (a) increasing R&D in public sector and (b) stimulating greater R&D investment in R&D performing firms. In 2000s the applied research system deteriorated and public sector became major research performer. The government decided (a) improve R&D infrastructure and support human resources in public sector. Bulk of national assistance to R&D investment was channelled via the RDA and VEGA agencies, and aimed at support to young researchers and basic research on Slovak Universities and the SAS. Assistance provided by Structural Funds was channelled to (privatised) industry research institutes and research units of (few) large domestic firms. Maintaining remnants of the pre-1989 network of the (domestic) industry research institutes was preferred to promoting new indigenous R&D firms and/or stimulating firms that do not perform R&D yet.

Table 8: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	The government opted to maintain incumbent R&D intensive firms, rather than promote new ones. There were some attempts to foster research-based spin-offs, but failed. Importance of this route in policy mix is low in Slovakia.	No changes.
2	Schemes stimulating greater R&D investment in R&D performing firms relied in assistance from the Structural Funds and helped to nurse traditional industry research institutes. This route of support accounted for high importance (in terms of total assistance provided). Schemes proved difficult to implement.	Calls for schemes based on the 2008 Innovation Policy launched in 2008-2009.
3	This route was mainly used for stimulating technology transfer in Slovak SMEs. Technology transfer is a fast and relatively cheap way to acquire advanced technologies in absence of strong R&D backing in less developed Member Countries. Importance of this route for stimulating R&D investment, however, is limited.	Calls for schemes based on the 2008 Innovation Policy launched in 2008-2009.
4	Most FDI coming to Slovakia in 1990s and 2000s went to car-making and manufacturing consumer electronics. Bulk of investment targeted low and medium-tech activities. Government declared its support to R&D intensive investments, but few specific measures were adopted. Importance of this route is likely to increase in the future.	Calls for schemes based on the 2008 Innovation Policy launched in 2008-2009.
5	Importance of this route in government rhetoric and official documents on R&D policies increased, real support (in terms of financial assistance) was limited. Policy measures addressing cooperation between the academia and industry sectors coped with low demand for R&D results by Slovak businesses.	No major changes.
6	The state support to public R&D accounted for spectacular increases since 2004. Public sector also is likely to be main beneficiary of the assistance provided by the Structural Funds. Increased support to R&D investment in public sector helped to stop deterioration of the Slovak research system.	Highlight of the 2008-2010 NRP. Calls for schemes based on the OPRD and RDA programmes launched in 2008-2009.

3.4 Progress towards national R&D investment targets

The Eurostat data reveal that share of GERD in GDP decreased from 1.08% in 1997 to 0.46% in 2007. Decrease in R&D intensity was more pronounced for business sector. While share of GERD financed by government in GDP decreased from 0.37% to 0.25%, share of business sector accounted for a catastrophic decline, from 0.68% to 0.16% in the abovementioned period.

Table 9: Indicators for policy mix

	2005	2006	2007	2008	EU-27 (latest year)	
					Average	Year
GERD (euro million)	194	217	252	na	226120	2007
R&D intensity (GERD as % of GDP)	0.51	0.49	0.46	na	1.83	2007
GERD financed by government as % of total GERD	57.0	55.6	53.9	na	34.2	2005
GERD financed by business enterprise as % of total GERD	36.6	35.0	35.6	na	54.5	2005
GERD financed by abroad as % of total GERD	6.0	9.1	10.2	na	9.0	2005
GBAORD (euro million)	108	120	150	na	87639	2007
GBAORD as % of general government expenditure	0.74	0.73	0.79	na	1.55	2007
BERD (euro million)	97	93	100	na	144089	2007
Business sector R&D intensity (BERD as % of GDP)	0.25	0.21	0.18	na	1.17	2007
BERD financed by government as % of total BERD	26.7	20.8	10.3	na	7.2	2005

Source: Eurostat. Note: Values in italics are estimated or provisional. na = not available

Share of GBAORD in total government expenditure was 0.79% in 2007 (about one half of the EU27 average). Ten years before (1997) the GBAORD share was 0.83%. While public expenditure on R&D increased in absolute terms, it stagnated in relative terms (partly due to high growth in GDP). Nevertheless, when most private and/or applied research activities evaporated, public research organisations and HEI became main research performers, and basic research main type of research activity.

Basic documents on research policy recognise importance of R&D funding by business sector and applied research activities. The 2007 Long-term Objective of the State S&T Policy up to 2015, for example, stated that 'to ensure the implementation of the objectives and goals of the development of science and technology by 2015, a total expenditure on science and technology will be required at 1.8% of the GDP in 2015. One important priority in the direct support for science and technology will be to raise the participation of the business resources in the support of science and technology so as to reach a 2/3 proportion of these resources in the overall support for science and technology in 2015'. Evidence on R&D spending by Eurostat indicated that some national targets in R&D investment (in business sector in particular) could prove overoptimistic. Importance of foreign resources, on the other hand, is likely to increase. Structural Funds and Framework Programmes should provide significant financial assistance to public research institutions and projects.

While progress towards national R&D investment targets was slow, institutional reform of the national R&D and innovation systems accounted for more improvements. The 2008-2010 National Reform Programme listed relevant recent policy measures and governance changes implemented by Slovak government, and supporting development of S&T and innovations:

- The 172/2005 Law on Organisation of the State Support to R&D was amended in May 2008. The Law defined bodies eligible for the State Aid in field of knowledge transfer between industry and academia sectors. Centres of excellence were recognised as a specific type of S&T bodies.
- The Central Information Portal for S&T and innovation was established.
- The financial scheme for co-financing participation of Slovak research teams in international research projects was approved.

- Proposal for an at least 30% share of the foreign evaluators of the Slovak R&D grant schemes was approved.
- Slovak Government passed the Innovation Policy document.

Research policy objectives set by Slovak government are coherent and so are proposed and/or implemented policy measures. Challenges posed by long-term neglect of R&D and innovation systems, however, are immense. A greater array of S&T policy measures and governance changes should enter into force in period 2009-2010. Their impacts are yet to be seen.

Table 10: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Dual economy and low wages generate low supply of and low demand on R&D solutions.	Outside of scope of the explicit R&D policies. Barriers are likely to be removed by market forces and framework supportive policies. These developments can take years to materialise.
Limited sources of R&D funding.	Opportunity: OPRD, OCPEG and OPE provide great volume of R&D funding. Risks: Significant increases in public support to R&D need not necessarily be reflected in corresponding investment by private sector. Increased public investment in human resources and R&D infrastructure may prove unsustainable, once Structural Funds assistance stops.
Limited attention paid to R&D issues in period 1990-2004; low understanding of importance by R&D for economic and social development.	Opportunity: Importance of R&D and innovation issues in government rhetoric increased. Slovak government also increased public outlays on R&D. Risks: Incumbent stock of human capital is low and ageing, and may not generate a critical mass needed for transition towards a knowledge-based economy. Brain-drain by young researchers remains a threat for development of highly skilled human resources in Slovakia.

4 Contributions of national policies to the European Research Area

ERAWATCH country reports 2008 provide a succinct and concise analysis of the ERA dimension in the national R&D system of the country. This Chapter further develops this analysis and provides a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA² which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers

² Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final (see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

Labour market for researchers accounted for dramatic, if not always positive changes in last two decades in Slovakia. There were some 60,548 R&D workers (of which 34,685 researchers) in headcounts in 1989. Demise of central planning and introduction of a market economy immediately were reflected in deep fall in GERD and stocks of human resources in R&D (Figure 3). In period 1989-1994 numbers of R&D workers and researchers dropped to one third and changed little since that time. By 2007 there were some 23,437 R&D workers (of which 19,375 researchers) in headcounts in Slovakia. Two major factors were behind the fall in human resources in R&D:

1. The 'shock therapy' model encouraged short-term considerations in company planning, whereas R&D requires long-term perspectives. The demand for traditional company-level research has declined in favour of technology. Collapse of communist regimes lifted ideological and strategic constraints on knowledge diffusion between East and West. The inflow of FDI, linked to privatisation, has often been followed by substitution of imported management and technology for in-house R&D, as part of wider corporate division of labour. Reduced public expenditure was related to the neo-liberal stabilisation programme, and led to a direct decline in R&D. The re-internalisation of trade has also had a negative impact on the R&D. Collapse of the former Council of Mutual Economic Assistance has meant reduced opportunities for exporting more technologically sophisticated goods, including military products. Many research institutes have been closed or severely emasculated and the financial squeeze imposed on the privatised enterprises has reduced R&D capacity. Indirect impacts were reflected in difficulties in finding complementary sources of R&D finance by private firms, as the business sector itself was undergoing a period of privatisation and thorough corporate restructuring.

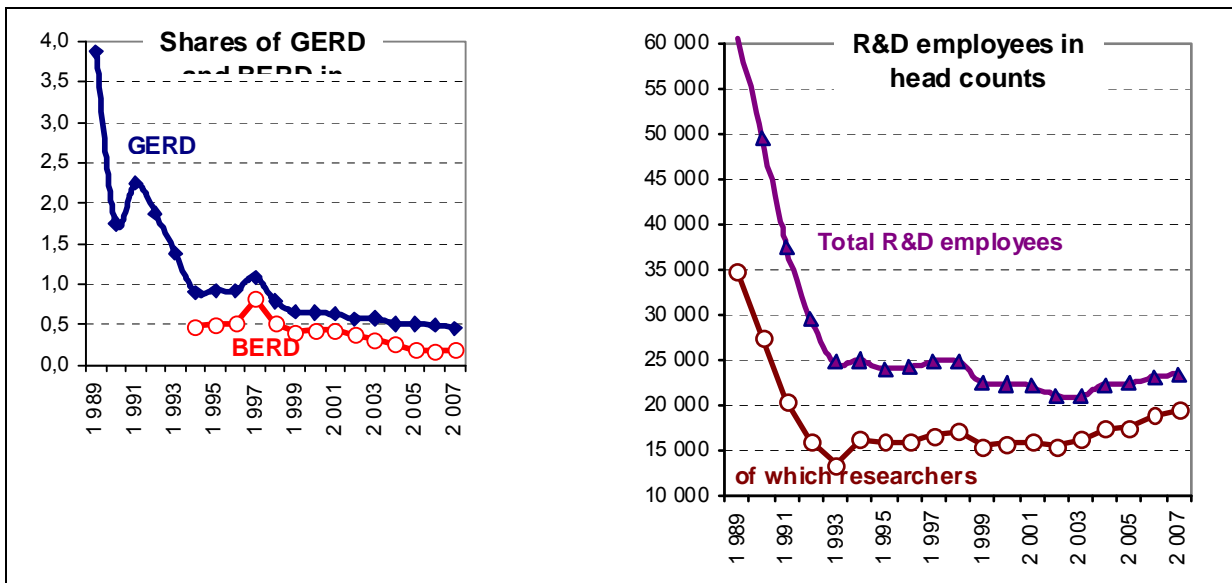
Economic and social transition generated strong demand for business, marketing, management, trade, finance and engineering skills. Shortages on these skills, as well as low salaries in R&D sector, prompted exodus by scientists from public research organisations and Universities to business and politics. Slovak R&D workforce was aging and young people did not consider research careers attractive.

2. Two basic research policy documents (the Concept of the National Science and Technology Policy by 2005) and (the Long-term Objective of the State S&T Policy up to 2015) contained priorities on:
 - creating conditions for human resources development, with particular regard to careers of young research workers and their professional growth,

- creating working conditions (salaries, training, modern infrastructure) for R&D workers to stop a brain drain to more attractive jobs in Slovakia and abroad,
- supporting mobility of R&D workers between different R&D sectors;
- supporting international mobility of R&D workers via attracting foreign professionals to Slovakia and supporting return migration by Slovak nationals;
- developing careers of young researchers and supporting excellent mentors of PhD students.

There also were some positive developments in the national labour market for researchers after 1989. These included (a) lifting ideological constraints on knowledge diffusion and (b) creating opportunities for Slovak scientists to travel and work abroad.

Figure 3: Development of financial and human resources R&D in Slovakia in 1989-2007.



Sources: Statistical Office of the Slovak Republic: The 2001 - 2009 R&D yearbooks; author's own computations.

4.1.1 Policies for opening up the national labour market for researchers

Access to Slovak national labour market depends on origin of an applicant. On the basis of the Treaty of Accession of the Slovak Republic to the European Union and Decree of the Government of the Slovak Republic No. 391/2004, from 1 May 2004, the Slovak Republic enables access to its labour market to citizens of all EU member states without any restrictions. According to the Act No 5/2004 Coll. on employment services a citizen of an EU member state and his family members shall have the same legal position in legal relations occurring pursuant to this Act as do citizens of the Slovak Republic. The rights relating to a citizen of an EU member state and his family members also refer to citizens and family members of states within the European Economic Area. Nationals from third countries have the same legal status as Slovak citizens, if they were issued a work permit and a temporary residence permit for the purpose of employment. The employer with a seat in the territory of the Slovak Republic may accept a foreign person in employment only if that person was issued a temporary residence permit for the purpose of employment and a work

permit by the competent Office. Temporary work and residence permit effectively preclude researchers from third countries to apply for tenured position.

An EU researcher may, in theory, apply for any research job and/or post in Slovakia. In real life, some managerial posts require fluent Slovak, which few foreign applicants can prove. There were examples (if only a few) of foreigners applying and winning top posts in Slovak University system. A Polish catholic priest and polyglot, for example, is rector of the Catholic University in Ružomberok.

The 172/2005 Law on Organisation of State support to R&D regulates provision of finance to public sector. Slovakia transposed the Council Regulation on special methods of accepting the citizens of third countries (outside the territory of the EU) into scientific research through the 2008 amendment of the 172/2005 Law. The amendment specified the terms and conditions under which R&D organisations can accept researchers from third countries. Bodies established in Slovakia are eligible for support. Individual researchers (including citizens of the EU and third countries) may hold grants and transfer these within Slovakia, but they have to produce acceptance documents by Slovak research institutions.

Slovakia applies flat income tax of 19%. There are no special tax incentives for researchers. Employees also had to pay health and social insurance taxes. As for the pension insurance, an employee can opt either to pay 18% of gross income to the (pay-as-you go) Social Security system or split his/her payment between the Social Security system and funded pillar managed by the private pension companies. There also is a private supplementary pension scheme. Foreign researchers are free to participate in funded pillar and supplementary pension scheme, and can transfer their contributions to their home countries.

PhD students are offered two types of jobs, depending on their choice and availability of funding. Regular employment, usually fixed-term, is the first option, fellowship the second one. PhD students on fellowship pay no social insurance taxes. They also pay no health insurance taxes up to age of 30. Remuneration in regular employment, however, is higher. Foreign PhD students enjoy the same rights and duties as Slovak nationals.

Slovak government also tried to support mobility by Slovak scientists within Slovakia and the ERA. The new comprehensive information system for science, research and innovations and the central information portal (CIP) were established in July 2008. They are supporting mobility by Slovak researchers within the ERA, and public and private R&D sectors in Slovakia via introduction of new information resources on mobility grants.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

Two national research organisations signed the Charter for Researchers in Slovakia, the Rectors of the Slovak Higher Education Institutions and the Slovak Academy of Sciences. These two bodies represent about 80% of the total researchers in Slovakia.

Employees in public sector are considered civil servants. Their remuneration is regulated by the official salary schemes set in the 553/2003 Law. These are based on education level, type of jobs and length of experience. The Law sets special wage tariff scale for the University teachers and R&D workers. Tariff wage can be complemented by bonus, if available.

The Statistical Office of the Slovak Republic published selected results of the 'Scientist Careers' in April 2008. The mailing survey was done on a full sample of all holders of the PhD degree residing in Slovakia by end of 2006 and accounted for return rate of 18.3%. The survey investigated country of origin, demographic data, employment status, working conditions and remuneration of the scientists.

- Some 94% of the survey participants were born in Slovakia and some 99.2% were Slovak citizens. It indicates very low levels of immigration by highly skilled professionals to Slovakia. There is a generation gap and a relative lack of young scientists. Some 18.8% of the survey participants were in age specific group up to 35 years, 20.3% in age specific group 35-44 years, while 53.6% in age specific group 45+ years.
- Slovakia accounts for very weak ties between the business and academia sector. This fact is reflected also in employment status by Slovak scientists. Some 97.92% of scientists reported employment status, while only some 1.55% were self-employed. Almost two thirds of the survey participants did research, while the rest worked outside of the R&D sector.
- Slovak researchers appreciated intellectual challenges, independence and social responsibility of their work. Limited career opportunities and low pay, on the other hand, were reported major sources of dissatisfaction. These opinions were corroborated by the wage data. Half of the scientists indicated their average gross wages lower than €740. Wages higher than €1184 were reported only by 11.6% of the scientists.

There is increased competition for the most talented R&D workers, unfortunately, mostly by foreign R&D institutions and domestic banking sector.

Slovakia accounted for above-average rates of female employment in R&D sector. Shares of female R&D personnel (in full time equivalent, FTE) in total R&D personnel were 44.8% in 2000 and 44.7% in 2007 in Slovakia, while 31.8% in 2000 and 33.1% in 2007 the EU27. Shares of female researchers (in FTE) increased from 38.8% to 41.4% in Slovakia, while from 27.1% to 27.8% in the EU27 in period 2000-2007 (Source: Eurostat, Data on Science and Technology).

No special provisions are made for equal gender representation in academic and research committees, boards and governing bodies. Women, however, are rather underrepresented in top managerial posts. There, for example, were only 3 female rectors on 33 Slovak higher education institutions in 2008.

All women in Slovakia are entitled to the 3 years maternity leave. Law guarantees return to the same type of work. The fixed-term contract is the only exception from this rule.

4.2 Governing research infrastructures

All government documents on R&D recognise weak research infrastructure of R&D a major barrier for development of science and technology. Infrastructure building, therefore, ranks among the highest priorities in research policies. Development of two types of research infrastructure is supported: generic and thematic infrastructure.

As for the generic infrastructure, two major national infrastructure projects started in 2008: (1) The national information system supporting research and development in

Slovakia and (2) Infrastructure for research and development – Data centre for research and development (see chapter 2.3.4 for more details).

Slovakia's strong industrial tradition and background in manufacturing are reflected in dominance of physics, chemistry and material science in high-quality research. These disciplines account for the highest numbers of papers and citations by Slovak scientists in international journals, relatively high funding and good research infrastructure.

The Cyclotron Centre probably is the largest national research infrastructure project. The Centre was established by the Slovak Government Resolution No. 659/99 of 4 April 1999. The Government Office for Normalisation, Metrology and Certification builds the Centre and cooperates with the Ministries of Education, Economy and Defence. Costs of Centre building originally were planned for €108m and paid from recovered loans provided to Russia in early 1990s (the same source was used for financing space flight by first Slovak astronaut in 1999). The International Atomic Energy Agency and Framework Programmes also contributed to the Centre building. Nuclear medicine, industrial applications, and research in particle physics, and material science are main Centre activities. The Centre, however, coped with problems related to recovering Russian debt and its operation are unlikely to start before 2010. Slovak Government considers issues related to Centre operations and handling nuclear material sensitive, and does not publish details on Centre budget, staff, technology equipment, etc.

The International Laser Centre (ILC) is an interdisciplinary organisation, focused on training, R&D in areas of progressive methods and technologies of photonics, and their application in various fields, and on various levels of national and international cooperation. The Centre was established by the Ministry of Education in January 1997, and based on cooperation by the Faculty of Electrical Engineering and Information Technology Slovak University of Technology in Bratislava, and Faculty of Mathematics and Physics of the Comenius University in Bratislava. The excellent research centre is equipped with up-to-date technology in field of advanced laser and optoelectronic technologies. The Centre operated with budget €0.55m in 2007.

The virtual network MatNet links Slovak scientific, academic and industrial institutions dealing with R&D in field of engineering materials and accompanying technologies in order to enable more efficient transfer of knowledge on modern materials and processes into Slovak industrial companies. This network was established in 2006 under the project 'Creation of Virtual Network for R&D in the Field of Engineering Materials and Technologies', which is financially supported by the European Social Fund. The network MatNet is based on co-operation of 9 Institutions from region of Bratislava (5 institutions of the SAS, 2 faculties of the Slovak Technical University and 2 private research institutions) in 2009.

Slovakia also participates in several intergovernmental infrastructure projects. The 2008-2010 NRP explicitly refers to priority 'increased participation of Slovak organizations in the solution of European research and development programmes and European research centre programmes'. There are no comprehensive data on accessing European intergovernmental R&D infrastructure by Slovak scientists. Membership in the European Organisation in Nuclear Research (CERN) probably was the most important initiative in this field. Ministry of Education is guarantor of Slovakia's membership in the CERN. The Ministry recognised that Slovakia's share in the total CERN budget is low (about 0.34%), but numbers of Slovak scientists and value of technology equipment delivered by Slovak enterprises surpass volume of

contribution several times. By 2008 Slovak physicists, for example, participated in two large experiments (ALICE and ATLAS).

4.3 Research organisations

The Higher Education Law No 175/2008 stipulates that Slovak HEI 'are part of the ERA' and 'develop cooperation with international and European HEI'. The EU nationals have the same rights as Slovak ones, when studying and/or working on Slovak HEI, including membership in top management and academic bodies.

The Law also recognizes category of the 'foreign HEI', which are those established in the European Economic Area and Switzerland. These institutions can apply to the Ministry of Education for establishing their branches in Slovakia. They must produce documents regarding recognition by their home country authorities, and personal and technical resources in Slovakia. Foreign HEI established in Slovakia must produce publicly available annual reports on their activities, and provide Ministry with all statistical data and other relevant information. One Czech HEI has already established its branch in Slovakia.

In January 2009 Slovak Government discussed amendment of the Law on Higher Education. The amendment contains an important initiative regarding foreign HEI. Criteria for establishing and operation HEI should be unified for public and private HEI. The amendment also removes several administrative obstacles for entry by HEI established in the OECD Member Countries to Slovak market of higher education. The US Universities in particular experienced problems, when establishing their branches in Slovakia. The aim of the amendment is to set equal opportunities Slovak and foreign HEIs, and increase quality of teaching and research.

Slovak HEI are self-governing institutions. The Rector is elected by the Academic Senate and appointed by the President of the Slovak Republic. The Academic Senate has at least 11 members. At least one third of these are students and the rest is elected by the academic staff. The Rector is advised by the Scientific Board, the Disciplinary Board, the Rector's collegiums and the Management Board. The Management Board discusses and approves HEI budget, all other important financial issues, and examines HEI's long-term development plans and annual reports. The Management Board has 14 members, 6 of whom are appointed by the Rector, 6 by the Minister of Education, 1 by academic staff and 1 by students. The Board members are elected from outstanding representatives of the business sector, regional government and central government.

Faculty Deans are elected by the Faculty Academic Senates and appointed by the Rector.

Candidates for directors of the SAS institutes are elected by the academic staff and appointed by the SAS presidium. Any EU national may apply for the post, but so far only Slovak directors were elected.

It is not legal hindrances, but low salaries, language barriers and poor equipment which impede interests by foreign scientists in applying for jobs and academic posts with Slovak HEI and the SAS.

4.4 Opening up national research programmes

This issue has been not covered by Slovak research policies so far. The 172/2005 Law on Organisation of State support to R&D in theory enables participation by foreign researchers in Slovak research programmes, but there is little experience with this issue, given limited interest by foreign researchers in working in Slovakia. Low salary and poor R&D equipment are major barriers for attractiveness of research careers in Slovakia both by Slovak and foreign nationals. Low financial and human resources and underdeveloped research infrastructure limit joint programming in Slovakia.

4.5 National ERA-related policies - a summary

There has been no distinctive policy mix regarding the ERA, but importance of the ERA-related policies in the government rhetoric increased in 2006-2008. The ERA-issues also became more visible in the national documents on research policies. The 2008 Strategy implementing the 'Long-term Objective of the State S&T Policy up to 2015', for example, set four targets in international R&D cooperation:

- Target 'Financial means for international R&D cooperation in general and EU research programmes and mobility programmes in particular' supports four specific goals: (a) supporting international R&D cooperation via cooperation between networks of centres of excellence; (b) supporting joint projects and research exchange between Slovak and foreign R&D organisations via cooperation between networks of centres of excellence; (c) supporting preparation of projects applying for the FP7 programme schemes and (d) providing 25% co-financing for successful Slovak R&D organisations and Universities participating in FP7 programme schemes. The Ministry of Education and RDA are responsible for execution of this target. State budget, private sector and European Union (OPRD) provide financial means for implementing particular goals.
- Target 'Ensuring operation of basic and support expert groups needed for implementing the FP7 programme schemes in Slovakia' is implemented by the Ministry of Education and financed from the state budget.
- Target 'Ensuring complementary provision of financial assistance under the OPRD and the FP7 programme schemes and promoting synergic effects in support to R&D' is implemented by the Ministry of Education and financed from the Structural Funds.
- Target 'Identifying options for the VAT refunds or VAT relief for projects developed under the FP7 programme' is implemented by the Ministry of Education.

There is little quantitative information for evaluating particular targets.

Table 11: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> • Medium importance, no influx of foreign researchers is envisaged. Brain-drain by Slovak scientists seems a more important issue. 	<ul style="list-style-type: none"> • Full access by EU nationals to Slovak research market. Policies aimed at preventing and/or reversing brain drain in place.
Governance of research infrastructures	<ul style="list-style-type: none"> • High importance, great interest in participation in European research infrastructure. 	<ul style="list-style-type: none"> • Increased support to research exchange and mobility, co-financing successful applicants in FP projects.
Autonomy of research institutions	<ul style="list-style-type: none"> • Medium importance, there are no formal barriers for autonomy of research institutions. 	<ul style="list-style-type: none"> • Slovak Government discussed amendment of the Law on Higher Education. Criteria for establishing and operating HEI should be unified for public and private HEI and access by HEI established in the OECD Member Countries made easier.
Opening up of national research programmes	<ul style="list-style-type: none"> • Low importance and little experience with the issue. 	<ul style="list-style-type: none"> • Provisions on foreign researchers in the 172/2005 Law.

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

Dual economy, low demand on and limited supply of R&D solutions, and limited national financial assistance to R&D are major barriers for implementing national R&D investment goals. These problems refer to current development stage of the country. Implementation of research infrastructure policies significantly is assisted by the European money, but results may take years to materialise. Major imbalances and policy risks include:

- rather excessive role of SMEs envisaged in research policies and neglect of cooperation with branches of MNCs established in Slovakia;
- potentially overoptimistic targets: '1.8% share of GERD in GDP' and '2/3 share of business expenditure in GERD' by 2015;
- fragmentation of limited research resources to 12 thematic priorities.

5.2 ERA-related policies

There is no coherent policy mix related to the ERA in Slovakia. Importance of the ERA-related policies, however, increased in 2008 and 2009. Some ERA-related priorities and policies explicitly are referred to in the 2008-2010 NRP. Among these (a) support to participation of Slovak organisations in international R&D projects,

particularly in the framework EU programmes, (b) establishing Central information portal supporting mobility by Slovak scientists within the ERA, and (c) implementation of European legislation on researcher mobility rank to most important.

Low levels of scientific outputs (in terms of publications, citations and patents), underfinanced research sector, underdeveloped national R&D infrastructure, and limited and ageing stock of human capital in research sector are the main challenges for Slovak R&D-system in relation to ERA-development.

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List of Abbreviations

ERA	European Research Area
FP	European Framework Programme for Research and Technology Development
GERD	Gross expenditure on research and development
GBAORD	Government budget appropriations or outlays for research and development
GUF	General University funds
HEI	Higher education institutions
IPR	Intellectual property rights
KEGA	Culture and Education Grant Agency
NRDP	National Research and Development Plan
OPRD	Operational Programme 'Research and Development
OPCEG	Operational Programme 'Competitiveness and Economic Growth'
OPE	Operational Programme 'Education'
PRO	Public Research Organisations
R&D	Research and development
RDA	Research and Development Agency
S&T	Science and technology
SF	Structural Funds

SAS	Slovak Academy of Sciences
SIEA	Slovak Innovation and Energy Agency
SOPIS	Sectoral Operational Plan for Industry and Services
SMEs	Small and Medium Enterprises
SRGBST	Slovak Republic Government Board for Science and Technology
SRDP	State Research and Development Programmes
VEGA	VEGA Scientific Grant Agency

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Slovakia.

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