Erawatch Country Report 2009: Hungary

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

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Attila Havas

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ERAWATCH COUNTRY REPORT 2009: Hungary

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

ERAWATCH Network – IQ-TANOK bt

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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.

Hungary, with its population of 10 million (2% of EU27 total) is a medium-sized EU member state. Its GDP is roughly 0.8% of the EU27 total. As for economic development, measured by GDP per capita (in PPS), the country ranked 22 in the EU27 in 2007, with 62.6% of the EU27 average. Hungarian GERD (~€977m in 2007) is approximately 0.4% of the EU27 total. The number of FTE researchers decreased by about 40% in the early 1990s, and reached the 1990 level only in 2007 (17,391; KSH). GERD/GDP has been stagnating around 1% since 2001, and stood at 0.97% of GDP in 2007, that is, well below the EU27 average (1.83%) and the Lisbon target.

Hungarian governments aimed at raising wages and modernising the economy's infrastructure in 2001-2006. These efforts exceeded the country's means and resulted in deteriorating budget deficits. From mid-2006, a new government launched a stabilisation programme, decreasing the general government deficit from 9.3% of GDP in 2006 to 3.4% in 2008. Economic growth, in the meantime, has slowed down significantly: from 4.6% in 2006 – fluctuating around 4-5% since 1997 – to 1.1% (2007) and 0.6% (2008).

The current global financial and economic crisis hits hard the Hungarian economy for two major reasons. First, Hungary is heavily indebted – the government, the private sector, as well as the population – and thus the worsening financial market conditions made it excessively expensive to finance the economy, given the increasing interest rates and the plummeting exchange rate of the Hungarian forint against the euro, US dollar and Swiss frank (around 25-30% devaluation since July-August 2008). Second, the share of exports in GDP is rather sizeable (more than 80%), and thus the strong deceleration in the export markets (mainly the EU) deteriorates significantly the export outlook, and hence the overall economic performance. The most recent estimates predict a 5.5-6% contraction in 2009.

In this context, the primary goals set in the National Action Programme for Growth and Employment (approved in November 2008) are to restore market stability and confidence, as well as to correct the excessive deficit. In order to enhance competitiveness and employment, the then government aimed at improving the business environment, creating incentives to work, increasing the education system's

responsiveness to labour market demands, and – if conditions make the reforms backing these objectives possible – promoting job creation.

However, a new government took office on 16 April 2009, launching a one-year "crisis management" programme, aimed at restoring market stability and confidence of foreign investors, as well as to keep the budget deficit at around 3% of the GDP. Structural reform initiatives are likely to be put on halt, given the severe economic crisis, as well as the lack of meaningful dialogue among the major political parties.

As already stressed, both GERD and BERD are below the Lisbon-Barcelona targets. The major reasons, as well as the opportunities and risks stemming from the policy mix are highlighted first in a table format, and then explained in more details.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Low share of innovative companies, especially indigenous SMEs, perceived lack of demand for new products and services	A large number of schemes and increased public funding are in place providing incentives for companies to engage in RTDI. These are not likely to be successful unless framework conditions for RTDI improve significantly.
Overall unfavourable framework conditions, especially macro-economic pressures, exacerbated by the global economic crisis since September 2008	Given the economic crisis and lack of meaningful dialogue among the major political parties, it is uncertain if fundamental reforms, needed to create more favourable conditions, can be implemented.
Differences between the incentive structure of public sector researchers and interest of businesses hamper exploitation and alignment between supply and demand of knowledge	The main opportunity is the on-going reform of the public research sector, placing more emphasis on exploitability of knowledge when evaluating research performance. Existing schemes provide incentives for strengthening academia-industry co-operation.
As for future R&D investments, the level of HRST might become insufficient in the coming years	A growing number of schemes are targeting this challenge. Financial incentives or mechanical increases in S&E enrolment themselves might not yield results without major changes in the research and education systems.

Macroeconomic imbalances have been particularly pressing since 2006. The global economic and financial crisis has further aggravated the prospects for recovery, and access to capital has become even more difficult. Although overall conditions for doing business have improved in recent years, administrative and tax burdens on firms are still high compared to the OECD average. The regulatory environment is characterised by frequent and unpredictable changes. These conditions are not favourable for long-term and high-risk activities, such as RTDI.

Only one fifth of firms operating in Hungary are innovative. The majority of companies (59%) do not innovate due to the lack of demand for new products and services. Similarly to the other countries, Hungarian enterprises mentioned "innovation costs too high" and "lack of own resources" as the two main obstacles hindering innovation activities. (CIS4) Thus these firms do not invest in R&D, either.

Researchers at universities and PROs are not sufficiently motivated to carry out economically relevant research. This, in turn, hinders exploitability of knowledge, and therefore may not provide sufficient incentives for private co-financing of research performed in the public sector. The on-going reform of the public research sector might put more emphasis on academia-industry co-operation among the set of evaluation criteria (i.e. not just on academic publications and citations).

As for the *longer term* RTDI investment objectives, the supply of HRST seems to be a major barrier. The number of S&T graduates and that of the PhD degree holders are low in international comparison. A growing number of schemes are targeting this challenge. Financial incentives or mechanical increases in enrolment in S&E themselves are unlikely to yield results without major changes in the research and

education systems. This observation is indirectly confirmed by the fact that in spite of government's efforts, the number of students in these areas has even been decreasing in recent years.

While GERD has stagnated, the BERD/GERD ratio has improved since 2005. Given the global financial crisis, these favourable trends might not continue in the coming years. Even if the current trajectory of R&D expenditures maintained, achieving the mid-term R&D goals would be rather challenging, according to a recent OECD study.

The lack of external evaluations of either the individual STI policy measures or that of the policy mix as a whole impedes a thorough appraisal of the impact of the policy mix. Independent experts have offered two major conclusions. First, a large number of potentially relevant STI policy measures are in place, addressing the identified challenges. Second, well-targeted efforts are needed, however, e.g. fine-tuning the direct and indirect instruments, sector-specific and generic schemes, streamlining the portfolio of measures to avoid overlaps and make it more transparent.

It seems unlikely that R&D investment targets, especially those of the private sector can be achieved simply by providing more public funding. The impact of strictly defined STI policies with the aim of leveraging R&D investments can only be enhanced if framework conditions for RTDI activities are also significantly improved. Given the economic crisis and lack of meaningful communication – let alone co-operation – among the major political parties, it is uncertain if fundamental reforms, needed to create more favourable conditions, can be implemented.

Structural reasons, that are difficult to address even by overall economic policies, let alone STI policies, can also be seen as obstacles to induce R&D investments. The large chunk of BERD (around 70%) is performed by foreign-owned firms, and their RTDI activities are largely determined by their parents' strategies, while domestic STI policies can only play a relatively minor role.

The issues identified as the four main pillars of ERA, analysed in this reports, have been important issues in Hungary, too, although quite often without explicitly referring to the ERA initiatives. (see first a summary in a table format, and then a more detailed discussion)

	Short assessment of its importance in the ERA policy mix	**Key characteristics of policies**
Labour market for researchers	• Research careers are not attractive: work conditions are not favourable; wages are less than 70% the EU average for researchers, and well below the income of professionals working for the private sector • The difference between male and female researchers' salary is small relative to EU figures • The number of foreign students studying in Hungary and that of Hungarian students studying abroad is low, and it is also the case for teachers and researchers	• Salaries of public sector researchers are regulated by law, with some flexibility to reward scientific performance • Simplified visa procedures for foreign researchers introduced in December 2007 • Full compliance with the 1408/71 regulation concerning social security policies • Several doctoral schools offer programmes in English • Several schemes promote international mobility of researchers

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Governance of research infrastructures	• Dispersed RI landscape • A few large RIs, open to the international research community	• A national RI development strategy to be devised by the end of 2009 • Participation in shaping the ESFRI Roadmap • A huge financial commitment to host the European Spallation Source
Autonomy of research organisations	• The autonomy of scientific research is a major building block of the Hungarian research system, entrenched in the Constitution	• Efforts to reform both the higher education sector and the Hungarian Academy of Sciences
Opening up of national research programmes	• Most Hungarian R&D support programmes are open to foreigners, yet, the share of foreign researchers working in Hungary is only 2%	• Participation in a number of ERA-NET projects and JTIs

Modernising public research organisations – both the MTA and universities – has been the most prominent intention in recent years. In terms of financial commitments, however, the Hungarian government's bid to host a major research facility from the ESFRI Roadmap – either the European Spallation Source (ESS) or Extreme Light Infrastructure (ELI) – is by far the largest, most expensive single project, especially momentous taking into account the size and level of development of the Hungarian economy and the research system. Besides, various Hungarian research units have expressed their strong interest to participate in over a dozen ESFRI projects.

Upgrading national research infrastructures and devising a strategy on obtaining access to transnational ones are the focus of the on-going National Research Infrastructure Survey and Roadmap project, to be completed by the end of 2009.

Although most Hungarian R&D support programmes are open to non-nationals, not many foreign researchers have seized these opportunities. Several schemes finance international R&D projects and researcher mobility: these measures facilitate outward mobility of researchers, and also promote the career of these researchers first abroad, and then indirectly, in a favourable case, back in Hungary, given their knowledge and skills gained at foreign R&D sites.

The main challenge for the Hungarian R&D system is to find its place in the broader national innovation system, and establish regular, organic, mutually beneficial co-operation with the other major players. The national innovation system, in turn, is not embedded sufficiently in the overall economic system. Hence, STI policy-makers are not among the key actors defining broad socio-economic goals, shaping the respective development strategies, and making major financial decisions.

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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 co-ordinated 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

Hungary, with its population of 10 million (2% of the EU27 total) is a medium-sized EU member state. Its GDP is around 0.8% of the EU27 total. As for economic development, measured by GDP per capita (in PPS), the country ranked 22 in the EU27 in 2007, with 62.6% of the EU27 average.

Hungarian GERD (~€977m in 2007) is approximately 0.4% of the EU27 total. The research system had shrunk significantly in the early 1990s when industrial research facilities were hit especially hard by economic transition. The number of FTE researchers decreased by 40% between 1990 and 1996 (from 17,550 to 10,408), and come close to the 1990 level in 2007 (17,391; Central Statistical Office [KSH]). GERD/GDP has been stagnating around 1% since 2001, and stood at 0.97% of GDP in 2007, that is, well below the EU27 average (1.83%) and the Lisbon target (3%).

2.1.1. The research governance structure

The science, technology and innovation (STI) policy governance structure has been in an almost permanent state of flux since the 1990s, including the highest level policy-making bodies, as well as the implementing agencies. Just to illustrate, two fundamental changes have occurred since May 2008, and further ones are still expected. In May 2008 a major government reshuffle took place, affecting the STI policy-making structures, too. A new position was created: a minister without portfolio was appointed, responsible for overseeing and co-ordinating R&D, technological innovation, and science policies. Furthermore, the STI policy action plan for 2007-2010 (approved by the government on 29 August 2007) stipulated that the STI governance system should be overhauled. Some elements of this plan were introduced by a government decree, approved on 28 March 2009. On 21 March, however, the prime minister announced that he would resign by mid-April.

Following that, the second fundamental change occurred on 16 April 2009, when a new government was formed, and the position of the minister without portfolio, responsible for co-ordinating R&D, technological innovation, and science policies was dissolved.

The Education and Science Committee, together with the Economic and Informatics Committee of the Parliament are the highest-level political bodies in the field of STI policy. Recognising the strategic importance and cross-sectoral nature of STI policies, a sub-committee of the Education and Science Committee of the Parliament, called “Science and Innovation Policy ad hoc Committee”, was established in August 2007.

The most important ministries with responsibilities for various domains of STI policies are the Ministry of Education and Culture (OKM) and the minister for national development and economy, who supervises the National Office for Research and Technology (NKTH).

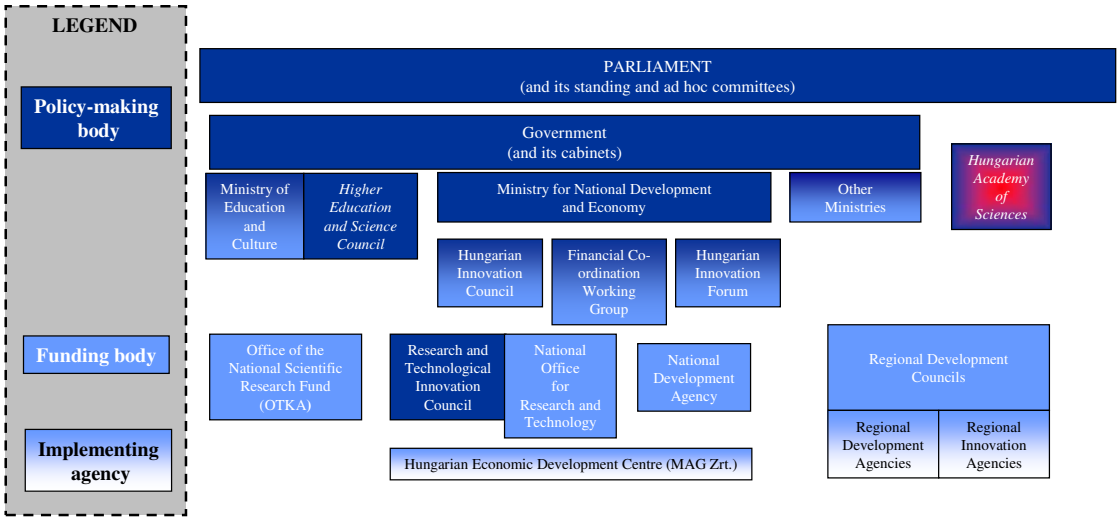
Just 2 weeks before the change of government, a new legislation created three new bodies on 28 March 2009: the Hungarian Innovation Forum, the Hungarian Innovation Council and the Research and Development Financial Co-ordination Inter-ministerial Workgroup, which were supposed to be advisory and co-ordinating bodies, assisting the minister without portfolio, responsible for co-ordinating R&D, technological innovation, and science policies. Now these bodies would work for the minister for national development and economy, who took over the responsibilities of the former minister without portfolio. However, as of the end of April 2009, these bodies only exist in the legislation: their members are yet to be appointed.

The Research and Technological Innovation Council (KuTIT) is responsible for overseeing the use of the Research and Technological Innovation Fund (the main national source for funding R&D and innovation policy schemes). The Council is a 15-strong body, with 6 members delegated by the relevant ministries (mostly state secretaries), 6 by various business associations and 3 other representatives of the RTDI community.

At the operational level, the National Office for Research and Technology (NKTH) devises R&D and innovation policy schemes, manages international R&D co-operation in bilateral and multilateral relations and supervises the network of Hungarian science and technology attaches. In brief, NKTH submits its strategic proposals to KuTIT, and implements the Council's decisions. STI policy observers – given the practice followed since 2004 – expect yet another major reorganisation of the NKTH in the coming months, for the third time since 2007, leading to new STI policy schemes.

The measures co-financed by the EU Structural Funds are managed by the National Development Agency.

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



Source: compiled by the author
Note: The institutes of Hungarian Academy of Sciences conduct research and hence the dual role of HAS is indicated by a combination of colours in the figure.

Hungary is a unitary and centralised country, where regions do not play a significant role in STI policy-making. The Regional Development Agencies and the Regional Innovation Agencies influence RTDI processes by devising regional innovation

strategies, as well as administering calls funded by the Research and Technological Innovation Fund[2] and the Regional Operational Programmes.

2.1.2 Main research performers

The business sector has become the largest research performer with its 40.2% share in full-time-equivalent (FTE) scientists and engineers in 2007. (KSH) Large, foreign owned firms, operating in a few sectors account for the bulk of BERD (73.2%; 69.7%; 66.6% in 2005-2007, respectively; KSH). The private sector performed 50.3% of the Hungarian GERD in 2007, while the EU27 average was 63.7%. Thus, the Barcelona target of a 2:1 ratio in favour of business R&D expenditures would be far too ambitious in Hungary.

The government sector's share in performing R&D is significant: 24.2% of GERD (2007; vs. 13.3% EU27 average), while its weight in employing research personnel is even larger: 26.3% of total FTE researchers. (KSH) The most important player in this sector is the Hungarian Academy of Sciences (MTA) with its extensive network of research institutes, and hence its substantial weight in the Hungarian research system. The MTA is a legal entity, a public body having self-governing rights, with high degree of autonomy in scientific and financial respects. Its main tasks are to develop, promote and represent science. It also gives its expert opinion to the Parliament or the Government, and can influence STI policies.

The largest number of research units is operated at higher education institutes (HEIs), but the average size of these units is rather small, just below 4 FTE researchers. HERD as a percentage of GERD was 23.3% in 2007, slightly above the EU27 average (22.1%).

Private non-profit research institutes are not significant in Hungary, as they perform a tiny bit of GERD.

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 (Havas A, 2009) 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 Reports can be found at the ERAWATCH web site.

The ERAWATCH Analytical Country Report 2008 (Havas A, 2009) has identified several strengths and weaknesses of the Hungarian national innovation system. These are summarised below, organised by the four main domains and the related policy challenges. A generic feature, affecting all the four domains, is that a large number of apparently relevant policy schemes are in place – yet, Hungary's

[2] It is stipulated that 25% of the Research and Technological Innovation Fund should be used to finance schemes fostering regional RTDI activities.

performance is lagging behind most EU countries.[3] One factor explaining this observation can be that policy-making structures and resource allocation mechanisms do not always operate as intended. Another major reason is that – as companies perceive – demand is weak for innovative products and services. (CIS4)

The strong traditions for science and technology and the relatively good performance of Hungarian scientists – in certain disciplines – are reflected by publication indicators. Yet, the inflow of research scientists and engineers (RSE) would be insufficient to enlarge the research system. Research positions are not attractive, and hence only a minority of young talents opt for S&E studies. Moreover, graduates are tempted to move abroad. In general, the unfavourable framework conditions, especially the macroeconomic tensions, have been deteriorating since 2008, and these are not conducive to invest in RTDI. Thus, both the GERD and BERD are way below the EU average, while the share of innovative companies is among the lowest in the EU. RTDI activities are concentrated to large, foreign-owned firms in a few sectors, whose strategies thus largely determine the dynamics of BERD.

There are no systematic mechanisms to co-ordinate knowledge demands, or to monitor their fulfilment.

Despite the international recognition of research carried out by the public R&D sector, a number of factors (e.g. mismatch in incentives, revenues weakly related to performance) hinder the production of economically relevant knowledge and the exploitation of research results. This may also hamper the formation of lasting, mutually beneficial university-industry co-operations in spite of the strong policy attention devoted to promote this type of collaboration.

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	• Strong traditions in science and technology • Low level of GERD and BERD; a small share of innovative companies
	Securing long-term investment in research	• Multi-year RTDI support schemes • High share of foreign R&D funds in international comparison, especially for firms • Policy-making structures and resource allocation mechanisms do not always operate as intended
	Dealing with barriers to private R&D investment	• Apparently appropriate measures to promote business RTDI activities • High concentration of RTDI activities (by firm size, ownership, and sectors) • Framework conditions not conducive to invest in RTDI • Low level of available venture capital
	Providing qualified human resources	• Highly respected S&E education system • The supply of qualified human resources to enlarge RTDI activities is insufficient • Unfavourable conditions for human resources: research is not an attractive career, potential brain drain

[3] It is clearly reflected in the EIS indicators (EIS, 2008), and have been noted by earlier reports; see, e.g., the annual country appraisal reports for the Inno-Policy TrendChart project, or the country report for the "Policy Mix Project" (Veres and Krisztics, 2006). A thorough overview of the Hungarian STI policy mix, including recommendations, can be found in the OECD Review of Hungarian Innovation Policy (OECD, 2008a), which substantiates the observations of the current analysis.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge demand	Identifying the drivers of knowledge demand	• No foresight activity at a national level since 2001 when the Hungarian technology foresight programme was completed (the first one in a former planned economy)
	Co-ordination and channelling knowledge demands	• No systematic efforts to co-ordinate knowledge demands since the first national technology foresight programme
	Monitoring of demand fulfilment	• No mechanisms in place to monitor the fulfilment of knowledge demand
Knowledge production	Ensuring quality and excellence of knowledge production	• High quality of research in a number of scientific fields in international comparison • Relatively productive researchers in the public R&D sector
	Ensuring exploitability of knowledge	• Block funding is still the dominant source of funding in the public R&D sector, and performance criteria are not given sufficient consideration • A strong emphasis on publications and citations (as opposed to commercialisation) when evaluating academic researchers, leading to a mismatch in the incentive structures between academic and business actors • Insufficient consideration of societal and business needs by the public R&D sector • Weak patenting activities in general
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• A number of policy measures to foster academia-industry co-operation; yet, low level of academia-industry co-operation • Low level of researcher mobility among R&D performing sectors
	Profiting from international knowledge	• Intense and successful participation in international RTDI projects • Several policy schemes in place to facilitate participation in international RTDI projects
	Enhancing absorptive capacity of knowledge users	• Several policy schemes in place to strengthen absorptive and innovation capacities of SMEs • Low absorptive capacity of firms, especially domestic SMEs: given the perceived weak demand for new products and services, these firms do not employ engineers for R&D activities

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 this section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

Hardly any major policy changes have occurred since 2008 as the important ones have taken place already in 2004-2007, when the framework of the current policy mix was developed. For a detailed discussion of changes in this period, see the ERAWATCH Analytical Country Report for Hungary (Havas A, 2009). As for the important policy measures launched in that period, see Chapter 3.

Most of the schemes under the relevant Operational Programmes of the New Hungary Plan, announced in the 2007-2008 Action Plans, were launched in 2008.

In February 2009, the government revised its STI policy Action Plan, listing all the actions to implement the government's mid-term STI policy strategy (2007-2013). The revised Action Plan overlaps to a large degree with its predecessor (approved in August 2007), with slightly or significantly extended deadlines, indicating that the implementation of the original plan has been behind schedule.

2.3.1 Resource mobilisation

Despite the serious fiscal situation, the previous government declared its commitment to increase public funding for RTDI. In 2009, competitive public funding (including national as well as EU Structural Funds and other resources) allocated to RTDI increased to around €650m, ~20% above the 2008 figures (in nominal terms). As a response to the economic crisis, the available resources within the RTDI priority of the Economic Development Operational Programme were planned to increase (see details in Chapter 3.3). The main objective of the measures under this OP is to increase BERD, and thus promote more intense business RTDI activities.

Available funds in the Research and Technological Innovation Fund were also planned to increase (from ~€220m in 2008 to ~€280m in 2009), and steps have been taken in order that it can function as an independent fund: the significant resources not used in previous years will gradually be made available for allocation by 2010.

Important schemes launched in 2007-2008 with the aim of mobilising resources for (primarily private sector) RTDI and explicitly noted in the National Lisbon Action Programme (NRP, 2008) are "Supporting market-oriented R&D", "Fostering innovation activities of firms", and the "National Knowledge Centres". Some schemes – e.g. the National Technology Programme, the most important large-scale national scheme for funding demand-driven applied research in a handful of broadly defined areas – received additional funding in 2008.

The number of S&E students and graduates is still low in international comparison, and previous years' attempts to increase their number had not been successful. Several schemes have been devised, primarily as part of the Social Renewal Operational Programme.[4] However, previously existing favourable tax exemptions for employing PhD students have been repealed in 2008.

All the above developments are explicitly noted, or at least referred to in the National Lisbon Action Programme. (NRP, 2008) Its main objectives are summarised in Textbox 2.1.

Table 2 summarises the main policy changes aimed at responding to the identified challenges within the four policy domains.

[4] The most important of these, the so-called National Excellence Programme has been delayed, and will be launched in 2009, a year later than planned. Its main objectives will be to make research positions more attractive, reverse brain drain, foster researcher mobility, and provide funding for setting up innovative research teams; in brief, to improve the quality of human resources.

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision	Increasing GERD and BERD, as well as integrating the Hungarian research system into the ERA are key priorities in the government's mid-term STI policy strategy and in the National Reform Programme. Increased government appropriations for RTDI are justified by the intention to increase BERD so as to enhance competitiveness.
Securing long-term investment in research	Significant resources have been allocated to RTDI in the multi-year programming documents, such as the New Hungary Development Programme (2007-2013) as well as the funding strategy of the Research and Technological Innovation Fund (2008-10), disconnected from the annual budgeting processes. The basic framework of the current policy mix was formulated in previous years. Budgets were increased for 2008-9.
Dealing with uncertain returns and barriers to private R&D funding	The reform of the STI governance system as well as more efficient policy-making and delivery practices are aimed at creating a more stable and favourable climate, facilitating private R&D investments.
Providing qualified human resources	Certain schemes within the Social Renewal Operational Programme aim at raising the level of qualified human resources by providing more favourable conditions to conduct research at Hungarian facilities.

Textbox 2.1:Changes in National Reform Programme regarding the role of research in the broader economic growth strategy

The Hungarian government prepared a document entitled National Reform Programme for Growth and Employment 2005-2008 in 2005, and revised it in 2006 (Revised National Lisbon Action Programme for growth and employment). In line with EU requirements, a new "National Action Programme for Growth and Employment 2008-10 – Compiled for the EU Lisbon Strategy" (NRP 2008-2010) was published in November 2008. This strategic document lists the priorities and recommendations of the European Commission's progress report, and summarises the related stipulations of the mid-term STI policy strategy of the Hungarian government (see Chapter 3.2), and its Action Plan (under Integrated Guidelines IG7 and IG8). Furthermore, it discusses measures already implemented or envisaged with the aim of addressing the European Commission's recommendations. In brief, these documents do not represent a major policy shift with regard to the role of RTDI in the broader economic growth strategy. Independent sources, e.g. the Hungarian Association of Innovation, argue that the most recent version of the document, outlining the measures (to be) implemented within the framework of the Lisbon agenda, does not contain sufficiently operational and accountable targets. Hence, it is difficult to monitor its implementation. The European Commission starts its assessment by stating: "The National Reform Programme (NRP) for 2008-2010 does not reflect a clear coherent strategy for the medium-long term."

The main research policy objectives (falling under IG7) declared in the most recent NRP (2008-10) are as follows:

- The reform of the STI system (including governance) and especially the Hungarian Academy of Sciences (e.g. asset management, introduction of new performance evaluation system, development of research infrastructure etc.);
- Promoting firms' RTDI activities (mainly by fostering market-oriented RTDI via the various schemes of the Economic Development Operational Programme, and the National Technology Programme [previously called „Jedlik Programme"]);
- Strengthening the autonomy of the Research and Technological Innovation Fund in order that its operation provides stable conditions for public RTDI funding;
- Increased academia-industry co-operation (in the fields of RTDI and education);
- Increasing the effectiveness of publicly financed RTDI programmes (e.g. increased policy co-ordination to avoid overlaps).

2.3.2 Knowledge demand

Several measures of the Economic Development Operational Programme (e.g. "Supporting market-oriented R&D activities") aim at providing incentives for the

private sector to develop new products and services based on research activities carried out in the public sector.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	Various measures of the Economic Development Operational Programme (New Hungary Development Plan, 2007-2013) put emphasis on fostering knowledge demand, e.g. "Supporting market-oriented R&D activities"
Co-ordinating and channelling knowledge demands	
Monitoring demand fulfilment	

2.3.3 Knowledge production

The reform of the publicly financed research sector has been continued with amendments to the Law on Higher Education (passed by the Parliament in December 2008) and to the Law on the Hungarian Academy of Sciences (effective since 6 April 2009). Both aim at modernising the governance of the respective organisations, increasing their financial autonomy in order to facilitate a more entrepreneurial approach to knowledge production. The reform of the MTA is one of the priorities highlighted in the National Lisbon Action Programme. (NRP, 2008)

As a continuation of the "Regional Knowledge Centres at Universities" scheme, the Strategy of the National Office for Research and Technology declares the intentions to support a smaller number (max 6-8) of large, internationally competitive centres of excellence, so-called "National Knowledge Centres", which facilitate stronger co-operation between private and public actors.

Several measures under the Economic Development Operational Programme place strong emphasis on the exploitation of knowledge, with an emerging importance of "innovative clusters" as a framework.

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	• A more focused approach to knowledge centres, to create a small number of large-scale, internationally recognised national centres within a selected few S&T fields • Amendments to the Laws on Higher Education and the Hungarian Academy of Sciences
Ensuring exploitability of knowledge production	• Strategic policy documents as well as the New Hungary Development plan places strong emphasis on the exploitation of knowledge, with several measures in place, and an emerging importance of "innovative clusters"

2.3.4 Knowledge circulation

As discussed in Chapter 3.3 in relation to the specific "policy routes", many schemes for fostering private sector RTDI activities give preference to, or require, mandatory co-operation between private and public sector organisations with the aim of facilitating knowledge circulation (including mobility of researchers) and the exploitation of research results. Furthermore, a number of schemes are in place with the primary objective of facilitating collaborative RTDI. Since 2008, the officially declared intention (also emphasised in the 2008 NRP) was to concentrate resources to a smaller number of centres of excellence.

Several measures, funded by the Research and Technological Innovation Fund have been launched or continued to facilitate Hungarian participation in EU and

international research projects and networks, e.g. ERANET – CORNET, FP7, ARTEMIS, ENIAC, EUROSTARS EUREKA, AAL.

The first "Innovative Cluster" calls were launched late 2008 to strengthen RTDI co-operation among companies within clusters in conjunction with the so-called "development pole cities". The various measures which are related to the so-called accredited clusters are given emphasis in the NRP 2008.

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	Re-focusing of long-standing measures fostering academia-industry co-operation (i.e. the intention to create a few large-scale, internationally competitive national centres of excellence)
Profiting from access to international knowledge	Sustained support for Hungarian participation in international research projects
Absorptive capacity of knowledge users	Significant resources earmarked for the development of innovative clusters

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

This section assesses whether the recent policy changes respond to the identified system weaknesses and take into account the identified strengths.

The policy opportunities and risks concerning specifically resource mobilisation and knowledge circulation will be discussed in Chapter 3. However, a number of policy developments may have impacts across the four domains. The main overarching policy opportunity, covering several areas, but potentially exerting a significant impact on resource mobilisation is the efficient use of the Structural Funds for RTDI. The available funds are significant (representing a major chunk of public RTDI funding) and the range of challenges and bottlenecks to be tackled is rather wide (see Chapter 3.3.1.).

Another important policy opportunity concerns the reorganisation of the STI governance system, with the aim of more efficient policy co-ordination as well as a more prominent position of STI policies at the highest political level. However, the STI governance structure has been fundamentally reorganised several times since 2000, and several plans (including draft government decrees) have been devised in recent years. Therefore, a potential risk is that the current plans are not (efficiently) put into practice and/or that the governance structure will not be stabilised.

The impact of the current economic crisis on knowledge production and demand is hard to assess. Regarding STI policies and resource mobilisation, the previous government had made commitments not to cut public RTDI funding: government R&D expenditures show an intended increase compared to 2008. It may, however, be regarded as a risk that the economic crisis could potentially reduce the RTDI activities of firms who will have to deal with more burning, short-term issues. Indeed, funds actually distributed in 2007-2008 from the RTDI related Priority of the Economic Development Operational Programme are much smaller than the amounts allocated in the 2007-2008 Action Plans (roughly €215m of the available €300m). This difference between distributed and planned funds might be interpreted as an indication of a potential slow down of business RTDI activities.

As of early 2009, there has been no other indication of a severe decline of RTDI activities in either the private or the public sector as a result of the serious economic crisis. However, these long-term activities with uncertain returns might be reduced for "survival" in the short run. The National Office for Research and Technology has announced its intentions of launching a scheme explicitly supporting the employment of research personnel laid off by companies.

The amendment of the Law on the Hungarian Academy of Sciences is widely perceived as an important development. Some argue that this is rather a new bill than an amendment of the existing one. The Parliament passed the bill with unanimity on 30 March 2009. The main objective of the amendments is to facilitate a more efficient operation of the MTA and its institutes, including the modernisation of the performance evaluation system and the decision-making processes, changing the asset management methods and competences, as well as redefining the tasks of the MTA as a public body.

In a similar vein, the Law on Higher Education has been amended several times since 2005, most recently in December 2008, aimed at modernising governance structures (see Chapter 4.3), providing incentives for economically more relevant research (e.g. settling IPR issues, creating spin-offs etc.), and giving more autonomy to the universities in asset management, etc.

Given the previous poor implementation practices and the lack of systematic evaluation of policy measures, it is uncertain if the government can achieve its ambitious objectives. A related risk is the lack of an overall, strong consensus among stakeholders and policy-makers on the desired objectives and instruments, and thus the policy environment is unpredictable (e.g. goals and commitments can be easily abandoned in case the responsible officials are replaced). Despite a wide range of potentially adequate policy measures and incentives, BERD and GERD are way below the EU27 average, as well as the Lisbon-Barcelona targets.

In terms of mobilising human resources, brain-drain is a major challenge. Counteracting brain-drain and attracting foreign researchers would only be possible by modernising the research system as a whole: 'isolated' measures are bound to be insufficient to bring about major changes. Despite the existing schemes (e.g. launched late 2008 by the Academy of Sciences), Western European and U.S. researcher positions are far more attractive for qualified Hungarian researchers (see Chapter 3).[5]

With regard to knowledge demand, the government's STI policy action plan stipulates that it is an important task to apply relevant, up-to-date methods – notably technology foresight, technology assessment and technology watch – to identify, co-ordinate and channel demands for knowledge. However, the prevailing practice is one of fragmented support for RTDI activities, without a comprehensive understanding of knowledge dynamics (drivers for the emergence of new knowledge, and demand for knowledge).

[5] Several measures are envisaged within the Social Renewal Operational Programme with the aim of tackling these challenges, such as the National Excellence Programme and "Support to innovative research teams". However, their implementation is well behind schedule. The government has also announced its intentions to pay more attention to raising awareness among secondary school students for science, technology and innovation in order to attract more youngsters to opt for researcher careers.

A strategy-building process was launched in 2008 to underpin policy proposals aimed at developing the R&D infrastructure, also emphasised by the National Lisbon Action Plan (2008-10) (see Chapter 4.2). Its Hungarian acronym is NEKIFUT ("Take-off"), derived from **Ne**mzeti **K**utatási **I**nfrastruktúra **F**elmérés és **Út**iterv (National Research Infrastructure Survey and Roadmap).

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	• Efficient use of the significant resources stemming from the Structural Funds to tackle bottlenecks of the Hungarian NIS • Implementation of the mid-term STI policy strategy, especially strengthening of the STI governance system	• Given the global economic crisis, firms might need to focus on short-term survival, leading to reduced RTDI activities, and hence not able to absorb available public funds for RTDI • Lack of an overall consensus on the desired objectives and instruments (leading to an unpredictable policy environment) • Lack of co-ordination among various STI policy measures and with major economic policies might lead to insufficient resources mobilisation • 'Isolated' measures aimed at tackling brain drain and attracting foreign researchers may be ineffective
Knowledge demand	• Application of relevant, up-to-date methods, most notably technology foresight, to identify, co-ordinate and channel demands for knowledge	• Fragmented support for RTDI activities, without a comprehensive understanding of knowledge dynamics (drivers for the emergence of new knowledge, demand for knowledge) • Stipulations of the recent policy documents might not be implemented
Knowledge production	• The reform of the MTA and HE sector, stressing socio-economic relevance of research in funding decisions • Incentives of PROs and HEIs to exploit research results • Devising a national research infrastructure development strategy	• The (potential) resistance of the MTA and HEIs against fundamental reforms • Measures aimed at increasing the level of BERD and industry-academia co-operation could lead to one-off, insulated joint RTDI projects
Knowledge circulation	• Focussing resources to create a small number of internationally competitive research centres • Improving absorption capacities of domestic SMEs	• The existing measures promoting academia-industry co-operation might lead to temporary co-operations, not facilitating knowledge circulation and exploitation to a sufficient extent

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

As already stressed, GERD has been stagnating around 1% of the GDP since 2001, and stood at 0.97% in 2007. Although BERD has increased significantly since 2004 both in absolute and relative terms, it was a mere 0.49% of the GDP in 2007 (42% of the EU27 average), well below both the EU targets, and the 0.9% goal defined in the mid-term STI policy strategy (to be achieved by 2013). A number of barriers hinder the achievement of R&D investment objectives. Some of these pose challenges to the immediate increase in R&D investments, whereas further obstacles need to be addressed in order to meet the longer term objectives.

The major barriers hindering *short-term* increase in R&D investments are the unfavourable framework conditions. In a broad sense, framework conditions include the following elements: macroeconomic situation and dynamics (especially growth prospects and access to capital); the overall entrepreneurial culture; conditions for doing business (entry and exit, the nature of competition, and the intellectual property rights regime); the public R&D sector and physical infrastructure for R&D; human resources; standards and regulation. (Havas and Nyiri eds., 2008, p. 6)

These conditions have been rather unfavourable in Hungary, especially since 2006, when the macroeconomic tensions became apparent. The economic and financial crisis, which has hit Hungary especially hard since September 2008, further deteriorated the situation and the prospects for the immediate future. The economy is predicted to contract by 5-6% in 2009, the national currency fell 20% in a few months, and the government debt is over 70% of the GDP. Access to capital is seriously limited by these factors, as banks are extremely cautious in lending money.

Administrative and tax burdens on firms have been reduced in recent years, but the overall conditions for doing business are still not highly favourable compared to the OECD average. The frequent and unpredictable changes in regulations are also noted as a serious obstacle. (OECD, 2008a, p. 79) This environment is not conducive for long-term and high-risk activities, such as RTDI.

The largest R&D performer firms have not reported major lay-offs due to the economic crisis, as the sectors hit particularly hard (automotive industry, electronics, construction) are not R&D-intensive ones in Hungary (or in general, either), and the R&D-intensive sectors which are indirectly effected by the plummeting demand (especially chemicals) are planning to shed their less qualified workers.

The crisis has already led to a new government, focussing on short-term crisis management. The next general elections are due in April 2010 at the latest, and in that short period no major initiatives can be launched to tackle long-term issues, given the fact that the current opposition is likely to take over, and there is no meaningful dialogue among the two main political parties. However, the new government seems committed not to cut public RTDI funding.

Only one fifth of firms operating in Hungary are innovative. The majority of companies (59%) do not innovate due to the lack of demand for new products and services. Similarly to the other countries, Hungarian enterprises mentioned “innovation costs too high” and “lack of own resources” as the two main obstacles hindering innovation activities. (CIS4) These firms do not invest in R&D, either.

While public RTDI funding has significantly increased recently (see Chapter 3.3), only 9.6% of BERD is financed by public sources (2007), including the EU Structural Funds. It is also telling that the annual R&D expenditures of the largest Hungarian pharmaceuticals company are equal to the public support available via the Research and Technological Innovation Fund. Hence, it is unreasonable to expect that national STI policy schemes alone, especially by simply allocating larger amounts of public funding for RTDI, can be sufficient to induce a considerable growth in BERD.

Finally, PROs and universities are not sufficiently motivated to carry out economically relevant research. This, in turn, hinders exploitability of research results, and therefore may not provide sufficient incentives for private co-financing of research conducted in the public R&D sector.

As for the *longer term* RTDI investment objectives, the following factors can be identified as potential barriers. The number of S&T graduates (40% of the EU average, EIS 2008), and the number of PhD degree holders, especially in the S&T fields, are very low (see Chapter 4.1). Despite governmental efforts, S&T qualifications are rather unpopular, and the number of students in these areas has even decreased in recent years. One of the root causes is the quality of secondary school science education, ineffective to raise awareness of S&T issues and motivate teenagers to opt for a research career.

Large parts of the public research sector are struggling with attracting the most talented Hungarian (let alone foreign) researchers due to unfavourable working conditions, in general, and low wages, in particular. (Chapter 4) Thus, brain drain is seen a threat, especially worrisome in the field of S&T. (Csanády *et al.*, 2008)

3.2 Policy objectives addressing R&D investment and barriers

The Hungarian government's mid-term STI Policy Strategy defines mid-term (2007-2013) targets, as well as longer-term visions. Explicitly referring to the Barcelona target, this document sets the following mid-term goals: "Total R&D expenditure in the function of available budgetary sources should possibly reach *1.4% of GDP in 2010*, then *1.8% of GDP in 2013*. In the interest of a more favourable R&D source structure it is a goal that every forint from the budget turned to R&D should attract at least one forint of corporate expenditure. *Corporate R&D expenditure* within total R&D expenditure should reach *45% in 2010, and 50% in 2013*." (Government, 2007, p. 10)

In order to achieve the R&D investment targets, the most important mid-term goals are as follows:

- "Expansion of companies' research and development activities;
- Establishment of internationally recognized research & development, innovation centres and research universities;
- Enhancing of the regions' research & development & innovation (R&D&I) capacity;
- Establishing a knowledge market which works on the principles of performance recognition and competition through the globalization of knowledge production and dissemination;
- Investment in large scientific facilities, primarily in the regional centres and the development poles, reducing regional differences (regional cohesion);
- The dynamic increase in yearly R&D expenditure, above all as a result of growth in corporate expenditure." (Government, 2007, p. 3)

The OECD Review of Hungarian Innovation Policy concludes that achieving the mid-term goals is a rather challenging task. More specifically, in order "to achieve efficient use and maximum leverage, a clear strategic orientation will be required, along with well-functioning governance mechanisms in STI policy, strong commitment, and the adoption of good practices in implementation – conditions which the preceding analysis has shown are not yet completely fulfilled." (OECD, 2008a, p. 203)

The most recent version of the National Lisbon Action Programme (NRP, 2008) reiterates the targets set in the mid-term STI policy strategy, and responds to the recommendations by the European Commission. The Hungarian Association of Innovation argues that the document does not contain sufficiently operational and accountable targets. Hence, it is difficult to monitor its implementation. (MISz, 2008)

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

This section describes the governance of the national policy and the toolbox 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 tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

There are no official statistics showing the precise breakdown of public R&D funds by modes of funding. Further, it is widely known that normative research support to the higher education sector is often used for other purposes, such as financing education activities and covering general operational costs.

Since 2004, when the EU Structural Funds (SF) and the Research and Technological Innovation Fund started funding RTDI activities, competitive funding has become the dominant mode. Total competitive funding for RTDI is planned to be around €650m in 2009, that is, a significant increase compared to ~€410m spent in 2007.[6] According to the 2009 Budget Act as well as the Action Plans of the relevant Operational Programmes, funding from the two main sources will be around ~€250m (Research and Technological Innovation Fund) and ~€350m (the Operational Programmes of the New Hungary Development Plan co-funded by the EU Structural Funds).

The prime objective of the Research and Technological Innovation Fund is to foster private sector RTDI activities. The most recent official figures reveal, however, that only one-third of the funds were allocated to firms in 2006. (NKTH, 2008, p. 12) Estimates for later years show that the private sector's share would reach almost 50% by 2008, and is expected to become the largest beneficiary sector in 2009. There is a clear policy focus on co-operative research and innovation projects, either by making co-operation compulsory, or giving it priority in specific schemes.

The Economic Development Operational Programme's (EDOP) Priority 1 (called "R&D and innovation for competitiveness") provides some €967m over the seven-year programming period (2007-2013). In 2009, approximately €250m will be available via the various schemes within the EDOP, the bulk of which is supposed to foster private sector RTDI activities. Some measures support the development of innovation clusters or aim at strengthening RTDI centres. The relevant schemes within Social Infrastructure and the Social Renewal OPs, in turn, are primarily targeted at large public research infrastructures and collaborative research, including basic research.

Other domestic funding sources only account for a minor proportion of public funding. Among these, various ministries finance mission-oriented research (partly through their own research institutes, ~€20m in 2007), while the National Scientific Research Fund (OTKA) provides competitive, "bottom-up" grants for basic research (~€20m in 2008).

In contrast to 2004-2006, when a number of large schemes were launched to promote specific S&T fields (such as biotechnology or ICT), more recently a few technology-specific programmes have been running. However, some large ones, most notably the National Technology Programme, support RTDI activities in pre-selected, broad strategic areas (such as life sciences, agricultural sciences, defence and security), defined in the government's mid-term STI policy strategy. Other

[6] Figures expressed in euro are based on the average 2008 exchange rate, when these budgets were calculated, originally denominated in Hungarian forint.

measures (e.g. the "Promotion of Accredited Innovation Clusters", or "Support for market oriented R&D activities") also indicate that projects related to strategically significant fields of research (such as medical sciences, energy, environmental technologies, etc.) will be given priority.

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.

A major methodological challenge needs to be stressed before trying to estimate the relative importance of these routes in Hungary. Most Hungarian STI policy measures do not differentiate between firms that do not yet perform RTDI activities and those that do. In general, promoting RTDI activities of firms (routes 1-3) is clearly at the centre of policy attention. As a rough estimate, 50% of the amount allocated to competitive RTDI funding in 2009 directly promotes firms' RTDI activities. Further, R&D and innovation is usually targeted simultaneously, therefore most measures have a wider scope than fostering R&D investments. Finally, several of the larger programmes (e.g. the National Technology Programme) support joint research projects with the participation of private and public research units.

The Structural Funds play a central role in each route via various Operational Programmes (OP).

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

There are a few schemes promoting the establishment of new indigenous enterprises conducting R&D. The Ötlet ("Idea") scheme supports individual entrepreneurs as well as micro and small firms that develop R&D-based new products, and thus fosters the creation of innovative start-ups. There was a scheme aimed at "Supporting innovation activities of technology- and knowledge-intensive micro-enterprises (start-ups and spin-offs)", co-financed by the EU Structural Funds in 2004-2006. The continuation of this measure was included in the Action Plan of the EDOP (co-financed by the SF in 2007-2013), but it has not been launched yet (as of April 2009).

Several other schemes, however, promote these activities indirectly, by supporting commercialisation of R&D results in the public research sector (often in collaboration

with the private sector), as well as the uptake of services offered by innovation consultancy firms, intermediary organisations, incubators, etc. For example, the "Promotion of Technology and Innovation Parks" is such a measure financed by the EDOP, whereas the "Technology Incubator Programme" (to be launched in mid-2009) is financed by the Research and Technological Innovation Fund. A number of other schemes support Intellectual Property Rights (IPR) protection either directly or through consultancy services.

The Co-operative Research Centres and the Regional Knowledge Centres at Universities schemes have also promoted the creation of spin-off companies, exploiting research results.

The Law on Research and Technological Innovation (2004) and the Law on Higher Education (2005) created more favourable conditions for those researchers who intended to commercialise their research results (especially in regulating IPR issues). These recent developments in legislation thus also promote the establishment of new indigenous R&D-based firms.

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

This route is clearly the most important approach for fostering RTDI in Hungary, and also the most significant objective of competitive funding. There are a number of eligible applicants and/or activities, which can also be listed as relevant to other routes. Therefore, it is impossible to provide a figure for the share of this important route in monetary terms within the total public RTDI funding.

Some of the larger programmes, and especially the ones included in Priority 1 (RTDI) of the EDOP, are clearly exploitation-oriented ones, and thus geared primarily towards experimental development, e.g. "Supporting market-oriented R&D activities" or "Promoting innovation activities of firms". A more pronounced emphasis has been placed on innovative clusters since 2007. Several measures, including large ones are aimed at building infrastructure directly related to the so-called accredited innovation clusters in regional hubs. Others promote the expansion and development of RTDI capacities at private firms by supporting the establishment of new research units or developing existing ones ("Strengthening R&D capacities of businesses").

The National Technology Programme is aimed at supporting RTDI projects with economic relevance in the medium-term within the defined strategic fields. Supported projects, therefore, must have clearly defined goals for the exploitation of their R&D results. It is one of the largest schemes with a yearly allocation of ~€65m; roughly 10% of total competitive funding.[7]

Tax incentives have also been important instruments in recent years, and various tax deductions may be applied for both in-house and extramural R&D activities. (see Route 5)

[7] This, and several other schemes primarily aimed at stimulating R&D activities of firms prescribe mandatory co-operation with PROs or universities. Therefore, these consortia comprise both public and private research performers. But, since the research projects are carried out in collaboration (e.g. an important aspect is the involvement of PhD-students in research activities pursued by firms), these cannot be regarded as purely "extramural R&D", and therefore these are not included under Route 5.

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

Hungarian STI policy measures do not differentiate between firms already performing R&D and those that do not. The schemes noted under Route 2 are, therefore, also relevant here.

The low share of innovative firms has been noted in official strategic documents. In order to tackle this challenge, a number of measures have been launched supporting the "complex technology development of SMEs", or the purchase of RTDI services from regional knowledge producers. Though these types of measures are not exclusively targeted at non-R&D-performing indigenous firms, these may nevertheless be the most important actual beneficiaries.

A number of foreign firms operate in Hungary with weak ties to the Hungarian NIS, and performing little or no RTDI activities in the country. Hence, some programmes offer funding for such companies (but not exclusively to foreign ones), to develop these activities, e.g. the "Strengthening R&D capacities of firms", a medium-sized scheme under the EDOP (and the Central Hungary OP).

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

The Investment and Trade Development Agency (ITDH) offers incentives for large-scale foreign R&D investments (min. €10m) in the form of direct grants and tax holidays, partly based on individual government decisions. Direct funding may be obtained for employing new research personnel and training, while tax holiday may be awarded for up to 80% of corporate tax for ten years. Maximum funding intensities (in line with EU state aid rules) are observed.

Several multinational companies have participated in large co-operative projects, such as the Co-operative Research Centres, i.e. there is demand for local knowledge and R&D capacities. These types of schemes may, therefore, indirectly foster RTDI activities of foreign firms.

Route 5: Increasing extramural R&D carried out in co-operation with the public sector

As noted under Route 2, there are several measures aimed at fostering co-operation between public and private research performers. In most cases, however, these are not extramural R&D arrangements *per se*, but rather collaborative research projects. Indeed, strengthening academia-industry co-operation has been one of the most prominent objectives of the Hungarian STI policies, served by several schemes, e.g. the "Co-operative Research Centres" and the "Regional Knowledge Centres at Universities". A new scheme, called "Developing and strengthening R&D centres", provides support to independent legal entities (business enterprises) founded by those HEIs and PROs, which had previously established Co-operative Research Centres or Regional Knowledge Centres. These shall provide RTDI services to firms, and are expected to play an active role in the development of new products, and to facilitate researcher mobility, etc.

A number of measures, such as "Supporting innovation activities of businesses", or "Supporting market-oriented research and development" include provisions for the purchase of extramural R&D services.

The "Innocsekk" scheme provides public funds to micro- and small enterprises for purchasing RTDI services from research institutes in their own region.

Some tax incentives also promote extramural R&D. For example, 200% of extramural R&D expenditures, if carried out by public or non-profit research organisations are deductible from the corporate tax base. Extramural R&D expenditures can also be deducted from the so-called innovation levy (a major source to finance the Research and Technological Innovation Fund).

Route 6: Increasing R&D in the public sector

The broad objectives of the Social Infrastructure and the Social Renewal Operational Programmes are to modernise and enhance the technological level of publicly financed research institutes (especially regarding equipment at natural science faculties), provide support to mission-oriented basic research activities of innovative research groups, facilitate knowledge and technology transfer from publicly financed research institutes, and provide incentives for pursuing researcher careers and high quality research.

Although the Research and Technological Innovation Fund was initially aimed primarily at supporting private sector RTDI activities, HEIs and PROs make extensive use of the Fund: approximately half of the funds were allocated to the public sector in 2008 (and an even larger chunk in previous years).[8]

The recent reforms of the Hungarian Academy of Sciences and the higher education sector may also foster R&D investments in the public sector. The application of stricter performance criteria, the modernisation of governance structures, settling IPR issues and increased decision-making competences in asset management are expected to provide incentives to carry out economically more relevant research, and thus attract private investments in public R&D activities.

The term “centres of excellence” is used to denote different types of entities in Hungary. First, six Centres of Excellence – among the 34 centres in the new member states – gained this title and funding from the EU in 1999. Second, the aim of the “Regional Knowledge Centres at Universities” scheme (launched in 2004) was to establish regional centres of excellence in co-operation with companies and other research organisations. Altogether 19 such centres received a total of ~€65m. Third, this measure is continued in the 2007-2013, but the declared intention is to focus the available resources, and hence only support a smaller number (not more than 6-8) of internationally competitive centres of excellence within prioritised technology areas. The centres to be supported by the “National Knowledge Centres” scheme (roughly ~€35m) will be selected in 2009.

The importance of education and innovation policies

Higher education policies strongly influence R&D activities. The HE sector is an important research performer, and also provides qualified HRST. As for the latter, the ratio of S&E graduates is rather low in Hungary in international comparison, and it might jeopardise future R&D activities. Therefore, education policies have an important – and very long-term – role to play in raising awareness for science and technology among primary and secondary school students.

One of the declared intentions of the HE reform has been to better align labour market demand and research and education activities of HEIs. (Chapter 4.3)

[8] Other players often claim that universities and PROs ‘disguise’ their basic research projects as applied ones in order to tap into the Fund’s resources, even though the economic usefulness of these projects is doubtful.

Two of the Operational Programmes of the New Hungary Development Plan (2007-2013) include major measures cutting across the domains of the "knowledge triangle". For example, the "Support to infrastructural and IT development aimed at increasing the quality of higher education" scheme of the SIOP serves research, education and innovation policy goals in the same time. Furthermore, the Social Renewal OP's 4th Priority Axis ("Developing the content and organisation of higher education to create a knowledge-based economy"), partly supports the "Expansion of the capacities of R&D&I&E [Research and development, innovation and education] of tertiary education", aimed at enhancing co-operation capabilities with businesses.

Assessment of the importance of policy mix routes and their balance

Most of the relevant STI policy schemes primarily target business RTDI activities in general, and the other routes are usually either not distinguished, or are side-objectives. Further, there is no distinction between firms, which previously had not conducted R&D activities and had done so.

As for recent changes, it should be noted that the current policy framework had mainly been developed prior to 2008 (especially when the New Hungary Development Plan and its Action Plans had been devised), and no major policy changes took place since January 2008.

Table 7: 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	Mainly promoted as side objectives of larger RTDI schemes. Various aspects are addressed by schemes supporting IPR, or indirectly by supporting intermediaries, innovation parks, etc.	No major policy change since 2008. Basic framework set out in the 2007-2008 Action Plans of the New Hungary Development Plan.
2	The dominant route of STI policy in Hungary, as raising RTDI activities of businesses is a major objective. The existing policy mix covers a wide range of activities.	Basic framework set out in the 2007-2008 Action Plans of the NHDP, most of its schemes launched in 2008, and continued in 2009-2010. Funding for major programmes (especially within the EDOP) has increased. The budget of the Research and Technological Innovation Fund has also increased.
3	Existing policies do not distinguish this route.	-
4	The ITDH supports large-scale R&D investments case by case. Attracting foreign companies to invest in R&D is also a side objective of broader schemes.	No major change since 2008.
5	Strengthening co-operation between private and public sectors is one of the central objectives of Hungarian STI policy. Several large schemes are dedicated to this objective. Most measures target collaborative research projects.	Major schemes had been launched before 2008, and continued since then. A current intention is to focus resources to create a smaller number of internationally competitive centres of excellence.
6	Modernising the public research sector is also a priority of STI policies; schemes provide funding to develop the research infrastructure as well as RTDI projects (often in co-operation with the private sector).	Major schemes within the Social Infrastructure and Social Renewal OPs were launched in 2007-2008, and will be continued in 2009-2010. Amendments to the Laws on Higher Education and the Academy of Sciences.

3.4 Progress towards national R&D investment targets

Hungary is significantly lagging behind the EU average and the targets stipulated in the Hungarian strategic documents, let alone the Lisbon-Barcelona objectives. Yet, public funding for RTDI has increased in recent years, mainly due to the resources allocated to this domain from the EU Structural Funds. BERD has also been increasing since 2004 both in absolute terms and as a percentage of GERD and GDP. Given the global economic and financial crisis, further aggravated by the severe domestic macroeconomic tensions, it is uncertain if these recent favourable trends would continue in the coming years. Moreover, a recent OECD review on Hungarian innovation policy concludes that, even based on the current trajectory of R&D expenditures, achieving the mid-term goals will be a rather challenging task. (OECD, 2008a, p. 203)

It is difficult to appraise the impact of the policy mix, given the lack of independent evaluation of either the individual STI policy measures or that of the policy mix as a whole. A large number of potentially relevant STI policy measures are in place, which address the identified challenges. Well-targeted efforts are needed, however, such as fine-tuning the direct and indirect instruments, sector-specific and generic schemes, streamlining the portfolio of measures to avoid overlaps and make it more transparent. (OECD, 2008a)

It seems unlikely that R&D investment targets, especially those of the private sector can be achieved simply by providing more public funding. The impact of STI policies aimed at leveraging R&D investments can only be enhanced if framework conditions are also significantly improved. The prospects for this happening, especially in the current economic climate are rather dim. Structural reasons, that are difficult to address even by overall economic policies, let alone STI policies, can also be seen as obstacles to induce R&D investments. The large chunk of BERD is performed by foreign-owned firms, and their RTDI activities are largely determined by their parents' strategies, while domestic STI policies can only play a relatively minor role.

Table 8: 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
Low share of innovative companies, especially indigenous SMEs, perceived lack of demand for new products and services	A large number of schemes and increased public funding are in place providing incentives for companies to engage in RTDI. These are not likely to be successful unless framework conditions for RTDI improve significantly.
Overall unfavourable framework conditions, especially macroeconomic pressures, exacerbated by the global economic crisis since September 2008	Given the economic crisis and lack of meaningful dialogue among the major political parties it is uncertain if fundamental reforms, needed to create more favourable conditions, can be implemented.
Differences between the incentive structure of public sector researchers and interest of businesses hamper exploitation and alignment between supply and demand of knowledge	The main opportunity is the on-going reform of the public research sector, placing more emphasis on exploitability of knowledge when evaluating research performance. Existing schemes provide incentives for strengthening academia-industry co-operation.
As for future R&D investments, the supply of HRST might become insufficient in the coming years	A growing number of schemes are targeting this challenge. Financial incentives or mechanical increases in S&E enrolment themselves might not yield results without major changes in the research and education systems.

In sum, despite the large number of apparently relevant policy responses, which do not show significant imbalances among the various policy routes, progress towards R&D investment targets has been modest.

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 ERA[9] 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
- 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 internationalisation 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

Demand for researchers fell drastically in the early 1990s. The number of scientists and engineers (FTE) reached the 1990 level (17,550) only in 2006 (17,547). Research at the private sector has increased since 2005 in all respects: the number of (FTE) researchers (4,309 in 2004 vs 6,986 in 2007), that of business R&D units (669 vs 1,125) and R&D expenditures (~€258m vs ~€495m). These trends were mixed for PROs and negative in the HE sector. (Chapter 2.1.2)

International mobility of researchers has been intensified lately. The number of foreign researchers employed in Hungary increased from 526 in 2006 to 638 in 2007, but they account only for 2% of the total number of researchers. (KSH) The vast majority (70.4%) of foreign researchers were EU citizens. An additional 600 foreign scientists conducted research in Hungary as grant holders, thanks to the growing number of scholarship schemes, especially financed by the EU. As for outward

[9] 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).

mobility, 238 Hungarian researchers worked abroad for more than six months in 2007 (17.8% increase compared to 2006).

The number of those holding a scientific degree (PhD or higher) was 12,060 in 2007, which has been relatively stable in recent years. (KSH) One third of these were in social sciences, 26.3% in natural sciences, and 12.9% in engineering and technology in 2007. In the 2007/8 academic year, the number of PhD graduates was 1,059. These figures indicate a rather poor performance in international comparison. Graduation rates at doctoral level remain at around half of the OECD average (0.6% vs. 1.3% of the relevant age cohort), while the proportion of S&E doctoral degrees is also one of the lowest (0.1% vs. 0.5%). (OECD, 2008b, p. 145)

Both the number and composition of degree holders seems to be inadequate in case of serious intentions to enlarge the research system. A recent study examining the supply of researchers has concluded that even in case of the most optimistic scenario the labour force with PhD degree will become the bottleneck of the Hungarian research system. (Tamás *et al*., 2005) Extrapolating the current trends, a shortage of PhD degree holders will occur in 5-10 years. This shortage will directly endanger the functioning and quality of the research system.

The yearly wages of researchers in Hungary were below the EU25 average both in absolute (€15,812 vs €37,948) and in PPS terms (€27,692 vs €40,126) in 2006. (EC, 2007) Hungarian researchers' ranking in terms of remuneration decreases along the career path among the 33 countries covered: Hungary ranks 20th in the group of researchers with 0-4 years of experience, and fall back to the 26th position for those with more than 15 years experience. Researchers in the private sector earn roughly 20-25% more than their colleagues working in the public research sector.

Hungarian university-level graduates have the highest earnings advantage among OECD countries: those with below upper secondary qualifications earn 73% of national average, while those with tertiary education 217% of that.[10] (OECD, 2007) Unemployment figures also show a much more favourable position compared to lower qualifications: 2.6% among ISCED 5-6 vs. 16% ISCED 0-2. (KSH)[11] This difference is smaller in many other countries.

A recent large-scale study concluded that the demand for PhD degree holders is strongest in the HE sector.[12] (Felvi, 2007) In general, the activities of doctoral schools are still not sufficiently aligned with the needs of businesses, given the lack of mutual understanding of each other's activities. More than two-thirds of those holding a doctoral degree work in the public research sector. These findings, especially the need to improve dialogue between HEIs and the industry regarding the economic relevance of curricula, have also been stressed by the recent OECD Review of Innovation Policy in Hungary. (OECD, 2008a)

It is still premature to assess the consequences of the global financial crisis. The number of workers laid off between September 2008 and March 2009 is estimated to be around 40,000, and unemployment reached 9.1% in February 2009 (up from 7.8% in Sept-Nov 2008; KSH), the highest level since the mid-1990s. Primarily low skilled workers have been affected in a number of key manufacturing sectors, and research

[10] These data refer to the 25-64 years old age group of the population in 2004.
[11] One also has to bear in mind that Hungarian employment rates are significantly below the EU average in all qualification groups.
[12] The study was conducted by the National Higher Education Information Centre in 2002 and 2007, based on in-depth interviews and surveys, using a representative sample of degree holders.

positions are less likely to be threatened. However, a new measure was launched in March 2009 with the explicit aim of providing financial support for employing researchers and technicians laid off by companies since September 2008.

4.1.1 Policies for opening up the national labour market for researchers

Researchers at PROs and HEIs fall under the generally strict but stable regulations of civil servants. They are usually not well paid, unless involved in various external, especially international, projects. (section 4.1.2) The MTA has implemented a number of measures to attract or retain young researchers in recent years.[13] The age composition of HE researchers also improved in 2003-2007.

Table 9: The distribution of researchers by age, 2003-2007 (per cent)

Higher Education							
	under 25 years	25 - 34	35 - 44	45 - 54	55 - 64	65 -	Total
2003	1.0	20.8	21.8	27.2	23.5	5.6	18 971 (100%)
2005	0.6	21.7	22.7	25.4	24.1	5.4	19 086 (100%)
2007	0.7	22.8	24.0	23.0	23.9	5.5	18 545 (100%)
*R&D institutes and other research units**							
2003	1.6	28.2	19.8	25.4	20.2	4.8	5 822 (100%)
2005	1.4	28.4	20.6	24.2	21.2	4.1	6 213 (100%)
2007	2.0	30.5	22.2	21.6	19.1	4.6	5 941 (100%)

Source: Calculation based on KSH data. * The share of MTA institutes is dominant in this sector.

In general, research positions at public research institutes are open to non-nationals, in most cases, however, command of the Hungarian language is among the prerequisites. That basically rules out the possibility of foreign nationals applying (with the exception of ethnic Hungarians coming from neighbouring countries).

Hungary was among the first countries to implement the 2005/71/EC Directive concerning the employment of researchers from third countries. Simplified visa procedures for third-country researchers have been implemented in accordance with the Directive by the 114/2007 Government Decree (in effect since December 2007). Accredited research units are entitled to employ researchers from third countries with simplified procedures.[14] As of early 2009, 74 organisations have been accredited: the vast majority being MTA institutes and universities, and only a handful of private (mostly not-for-profit) research units. However, it has not yet resulted in any contracts hosting foreign researchers.

With regard to social security policies, Hungary fully complies with the 1408/71 regulation. Third country nationals are entitled to social security and medical services according to bilateral agreements. Relevant information on social security agreements is not provided in a systematic way: it is at best fragmented and difficult to obtain.[15]

There are a number of doctoral schools offering programmes in English for foreign candidates. However, these programmes are not sufficiently attractive for financial

[13] A recently launched programme called “Lendület” (“Momentum”) aims at attracting excellent young Hungarian researchers by providing stable, multi-year funding for the establishment of research groups within the various institutes of the MTA.

[14] Accreditation is to be conducted by the NKTH, following the procedures stipulated in a separate government decree. Employment should exceed 3 months.

[15] The Hungarian Euraxess website, operated by a public foundation, does not contain systematic information regarding social security and other regulations pertaining to researcher mobility.

reasons: scholarship schemes are scarce, whereas full tuition fees must be paid by the applicants as doctoral schools are only entitled to normative state support for Hungarian PhD students. Hence, the number of foreign students enrolled in Hungarian doctoral programmes is relatively modest (8.1% vs. 18.5% OECD average in 2006). (OECD, 2008b)[16] The Hungarian Bologna Progress Report acknowledges this challenge: "The number of foreign students studying in Hungary and that of Hungarian students studying abroad is yet insufficient, and it is also the case for teachers and researchers. This situation must be improved. Additional incentives must be identified so that more joint degree programmes are organised. The number of programmes offered in foreign languages must be increased. Creating the financial conditions for mobility and providing for equal opportunities is a serious challenge." (Bologna Report, 2009, pp. 58-59)

4.1.2 Policies enhancing the attractiveness of research careers in Europe

Uptake of the Charter of Researchers

As of March 2009, 10 organisations have signed the Charter for Researchers: 7 HEIs (10% of all HEIs), 1 research centre at the Budapest University of Technology and Economics, and 2 not-for-profit private research centres. These research institutes represent a small fraction of the public research sector. The National Office for Research and Technology promotes the uptake of the Charter, and disseminates the names of organisations signing it.

Remuneration policies

The salaries of academic staff in the public research sector are determined by law, based on scientific seniority. On the basis of scientific performance, however, employers may provide supplementary salaries. Researchers' additional income stems from various projects, or scholarship schemes. There are no readily available figures to assess the relative weight of these sources of income. In general, however, researchers employed in the public sector are modestly paid, and therefore (i) salaries are not the key motivating factor for pursuing a scientific career; (ii) it is a must to earn additional income from either research and/ or consultancy projects or even other (not research-related) activities.

Promotion of women

The share of female research personnel within the total was 43.5% in 2007, while among the scientists and engineers women's share was only 33.5%.[17] (KSH) Hungary performs around average compared to EU countries: using the most recent available data, the highest shares were recorded for Portugal (44.4%; 2003) and Slovakia (41.5%; 2005), whereas the lowest ones in the Netherlands (17.3%; 2003) and the Czech Republic (28.8%; 2005). (OECD, 2007, p. 55)

[16] The total number of foreign students enrolled in "advanced research programmes" was 537 in 2004, compared to 1,020 in Sweden, 1,400 in Belgium, both countries comparable in size. (OECD, 2007, p. 45) Tertiary programmes offered for exchange as well as full-degree international students are summarised at the Campus Hungary portal (www.campushungary.hu), sponsored by the Ministry of Education and Culture to promote both inward and outward student mobility.

[17] There are important differences by research performers: these shares are 38.8% in PROs, 37% at HEIs, and 22.3% in the business sector.

By fields of research, female researchers' share is highest in medical sciences and humanities and the lowest in engineering. The share of women among higher education graduates and among PhD students is around or even above 50%, but their ratio decreases dramatically among researchers with scientific degrees (roughly 20%), employed in higher positions (professors: 11.9%; members of the MTA: 4%) and generally along the career path. The same goes for members of the STI policy-making bodies, where women are only rarely represented. (Palasik and Papp, 2007, pp. 30-31)

The gap between male and female researchers' salary is 12.2%, which is a relatively low figure compared to EU countries: the corresponding figures for Austria, Belgium or the Czech Republic are 35.8%, 31.2% and 34.2%, respectively. (EC, 2007, p. 160) There are no special regulations for women in research jobs for maternity leave. Both the father and the mother are entitled to childcare support schemes on identical terms, but men rarely take this opportunity (only 5-6% of cases), and typically not in well-paid and secure positions. The Hungarian Labour Code stipulates that workers may not be laid off while receiving benefits from the so-called Childcare Aid scheme, i.e. up to three years.

No specific programmes or initiatives are aimed at promoting female researchers in S&T fields where they are underrepresented. This issue is not high on the policy agenda. Proposals for woman- and family-friendly workplaces and related initiatives have been made as part of the reform process of the MTA. (Palasik and Papp, 2007) In early 2009, the MTA launched initiatives in this area, based partly on international studies, and taking into consideration practices in other EU countries, as well as the recommendations of the European Researcher Charter and the Code of Conduct. One of the measures that the MTA can implement internally is that the age limit for all its scholarship schemes targeted at young researchers will be extended by two years for every child the female researcher has. When evaluating researchers' performance, these considerations will also be taken into account explicitly.

Gender mainstreaming, more flexible working hours suited for mothers with small children, and committees/ focal points at research organisations dealing with equal opportunities for women have also been proposed by the respondents of a survey carried out by the Central European Centre for Women and Youth in Science project, but without any tangible impact so far. (CECWYS, 2006)

4.2 Governing research infrastructures

No explicit research infrastructure (RI) development strategy has been devised in Hungary until recently. Some dedicated schemes have provided funding specifically for purchasing R&D equipment, while other, more general ones also supported obtaining research equipment, e.g. as parts of strengthening business R&D units. Capital investments in research infrastructures varied widely since 2000: 18.2%, 17.9%, and 11.6% of GERD in 2000, 2006, and 2007, respectively. In absolute terms, the amount increased from ~€100m in 2004 to ~€158m in 2006, and then dropped to ~€110m in 2007. Business R&D units spent 68% of the latter amount, including public funding, too, as already mentioned.

The Hungarian RI landscape can be characterised as dispersed. Only a small fraction of the Hungarian RIs can be regarded as large RIs, mainly in physics. The

best known example is the research reactor operated by the Atomic Energy Research Institute (MTA), open to the international research community.[18]

Hungary holds membership in CERN, has participated in preparing the European Strategy Forum on Research Infrastructures (ESFRI) roadmap, and has announced its intent to host either the European Spallation Source,[19] or ELI, the Extreme Light Infrastructure,[20] both specified within that framework. Besides, several Hungarian research units have expressed their interest to participate in over a dozen ESFRI projects.

As already mentioned in section 2.4, a national RI development strategy is currently being prepared, to be completed by the end of 2009. This project – called NEKIFUT ("Take-off"), derived from "National Research Infrastructure Survey and Roadmap" in Hungarian – would define a roadmap for building new infrastructures in Hungary, as well as those areas of specialisation where participation in new transnational infrastructures is favourable. Around 80 researchers and business people participate directly as members of the project's three panels and its Steering Committee, and a broader set of experts are involved via various channels of wider consultations.

4.3 Research organisations

The autonomy of universities is a central element of the Hungarian research system, entrenched in the Constitution:[21] HEIs have a large degree of autonomy in managing research budgets, hiring research personnel, and designing research agenda. Some areas, such as asset management, are strictly regulated by law. Promotion of university staff is decided internally, while professorships are formally awarded by the President of the Republic. Salaries of academic staff are also determined by law, with some room for performance-based complementary payments.

The Law on Higher Education (2005) introduced a number of amendments aimed at modernising university governance structures, while keeping the autonomy of HEIs as a key principle. The *Rector*, as head of the HEI, has remained the academic leader. The Law stipulates that eligible candidates for rector are university professors. The majority of universities apply open tender processes, while some only allow tenured professors to apply. In any case, due to the stipulation of the Law, rectors (and deans) are exclusively academics, chosen by the universities' Senate, and finally approved by the President of the Republic. Even in the case of open tenders, most rectors tend to be chosen from within own ranks of universities.

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[18] "Research instruments at the Budapest Research Reactor have been offered to the entire international user community, and in particular, for EU and associated countries of the European Union in the "Access to Research Infrastructures" action of the 6th Framework Programme (FP6)." (http://www.kfki.hu/brr/indexen.htm)

[19] ESS is a major supranational project, listed on the October 2006 roadmap of the European Strategy Forum for Research Infrastructures (ESFRI). It will be an accelerator-based facility, producing intense neutron beams by the spallation process for the study of atomic, molecular or nanoscale structure, and properties of all kinds of materials. (http://www.esshungary.eu/miazess_eng.html)

[20] ELI would be the first infrastructure dedicated to the fundamental study of laser-matter interaction in a new and unsurpassed regime of laser intensity: the so-called ultra-relativistic regime. At its centre would be an exawatt-class laser, around 1000 times more powerful than either the Laser Mégajoule in France or the National Ignition Facility (NIF) in the US. (http://www.extreme-light-infrastructure.eu)

[21] This stipulation of the Constitution is taken as an absolute principle, overriding any other initiatives: see below the case of the Economic Councils, proposed by the Law on Higher Education (2005).

The 2005 Law introduced two new governing bodies: the Senate and the Economic Council. The Senate oversees all aspects of the operation of a given HEI: approves a Development Plan, devises and implements RTDI strategies. It is mainly composed of academics, but also other employees of the HEI and student representatives. The *Economic Council* was originally supposed to make financial decisions and to supervise their implementation. Three members of these councils (composed of 7 or 9 members in total) are delegated by the government, and thus these provisions were declared unconstitutional by the Constitutional Court. The Economic Councils, therefore, only have an advisory and monitoring role. For publicly financed HEIs it is compulsory to set up an Economic Council, while it is optional for private ones. The members nominated by the Minister of Education and Culture are typically non-academics (e.g. businessmen and financial experts), as are often the ones appointed by the Senate. The role played by the Economic Councils at the different universities varies considerably: while some are rather active and have a significant influence on strategic decisions, in most cases they remain formal consultative bodies.

In sum, universities have a high degree of autonomy in determining research topics and allocating budgets. These decisions, in turn, remain in the hands of academics.

There have been no significant changes in recent years with regard to the legal status of HEIs. There was a major integration process in the early 2000s, but the number of universities and colleges is still rather high: 18 state universities, 7 non-state universities (5 maintained by churches), 11 state colleges and 34 non-state colleges. Colleges only exceptionally offer post-graduate programmes. In the 2007/8 academic year 1,032 of the 1,059 PhD degrees were granted by state universities and the remaining 27 by HEIs maintained by churches. (OKM, 2008) These figures indicate the dominance of state universities in supplying new researchers.

There are two main channels of research funding for universities: core (block) funding for RTDI and project-based competitive funding. In line with the stipulations of the Law on Higher Education (2005), the so-called “scientific appropriation” (basically grants for the purpose of scientific activities of HEIs, including post-graduate education) is based on the number of full-time professors, the number of professors holding scientific degrees, PhD students and PhD graduates. Neither publication and citation performance, nor patent applications per grants indices are used as evaluation criteria. HEIs are entitled to distribute the funds among faculties or research groups autonomously, and they occasionally apply performance criteria (such as bibliometric indicators or external funding generated by the respective unit). The use of the block funds are not followed closely, i.e. they can be used for financing education activities or covering general costs, such as heating and lighting.

HEIs can also apply for various types of grants offered by national or foreign funding organisations. These have clearly gained significance in recent years; HEIs have rather actively and successfully applied for such grants. The most important ones are financed by the Research and Technological Innovation Fund (especially the schemes promoting co-operative research), and the New Hungary Development Plan (supporting e.g. research infrastructures and improving working conditions at Hungarian research facilities, i.e. attracting Hungarian and foreign researchers). The National Scientific Research Fund (OTKA) provides competitive funding for basic research to both publicly financed research institutes and individual researchers (including foreign researchers and international collaborative projects), which is a

significant source of income for HEIs.[22] The EU RTD Framework Programmes is also gaining significance as a source of income for HEIs.

4.4 Opening up national research programmes

One of the objectives of the government's mid-term STI policy strategy (2007-2013) is to „strengthen knowledge supporting the competitiveness of society". Under this heading the government aims at strengthening the „openness of higher education, the utilization of EU labour-market opportunities, and the domestic employment of foreign educators and researchers. We shall offer incentives for acquiring international experience (student, educator and researcher exchange programs, and scholarships)." (Government, 2007, p. 18)

Most STI policy measures are open to non-nationals, and some of them, e.g. a joint OTKA-NKTH scheme for developing human resources in basic research, explicitly identify foreign researchers as one of the target groups. In most cases, however, the supported research project should be carried out at a Hungarian facility (and the grant holder should be employed by the organisation). There are also schemes for supporting joint international projects and researcher mobility.

In spite of these opportunities, the share of foreign researchers working in Hungary is rather modest (approximately 2% of the total; see section 4.1). Possible obstacles include the relatively low profile of research programmes that can be conducted in Hungary, the language barrier, low overall funding and remuneration by international standards (e.g. low country correction factor in the case of Marie Curie grants), and bureaucratic hurdles for third-country nationals, for example family reunification.

The National Office for Research and Technology has joined 12 ERA-NET projects, e.g. on biodiversity, environment, food safety and SME research. A number of other organisations have also joined ERA-NETs: e.g. the Ministry of Environment and Water represents Hungary in the CIRCLE and BiodivERsA, and the Hungarian Academy of Sciences has joined ERA-Chemistry. Hungary also contributes to Joint Technology Initiatives (JTIs), such as Eurostars, AAL, Artemis, Eniac and IMI. The "Institutional Strategy" of the NKTH declares that joining these community initiatives is a "strategic interest", and the participation of industrial players should be promoted in order to efficiently exploit the opportunities provided by these collaborative projects. (NKTH, 2007) Several schemes support Hungarian participation in these initiatives, while conferences, information days and other similar events are also organised by the NKTH to raise awareness. Besides, the Hungarian government has signed bilateral STI co-operation agreements with 34 countries by June 2009, in addition to EU members also with Argentina, China, Croatia, India, Israel, Japan, Korea, Malaysia, Mexico, Russia, South-Africa, Thailand, Turkey and Ukraine (for further details, consult http://www.nkth.gov.hu/english/bilateral-cooperation/bilateral-t)

4.5 National ERA-related policies - a summary

Taking a somewhat mechanistic approach, the European Research Area does not feature prominently in Hungarian STI policy documents. It is only mentioned in the government's mid-term STI policy strategy in a footnote, when referring to important

[22] The size of the OTKA budget is roughly 10% of the Research and Technological Innovation Fund: ~€20m vs. ~€200m per annum.

EU policy documents. Further, ERA is mentioned in the National Lisbon Action Plan (2008-10) in connection with the National Research Infrastructure Survey and Roadmap (NEKIFUT, Nemzeti Kutatási Infrastruktúra Felmérés és Útiterv) project, as well as when listing other ERA-related activities, concerning joint programming, mobility schemes and international co-operation.

In a more substantive way, the issues identified as the four main pillars of ERA, analysed in this chapter, have been important issues in Hungary, too, although quite often without explicitly referring to the ERA initiatives. Out of these issues, modernising research organisations – both the MTA and universities – has been the most prominent one in recent years. In terms of financial commitments, however, the Hungarian government's offer to host the European Spallation Source is by far the largest, most expensive single project, which would equal to over 80% of annual public R&D expenditures. That would be a significant contribution to building world-class infrastructures accessible to research teams from across the EU and beyond – especially momentous taking into account the size and level of development of the Hungarian economy and research system. Upgrading national research infrastructures and devising a strategy on obtaining access to transnational ones are the focus of the National Research Infrastructure Survey and Roadmap project, launched in 2008. Most Hungarian R&D support programmes are open to foreigners; but these research activities should be conducted in Hungarian. Yet, not many foreign researchers take advantage of these measures. Several schemes finance international R&D projects and researcher mobility: these measures facilitate outward mobility of researchers, and also promote the career of these researchers first abroad, and then indirectly, in a favourable case, back in Hungary, given their knowledge and skills gained at foreign R&D sites.

Table 10: 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	• Research careers are not attractive: work conditions are not favourable; wages are less than 70% the EU average for researchers, and well below the income of professionals working for the private sector • The difference between male and female researchers' salary is small relative to EU figures • The number of foreign students studying in Hungary and that of Hungarian students studying abroad is low, and it is also the case for teachers and researchers	• Salaries of public sector researchers are regulated by law, with some flexibility to reward scientific performance • Simplified visa procedures for third countries researchers introduced in December 2007 • Full compliance with the 1408/71 regulation concerning social security policies • Several doctoral schools offer programmes in English • Several schemes promote international mobility of researchers
Governance of research infrastructures	• Dispersed RI landscape • A few large RIs, open to the international research community	• A national RI development strategy to be devised by the end of 2009 • Participation in shaping the ESFRI Roadmap • A huge financial commitment to host the European Spallation Source

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Autonomy of research organisations	• The autonomy of scientific research is a major building block of the Hungarian research system, entrenched in the Constitution	• Efforts to reform both the higher education sector and the Hungarian Academy of Sciences
Opening up of national research programmes	• Most Hungarian R&D support programmes are open to foreigners, yet, the share of foreign researchers working in Hungary is only 2%	• Participation in a number of ERA-NET projects and JTIs

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

GERD reached 0.94% of the GDP in 2001, and fluctuated around 0.9-1.0% since then, standing at 0.97% in 2007. The BERD/GDP ratio was 0.49% in 2007 (42% of the EU27 average). These figures are well below the Lisbon-Barcelona targets.

The major barriers hindering R&D investments in the *short run* are the unfavourable framework conditions, that is, the macroeconomic situation and dynamics (especially growth prospects and access to capital); the overall entrepreneurial culture; conditions for doing business (entry and exit, the nature of competition, and the intellectual property rights regime); the publicly financed R&D organisations and physical infrastructure for R&D; human resources; standards and regulation.

Macroeconomic imbalances have been particularly pressing since 2006. The global financial and economic crisis has further aggravated the prospects for recovery, and access to capital has become even more difficult. Although overall conditions for doing business have improved in recent years, administrative and tax burdens on firms are still high compared to the OECD average. The regulatory environment is still characterised by frequent and unpredictable changes. These conditions are not favourable for long-term and high-risk activities, such as RTDI.

Only one fifth of firms operating in Hungary are innovative. The majority of companies (59%) do not innovate due to the lack of demand for new products and services. Similarly to the other countries, Hungarian enterprises mentioned “innovation costs too high” and “lack of own resources” as the two main obstacles hindering innovation activities. (CIS4) Thus, these firms do not invest in R&D, either.

Researchers at universities and PROs are not sufficiently motivated to carry out economically relevant research. This, in turn, hinders exploitability of knowledge, and therefore may not provide sufficient incentives for private co-financing of research performed in the public sector. The on-going reform of the public research sector might put more emphasis on academia-industry co-operation among the set of evaluation criteria (i.e. not just on academic publications and citations).

As for the *longer term* R&D investment objectives, the supply of HRST seems to be a major barrier. The number of S&T graduates and that of the PhD degree holders are low in international comparison. Several schemes are targeting this challenge. Financial incentives or mechanical increases in enrolment in S&E themselves, however, are unlikely to yield results without major changes in the research and education systems. This observation is indirectly confirmed by the fact that in spite of

government's efforts, the number of students in these fields has been decreasing in recent years.

While GERD has stagnated, the BERD/GERD ratio has improved since 2005. Given the most recent global and domestic economic developments, these recent favourable trends might not continue in the coming years. Further, even if the current trajectory of R&D expenditures will be maintained, achieving the mid-term R&D goals would be a rather challenging task, according to a recent OECD study. (OECD, 2008a)

The lack of external evaluations of either the individual STI policy measures or that of the policy mix as a whole impedes a thorough appraisal of the impact of the policy mix. Independent experts have offered two major conclusions. First, a large number of potentially relevant STI policy measures are in place, addressing the identified challenges. Second, well-targeted efforts are needed, however, e.g. fine-tuning the direct and indirect instruments, sector-specific and generic schemes, streamlining the portfolio of measures to avoid overlaps and make it more transparent. (OECD, 2008a)

It seems unlikely that R&D investment targets, especially those of the private sector can be achieved simply by providing more public funding. The impact of strictly defined STI policies aimed at leveraging R&D investments can only be enhanced if framework conditions are also significantly improved. Given the economic crisis and lack of meaningful communication – let alone co-operation – among the major political parties it is uncertain if fundamental reforms, needed to create more favourable conditions, can be implemented.

Structural reasons, that are difficult to address even by overall economic policies, let alone STI policies, can also be seen as obstacles to induce R&D investments. The large chunk of BERD is performed by foreign-owned firms, and their RTDI activities are largely determined by their parents' strategies, while domestic STI policies can only play a relatively minor role.

5.2 ERA-related policies

The European Research Area does not feature prominently in Hungarian STI policy documents. The issues identified as the four main pillars of ERA, analysed in this report, have been important issues in Hungary, too, although quite often without explicitly referring to the ERA initiatives. Out of these issues, modernising research organisations – both the MTA and universities – has been the most prominent one in recent years. In terms of financial commitments, however, the Hungarian government's offer to host the European Spallation Source is by far the largest, most expensive single project, which would equal to over 80% of annual public R&D expenditures. That would be a significant contribution to building world-class infrastructures accessible to research teams from across the EU and beyond – especially momentous taking into account the size and level of development of the Hungarian economy and research system. Upgrading national research infrastructures and devising a strategy on obtaining access to transnational ones are the focus of the on-going National Research Infrastructure Survey and Roadmap project, to be completed by the end of 2009. Although most Hungarian R&D support programmes are open to non-nationals, not many foreign researchers have seized these opportunities. Several schemes finance international R&D projects, as well as inward and outward researcher mobility.

The main challenge for the Hungarian R&D system is to find its place in the broader national innovation system, and establish regular, organic, mutually beneficial co-operation with the other major players. The national innovation system, in turn, is not embedded sufficiently in the overall economic system. Hence, STI policy-makers are not among the key actors defining broad socio-economic goals, shaping the respective development strategies, and making major financial decisions.

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List of Abbreviations

BERD	Business Research and Development Expenditures
CECWYS	Central European Centre for Women and Youth in Science
CIS4	Communitiy Innovaton Survey (2002-2004)
EDOP	Economic Development Operational Programme
EIS	European Innovation Scoreboard
ERA	European Research Area
EU	European Union
EU RTD FP	European Framework Programme for Research and Technology Development
FTE	Full-time-equivalent

GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GOVERD	Government Research and Development Expenditures
HEI	Higher education institutes
HE	Higher education
HERD	Higher Education Research and Development Expenditures
HRST	Human resources for science and technology
ISCED	International Standard Classification of Education
ITDH	International Trade Development Agency
JTI	Joint Technology Initiative
KSH	Hungarian Central Statistical Office
KTIT	Research and Technological Innovation Council
MISz	Hungarian Association of Innovation
MTA	Hungarian Academy of Sciences
NKTH	National Office for Research and Technology
NRP	National Reform Programme
OECD	Organisation for Economic Co-operation and Development
OECD MSTI	OECD Main Science and Technology Indicators
OKM	Ministry of Education and Culture
OP	Operational Programme
OTKA	National Scientific Research Fund
PPS	Purchasing power standard
PRO	Public Research Organisations
R&D	Research and development
RI	Research infrastructure
RTDI	Research and Technological Development and Innovation
SF	Structural Funds
STI	Science, technology and innovation
S&T	Science and technology
SIOP	Social Infrastructure Operational Programme
SROP	Social Renewal Operational Programme

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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 Attila Havas.

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