ERAWATCH country reports 2010: Hungary

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Executive Summary

Hungary, with its population of 10 million (2% of the EU27 total) is a medium-sized EU Member State. Its GDP was 1.26% of the EU27 total in 2009. As for economic development, measured by GDP per capita (in PPS), the country ranked 21-22 in the EU27 in 2009 (with Estonia), with 62.7% of the EU27 average.

The Hungarian GERD (€1,067.2m) was 0.45% of the EU27 total in 2009. It increased from €721.3m in 2004 in every single year, particularly fast in 2005 (16.1%), then by 7-8% a year in 2006-2008, and by 0.8% in 2009. (Eurostat data, and author's calculation) The share of businesses in financing GERD grew from 37.1% in 2004 to 46.4% in 2009, while that of public funds decreased from 51.8% to 42.0% (2004-2009). The share of FTE researchers in total employment increased from 0.39% in 2004 to 0.53% in 2009, while that of all FTE R&D employees from 0.59% to 0.79% (2004-2009).

The GERD/GDP ratio was stagnating around 0.9-1% in 2001-2008, and increased to 1.15% in 2009 (KSH). This rise is a combined effect of two factors: (i) given the global financial and economic crisis, the Hungarian GDP shrank by 6.7% (preliminary data, KSH), while (ii) GERD continued to rise in nominal terms. In spite of this, the Hungarian GERD/GDP trails the EU27 average (2% in 2009), and has been well below the Lisbon target (3%).

In order to keep the budget deficit at the target level of 3.8%, the new government decided to cut several types of expenditures in June 2010 in a way that would not harm directly the population. As a part of this broader measure, HUF16b (~€58.2m) was blocked from the Research and Technological Innovation Fund (that is, 36.6%).

The Hungarian BERD has been increasing since 2004 both in nominal terms (from €296.5 to €610.8m) and as a percentage of GERD (from 41.1% to 57.2%), even in 2009. Yet, the BERD is still below the EU27 average (63.9% of GERD; 2008)

It seems unlikely that the R&D investment targets (GERD at 1.8% of GDP, while BERD at 0.9% of that by 2013) 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. Notably, the macroeconomic situation, the 'two-tier' structure of the economy, the intensity and type of competition, the overall entrepreneurship culture, the quality and directions of projects conducted by the publicly financed R&D units have unfavourable impacts on RTDI activities of firms. The incentives provided by the STI policy schemes cannot counterbalance those effects. Structural reasons, which are difficult to address even by overall economic policies, let alone STI policies, can also be seen as obstacles. The bulk of BERD is performed by foreign-owned firms, and their RTDI activities are largely determined by their parents' strategies, while domestic STI policies can play a relatively minor role.

Knowledge Triangle

The science, technology and innovation (STI) policy governance structure has been reorganised at least once by every government since the 1990s, including the highest level policy-making bodies. Moreover, the latter ones have only worked intermittently: in certain periods had been 'dormant' for years. Hence, policies affecting the RTDI processes – notably education, STI, macroeconomic, industrial, investment promotion and regional development policies – could not possibly be designed and implemented in a strategic, coherent and integrated framework. The implementing agencies are also frequently reorganised. These permanent changes in governance structures prevent organisational learning of policy design and implementation bodies, and this lack of stability also hampers the efficient functioning of these bodies.

No major changes have occurred in the national STI policy mix since 2009. The 84-page government programme, approved in May 2010, devotes 8 lines to R&D and innovation. A new technology and innovation policy document, underpinning the policy measures to be launched in 2011, would be finalised in January 2011.

Effectiveness of knowledge triangle policies

	Recent policy changes	**Assessment of strengths and weaknesses**
Research policy	• The Law on Higher Education was amended in December 2008 to facilitate a more entrepreneurial approach • The Law on the Hungarian Academy of Sciences (MTA) was amended in April 2009 to increase the financial autonomy of the MTA	• High quality of research in a number of scientific fields • Research is not an attractive career, brain drain is a severe threat • Mismatch between the incentives of academic researchers and the interests of businesses
Innovation policy	• Withholding HUF16b (~€58.2m) from the Research and Technological Innovation Fund; June 2010	• Significant funds allocated to RTDI in multi-year programming documents • Innovation performance is poor in international comparison
Education policy	• Higher quota of publicly financed students enrolled at S&E faculties • Schemes aim at raising the level of qualified human resources	• Internationally respected S&E education system in several fields • The level of qualified human resources for an enlarged research system would be inadequate
Other policies	• No major changes in those policy domains, which affect RTDI performance	• STI policy measures cannot counterbalance unfavourable framework conditions for business RTDI activities

European Research Area

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 EU policy documents. ERA is mentioned in the National Lisbon Action Plan (2008-10) in connection with the National Research Infrastructure Survey and Roadmap project, joint programming, mobility schemes and international co-operation.

Given the size of the Hungarian economy and the level of public funding for R&D, Hungary cannot be a major player in many of the ERA initiatives listed below.

Assessment of the national policies/ measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• Higher quota of publicly financed students enrolled at S&E faculties • Simplified visa procedures for foreign researchers introduced in December 2007 • Full compliance with the 1408/71 regulation concerning social security policies	• The share of S&E graduates is less than half of the EU average • Small difference between male and female researchers' salary • The same position after maternity leave is safeguarded • Several mobility schemes for Hungarian researchers, with scarce funding, though • Research positions at PROs are open to non-nationals, yet the share of foreign researchers is 2% in the total number of researchers
2	Increase public support for research	• Public funding for R&D increased from €373.7m (0.45% of GDP) in 2004 to €448.0m (0.48% of GDP) in 2009 • HUF16b (~€58.2m) "blocked" from the Research and Technological Innovation Fund	• Low level of public R&D expenditures, around three quarters of the EU27 average (0.65% of the GDP in 2008)
3	Increase European co-ordination and integration of research funding	• Hungarian participation in 46 ERA-Net projects (as of 2010), and several Joint Technology Initiatives (JTIs)	• Given the size of the Hungarian economy and the level of public funding for R&D, Hungary cannot be a major player in these initiatives
4	Enhance research capacity across Europe	• Measures to create R&D jobs in the business sector, and make HEIs and PROs more attractive	• The number of FTE researchers increased from 17,391 (2007) to 20,064 (2009), in spite of the crisis
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Measures to modernise RI are in place for a long time • A strategy-building process to underpin RI policies launched in 2008 • Participation in devising the ESFRI Roadmap, commitment to host one of the ELI sites	• A few large RIs, all open to foreign researchers • An uneven technical level of RIs: a mix of up-to-date and outdated facilities • Lack of a comprehensive RI investment strategy; suboptimal use of public funds
6	Strengthen research organisations, including notably universities	• Several schemes to modernise education and research facilities at universities, incl. the "Research university" title awarded for elite universities in 2010	• Uneven performance of HEIs • Only a few Hungarian universities are listed among the most prestigious ones in the world

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
7	Improve framework conditions for private investment in R&D	• Tax incentives for private R&D investment for long time	• Volatile macroeconomic environment for businesses • High interest rates and crowding out effect of the fiscal deficit • Market conditions are not conducive to RTDI activities
8	Promote public-private co-operation and knowledge transfer	• Several STI policy measures foster industry-academia collaboration	• Some improvement in the intensity of industry-academia collaboration
9	Enhance knowledge circulation across Europe and beyond	• Various schemes promoting Hungarian participation in EU FP and EUREKA projects are in place for a long time	• Hungarian STI support schemes are open to non-nationals, but funding is limited for them
10	Strengthen international co-operation in science and technology and the role and attractiveness of European research in the world	• Bilateral STI co-operation agreements with 37 countries (on four continents) • Participation in multi-lateral STI co-operation agreements and organisations	• Active participation in FP, EUREKA, and COST projects
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• The Research and Science Policy Council, set up after a long 'interval' in September 2009, was dissolved on 15 December 2010 • Decision on 15 Dec 2010 to establish the National Research, Innovation and Science Policy Council • The Government's mid-term STI policy strategy calls for evidence-based policy-making practices	• STI policy governance structures have been frequently reorganised • The highest level co-ordination body has worked intermittently • Policies affecting RTDI processes could not possibly be designed and implemented in an integrated framework • An S&T Observatory should have been set up originally by June 2008, then by the end of 2010, but it is not working yet
12	Develop and sustain excellence and overall quality of European research	• Measures to improve conditions required for excellence are in place for several years	• High quality of research in a number of S&T fields in international comparison
13	Promote structural change and specialisation towards a more knowledge-intensive economy	• No structural policies, strictly defined • Key technologies and related industries are identified in the New Hungary Development Plan and the Government's mid-term STI policy strategy	• Strong performance in high and medium-high-tech EIS indicators • The difference between statistical classification of sectors and the actual knowledge-intensity of activities performed in Hungary is not taken into account when devising policy measures
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Most Hungarian STI policy schemes had been devised prior to the identification of the grand societal challenges in various EU policy documents	• Enhancing competitiveness is a major objective of several STI policy schemes • Various other societal challenges are also addressed
15	Build mutual trust between science and society and strengthen scientific evidence for policy-making	• No specific measure to build mutual trust between science and society	• The MTA gives its expert opinion to the government on major issues

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1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national innovation system and its governance

This section presents the main characteristics of the governance structure of the Hungarian national innovation system.

Hungary, with its population of 10 million (2% of the EU27 total) is a medium-sized EU Member State. Its GDP was 1.26% of the EU27 total in 2009 (fluctuating between 1.26-1.31% in 2004-2009). As for economic development, measured by GDP per capita (in PPS), the country ranked 21-22 in the EU27 in 2009 (with Estonia), with 62.7% of the EU27 average.

The Hungarian GERD (€1,067.2m) was 0.45% of the EU27 total in 2009. (Eurostat data, and author's calculation) The share of FTE researchers in total employment increased from 0.39% in 2004 to 0.53% in 2009, while the share of all FTE R&D employees from 0.59% to 0.79% in the same period. The GERD/GDP ratio was stagnating around 0.9-1% in 2001-2008, and increased to 1.15% in 2009 (KSH), that is, well below the EU27 average (2.01% in 2008) and the Lisbon target (3%).

Main actors in STI policy governance

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. These frequent changes in governance structures prevent organisational learning of policy design and implementation bodies, and this lack of stability also hampers their efficient functioning. Moreover, these frequent changes put a significant administrative burden on research performers. (ÁSz, 2008a, 2008b; Ernst & Young and GKI, 2010b; OECD, 2008)

Just to illustrate, two fundamental changes have occurred since May 2008, when a major government reshuffle took place, affecting the STI policy-making structures, too. A new position was created at that time: 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. The prime minister, however, resigned in April 2009, and these organisational changes had not been implemented, except for one: the highest-level co-ordination body in the field of STI policy – called Science and Technology Policy Council (TTPK), headed by the prime minister – was abolished. The second fundamental change occurred in April 2009, when a new government was formed (supported by the same political party as in the case of the previous government), and the position of the minister without portfolio, responsible for co-ordinating R&D, technological innovation and science policies was dissolved.

Following the general elections held in April 2010, a new government took office on 29 May 2010, and thus further changes are still expected until all the major STI policy bodies are reorganised. The current situation (as of December 2010) can be summarised as follows.[1] The Education, Science, and Research Committee, together with the Economic and Informatics Committee of the Parliament are the highest-level political bodies in the field of STI policy.

A new high-level STI policy co-ordination body had been created by a government decree in September 2009, called Research and Science Policy Council (to replace the dissolved Science and Technology Policy Council), with somewhat revised responsibilities. It had held its first and only meeting on 17 February 2010, chaired by the prime minister. It was disbanded on 15 December 2010 by a government decree stipulating the creation of the National Research, Innovation, and Science Policy

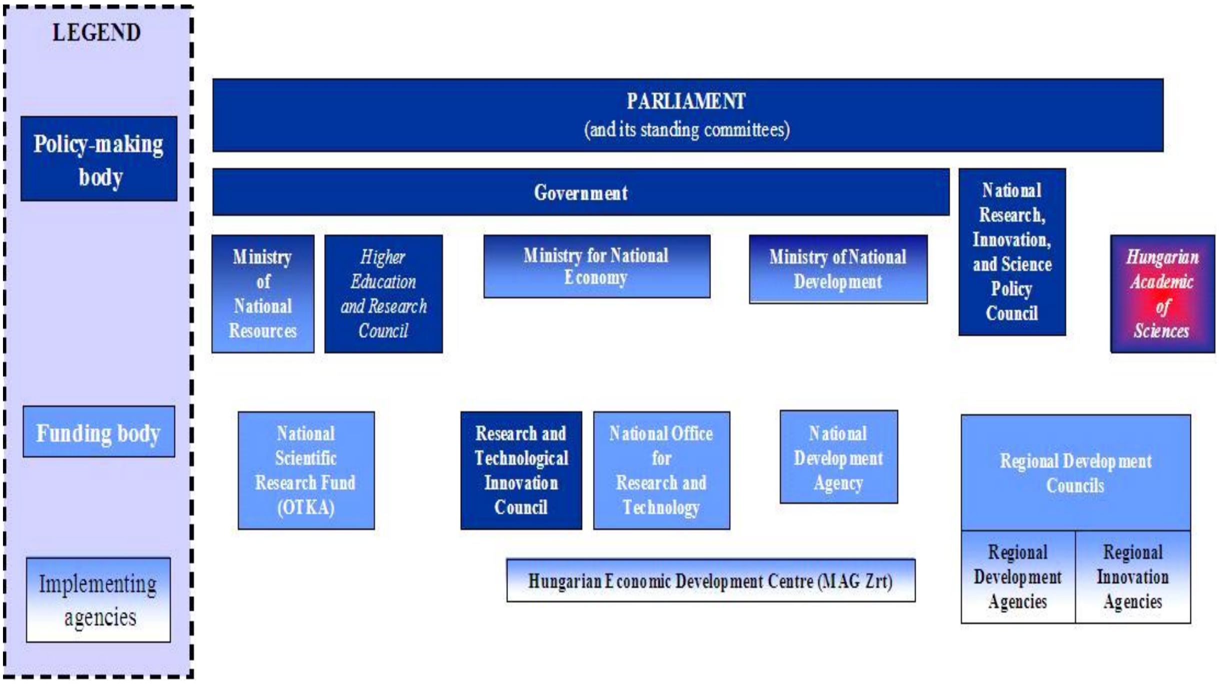
[1] The description of the STI policy governance system is regularly updated at http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/hu/country.

Council. It is chaired by the deputy prime minister, co-chaired by the president of the Hungarian Academy of Sciences, and composed of three ministers (see below).

The ministries with responsibilities for various domains and tasks of STI policies are the Ministry for National Economy (its minister also supervises the National Office for Research and Technology [NKTH]), the Ministry of National Development (its minister oversees the Research and Technological Innovation Fund [KTIA], the main national source for funding R&D and innovation policy schemes, as well as the National Development Agency, managing the measures co-financed by the EU Structural Funds), and the Ministry of National Resources (supervising all levels of education, including higher education, and co-ordinating science policy).

The Research and Technological Innovation Council (KuTIT) provides strategic guidance to the National Office for Research and Technology (NKTH). It 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.

Figure 1: Overview of the Hungarian STI policy governance structure (as of December 2010)



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.

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 also to new STI policy schemes.[2]

[2] The NKTH was established in 2004, and its president is supposed to have a fixed, 6-year term. Yet, the first president left his office after 3 years, and since then two other persons shared this fate. Since 12 August 2010 it is managed by an acting president.

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

The role of regions in STI policy governance

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[3] and the Regional Operational Programmes.

Main research performers

The business sector has long been the largest research performer: it accounted for 57.2% of the Hungarian GERD in 2009 (up from 40.1% in 2001).[4] It also became the largest employer of researchers in 2006, and its share in full-time-equivalent (FTE) scientists and engineers reached 44.7% in 2009. Large, foreign owned firms, operating in a few sectors, account for the bulk of BERD (66.6%, 59.2%, and 58.2% in 2007, 2008, and 2009, respectively).

The government sector's share in performing R&D is significant: 20.1% of GERD, while its weight in employment is even larger: 24.6% of total FTE researchers. 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 in the higher education sector, but the average size of these units is rather small (4.4 FTE researchers). HERD as a percentage of GERD was 20.9% in 2009.

Private non-profit research institutes perform a tiny part of GERD (and thus not regarded as a separate "research performing sector" in Hungarian statistics).

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section assesses the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. The main assessment criteria are the

[3] It is stipulated that 25% of the Research and Technological Innovation Fund should be used to finance schemes fostering regional RTDI activities.
[4] All data are from KSH, and refer to 2009 in this sub-section, unless otherwise indicated.

degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

This section briefly describes public research funding and the various funding modes and mechanisms prevalent in Hungary.

Progress towards R&D investment targets

The Government's mid-term STI policy strategy (2007-2013) stipulates that GERD should increase to 1.8% of the GDP by 2013 (up from 1.0% in 2006), while BERD should reach 0.9% of the GDP (from 0.45% in 2006). These goals seem to be overly optimistic: independent analysts had expressed serious doubts concerning the feasibility of these targets even before the global financial crisis. (OECD, 2008) Data have confirmed these doubts: the Hungarian GERD/GDP ratio remained at 1% in 2007-2008, and only grew in 2009, reaching 1.15%. (KSH) This increase is a combined effect of two factors: (i) given the global financial and economic crisis, the Hungarian GDP shrank by 6.7% (preliminary data, KSH), while (ii) GERD continued to rise in nominal terms (by 12.3% at current prices, in HUF). In spite of this, the Hungarian GERD/GDP trails the EU27 average (2.01% in 2009).

Provisions for R&D activities

The above, multi-annual strategy document defines six priorities:

- "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 strategy document itself does not present SWOT analyses either at national or regional level. As already mentioned, major policy-making bodies have been frequently reorganised and several changes occurred in key positions in a short period, and thus no strategy document could possibly provide a predictable policy framework.

Public funding for research is allocated via the Research and Technological Innovation Fund; the Operational Programmes of the New Hungary Development Plan (these two funds provide support for innovation activities, too, besides R&D); the Hungarian Scientific Research Fund (OTKA); and other, minor schemes (financed by international sources).

The Research and Technological Innovation Fund is the main source of nationally financed STI policy schemes. As a basic rule, its two major sources are the so-called innovation levy paid by medium-sized and large firms, and the matching contribution from the central budget (that is, the share of these two sources should be 50-50). This rule was not followed in 2010, however: the Act on the budget stipulated that ~€74m (HUF20b) could be the maximum contribution from public sources.[5]

The vast majority of these funds are distributed on a *competitive* basis, but HEIs and PROs receive *institutional funding*, too. As for HEIs, however, there are no publicly available data to establish how much of the total HERD[6] is financed in this way. Further, the use of normative support for research at universities is not monitored closely, i.e. education activities or general costs, such as heating and lighting, might also be financed by these sources. Besides normative public support for research, HEIs also apply for grants offered by national or foreign funding organisations.

As for the Hungarian Academy of Sciences (MTA), in the 2010 Budget Law it was allocated some €135.4m (HUF36.6b), that is, 2% less in nominal terms than in 2009. The amount provided by the central budget is complemented by the MTA's (and its institutes') own revenues, the volume of which is planned to be ~€43.8m (HUF11.8b) in 2010. Data on public support for other PROs are not publicly available, but that amount is negligible compared to the support received by the MTA.

Competitive (especially "bottom-up") funding for basic research is small. Several studies, however, have argued that a noteworthy share of competitive grants intended for application-oriented research – obtained by PROs and universities – is in essence financing basic research. (Arnold *et al*., 2007; OECD, 2008)

No comprehensive analysis is publicly available to establish if an adequate balance between institutional and project-based funding of research is provided.

The Operational Programmes (OPs) of the New Hungary Development Plan are a key source for financing RTDI in the period 2007-13. The budget of the most important Economic Development Operational Programme (EDOP), Priority 1, "R&D and innovation for competitiveness", is €990m.[7] To compare, its yearly allocations (on average) roughly correspond to the funds available from the Research and Technological Innovation Fund. Within the RTDI priority of the EDOP, primarily aimed at boosting market-oriented RTDI activities of firms, the following objectives have been set:

- promoting the demand for R&D results;
- developing R&D supply by providing the necessary human resources and infrastructure;
- increasing the effectiveness of the research and innovation market (p. 51) by developing a network of bridging organisations, technology parks and incubators as well as technology transfer offices;
- achieving a more effective utilisation of research results through enhanced co-operation between different domestic and foreign actors;
- improving the access to financial resources.

The Social Infrastructure OP (SIOP) also contains measures relevant for research, e.g. for upgrading research infrastructure at higher education institutes (HEIs).

[5] Moreover, HUF16b (~€58.2m) was "blocked" from the 2010 budget of the Research and Technological Innovation Fund by the government in June 2010, see below in this section.
[6] The total HERD was €223.4m in 2009, of which public funding amounted to €164.7m. (Eurostat)
[7] Figures on OPs include 15% national contributions.

Though the EDOP also supports research infrastructures, the focus of that OP are projects carried out by firms, whereas the SIOP is dedicated exclusively to HEIs. In total, €310m is earmarked for these purposes in 2007-2013.

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, thus supporting the enhancement of institutional co-operation with businesses". This amounts to €507m in 2007-2013, mainly with the objective of establishing "the HR and organisational conditions necessary for the enlargement of higher education's Research & Development capacities in the interest of institutional co-operation with businesses." (p. 144)

Firms conducting R&D activities receive *tax incentives*, too. Indirect government support through R&D tax incentives amounted to 0.08% of GDP in 2007, while direct government funding of BERD was 0.05% of GDP. (OECD, 2010b, p. 77) More recent data in this format are not available, but it should be mentioned that the share of public funding in BERD increased significantly: from 9.6% in 2007 to 15.5% 2009. BERD has also grown since 2007 (Table 1 in Section 2.2.2), and hence the amount of R&D tax incentives must have risen, too.

Given the general elections in April 2010, followed by local elections in October 2010, STI policies received hardly any attention from politicians throughout the year, and thus no STI policy changes occurred. It is in line with the fact that not much weight is given to R&D and innovation in the 84-page government programme, approved in May 2010, either: a mere 8 lines are devoted to these issues. (Government, 2010) A new technology and innovation policy document, underpinning the policy measures to be launched in 2011, would be finalised in January 2011.

The new government, however, suspended all disbursements from the Research and Technological Innovation Fund in June 2010;[8] and new project proposals cannot be submitted, either.[9] Different types of reasoning can be gathered for this decision: (i) to check if previous funding decisions had been lawful; and (ii) to cut government spending. The government decree stipulates that HUF16b (~€58.2m) should be "blocked", that is, 36.6% of the 2010 budget of the Research and Technological Innovation Fund.[10] (1132/2010. (VI. 18.) Korm. határozata)

There is no explicit long-term strategy to build mutual trust between science and society.

The so-called grand societal challenges had not been identified prior to the planning of the current main STI policy schemes, and thus it cannot be assessed if resource allocations reflect these challenges. However, enhancing competitiveness is a major rationale of EDOP schemes, and that of most schemes supported by the Research and Technological Innovation Fund (KTIA). Besides, several KTIA schemes, as well

[8] See at http://www.nih.gov.hu/aktualis-hirek-esemenyek/2010/innovacios-alapbol; only visible at the Hungarian version of the NKTH website. Since then the NKTH has received a special permission to fulfil some of its obligations vis-à-vis some of the on-going projects, that is, it could be only a partial compliance with its contractual obligations.

[9] http://www.nkth.gov.hu/english/news-events-meetings/announcement

[10] Stakeholders – the Hungarian Association for Innovation and the Hungarian Biotechnology Association, among others – have heavily criticised this decision, see, e.g. http://index.hu/tudomany/2010/07/02/zavart_keltett_az_innovacios_alap_befagyasztasa/; http://www.vg.hu/gazdasag/gazdasagpolitika/mostohagyerek-marad-a-kf-319728.

as the ones supported by the Social Infrastructure OP and the Social Renewal OP address various societal challenges.

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

This section gives an overview of the policies aimed at increasing private R&D investment.

Evolution of BERD

The Hungarian BERD has increased significantly since 2004 at current prices (by 105.9% by 2009), at 2000 prices, expressed in PPS (by 85.6%), as a percentage of GERD (by 39.2%) and GDP (by 83.3%). It grew even in 2009, in spite of the global financial and economic crisis, which hit Hungary rather hard.[11] Yet, the share of Hungarian BERD in GERD was 11.3 percentage points below the EU27 average in 2008, while the BERD/GDP ratio was 44% of the EU27 average. (Table 1)

There are several schemes to encourage business R&D expenditures, and BERD has increased, indeed, since 2004. (Table 1) Of course, several other factors are also likely to contribute to this growth, especially firms' strategies. In any case, the share of public funding in BERD increased significantly in the last few years: from 4.2% in 2004 to 8.6% in 2008; and thus exceeded the EU27 average (7.3% in 2008). The role of public resources in financing BERD further increased in 2009, and reached 15.5%. This is most likely due to the schemes co-financed by the EU SF, but data on the actual sources of public funding for R&D activities are not available.

Table 1: Evolution of BERD: Hungary compared to EU27, 2004-2009 (current prices)

	2004	2005	2006	2007	2008	2009
BERD (HUF m)	74,641	89,703	114,872	123,669	140,042	171,225
BERD (€ m)	296.6	361.6	434.7	492.0	556.8	610.8
BERD/GERD (%)	41.1	43.2	48.3	50.3	52.6	57.2
EU27 BERD/GERD (%)	63.6	63.1	63.7	64.1	63.2	62.1
BERD/GDP (%)	0.36	0.41	0.48	0.49	0.53	0.66
EU27 BERD/GDP (%)	1.16	1.15	1.17	1.18	1.21	1.25

Source: Eurostat data, and author's calculation

Policies towards increased private R&D investment

This sub-section follows the approach developed by the Policy Mix Project, which has 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 co-operation with the public sector or other firms;
6. increasing R&D in the public sector.

[11] As already mentioned, the Hungarian GDP dropped by almost 7% in 2009.

These routes cover the major possible 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 Hungarian STI policy measures do not differentiate between firms that do not yet perform RTDI activities and those that do, it is not possible to estimate the relative importance of these routes in Hungary. 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 directly promoted firms' RTDI activities in 2009. 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 several Operational Programmes (OP).[12]

In sum, policy measures are not planned following this logic, and thus the weight of the various routes cannot be established, either. As for the overall policy mix towards increased private R&D investment, professional associations, business interest organisations, as well as the State Audit Office have claimed that the number of STI policy schemes is too high, because these schemes are not well-targeted and clearly differentiated. Given the large number of these schemes, firms have to shoulder a significant administrative burden when searching for support and devising project proposals, and hence access to these schemes is not easy. A large number of SMEs, in particular, cannot afford to devote the required amount of time to identify the relevant schemes and develop applications. Further, the activities of implementation agencies also become unnecessarily complicated, and decision-making processes are too long, cumbersome, and insufficiently transparent. The reports by committees appraising project proposals are not always made available for the applicants.[13,14] As the Hungarian Association for Innovation has pointed out several occasions, even after a funding decision has been made, it takes unduly long time before the contracts are signed (let alone disbursements), not least because new project documents are demanded even at this stage of the procedure.

Only four nationally funded STI policy schemes have been evaluated since 2006,[15] while schemes co-funded by the EU Structural Funds must be evaluated, following the EU rules (ex-ante, mid-term and ex-post evaluations).

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[12] For further details, see the 2009 ERAWATCH Country Report.

[13] The evaluation report on the operation of the KTIA in 2004-2009 summarised the relevant findings as follows: "Owing to a lack of stability and to frequent organisational changes, the timing of managing the grants and the projects (e.g. contract preparations, reimbursement of costs) was highly hectic and this has had a damaging effect on the quality of technical performance.
We have observed weaknesses in the process of evaluating the proposals (e.g. there were incomplete procedure manuals, sketchy documentation, not sufficient information contained in the letters explaining rejection of proposals etc.). In addition, in some cases and referring to the first half of the period evaluated, some interviewees reported professional and ethical types of conflicts of interest and other not purely professional considerations (about external impacts beyond the operation and regulation of the Fund) experienced in the decision making process (an in-depth case-by-case assessment was beyond the scope of our review.)" (Ernst & Young and GKI, 2010a, pp. 4-5)

[14] The NKTH claims, however, that the full appraisal reports (anonymously) are made available to applicants on request. (NKTH, 2006, p. 17)

[15] The evaluation report on the operation of the KTIA in 2004-2009 also noted these weaknesses: "Until the end of the reviewed period, NKTH performed rather poor monitoring. As a result, the Fund's programmes and projects could not provide the feedback important for programme planning or

Innovation-oriented procurement policies are not part of the Hungarian STI policy mix.

Besides STI policies *per se*, several *other policies affect private R&D investment* via influencing its framework conditions. *Macroeconomic policies* have failed to create a stable, predictable environment for businesses. Economic growth has been volatile at least since the mid-1990, due to the stop-go type policies to a large extent. Inflation has constantly been above the target. Government behaviour has also been unpredictable (e.g. the tax code has been rewritten frequently). Both the general government deficit and the general government debt (as a percentage of GDP) have been rather high, i.e. the economy has suffered from twin deficit, as well as a high level of government borrowing. Businesses, in turn, felt the crowding out effect of the mounting fiscal deficit. In sum, the macroeconomic environment has been unfavourable for RTDI activities of firms.

Administrative costs incurred by businesses are high by international standards, and that is especially unfavourable for SMEs. The tax system is also putting significantly higher administrative burden on companies, and the total tax rate is significantly higher than the OECD average.[16]

Survey results suggest that *the share of genuine entrepreneurial businesses* is rather small in Hungary. The most important motivation to set up a business is “no possibility for being employed”,[17] (MVKA, 2004) while among the motives for opting for a self-employed status „a business opportunity” is ranked only fourth. (EC, 2004)

After decades of a highly skewed size distribution of companies, dominated by large firms in the centrally planned economy era, the share of SMEs in the Hungarian economy has become fairly similar to that in the European Economic Area (EEA) already by the early 2000s (52.6% vs. 51%, respectively; 2003), while the share of medium-sized enterprises is higher (18.3% vs. 15.7%). The weight of small firms might suggest a high degree of entrepreneurship. Yet, the share of innovative Hungarian SMEs – especially that of small firms – is rather low in international comparison, and way below the share of innovative large Hungarian businesses. (CIS data)

As for *competition legislation and oversight*, Hungary has caught up with typical OECD practice, thanks to the entry to the European Union to a large extent. (OECD, 2007a) The government has not sheltered industry through standard protectionist measures. The Competition Office applies harsh penalties when cartel practices are noticed and can be proved. Regulation itself, however, does seem to be sufficient to create strong enough competitive pressures, which, in turn, would foster competition. Respondents to Hungarian CIS surveys indicated that financial constraints are the

evaluating the proposals. The Fund does not use indicators to monitor the progress of its mid-term strategy, programmes or projects or to monitor direct and indirect impacts.
In the reviewed period, NKTH commissioned independent experts only occasionally with the task of evaluating the Fund’s operation, and no such evaluation was directed towards the Fund’s operations or the programmes as a whole. Thus, NKTH could not experience the benefits of constructive feedback. The majority of these evaluation reports were not disclosed to public.
The current management of NKTH (in office since September 2008) also perceived the above weaknesses and efforts have been made to improve the most important areas.” (Ernst & Young and GKI, 2010a, p. 5)

[16] For details, see http://www.doingbusiness.org/economyrankings

[17] It is usually referred to as “forced entrepreneurship”.

most severe barriers to innovation, but market-related factors have also been selected by a large proportion of enterprises as highly important hampering factors.

Table 2: Factors hampering innovation activities, 2002-2004; 2004-2006* (%)

	2002-2004		2004-2006	
	Innov.	Non-innov.	Innov.	Non-innov.
	enterprises		enterprises	
Lack of funds within your enterprise or enterprise group	*27.5*	*21.0*	*28.8*	*25.5*
Lack of finance from sources outside your enterprise	*19.6*	*12.2*	*19.9*	*17.0*
Innovation costs too high	*26.3*	*23.9*	*27.3*	*28.2*
Lack of qualified personnel	7.5	6.5	14.0	8.9
Lack of information on technology	1.8	2.6	3.6	4.9
Lack of information on markets	3.5	3.7	3.8	5.6
Difficulty in finding co-operation partners for innovation	4.8	7.8	6.6	8.8
Markets dominated by established enterprises	*14.7*	*16.6*	*15.4*	*17.6*
Uncertain demand for innovative goods or services	*15.0*	*18.0*	*14.0*	*20.4*
No need to innovate due to prior innovations	1.5	4.3	2.3	6.4
No need to innovate because no demand for innovations	2.7	6.1	4.0	10.5

Source: Eurostat; * percentage of firms selecting a given factor as a highly important one
Notes: Innovative enterprises are understood as firms active in technological innovations. More recent data are not available as these questions were not included in the Community Innovation Survey covering the 2006-2008 period.

The Hungarian *IPR legislation* is in accordance with the EU legislation and international treaties. The respective industrial property acts are suitable to comply with the requirements of a market economy and offer an adequate protection for the innovators.

In sum, the macroeconomic situation, the structure of the economy, the overall entrepreneurship culture together with the intensity and type of competition might influence firms' innovation activities with such a power that STI policy schemes cannot offer strong enough incentives to overrule their unfavourable effects.

2.2.3 Providing qualified human resources

The share of human resources in science and technology (HRST) in the economically active population in the age group of 25-64 increased from 31.7% in 2007 to 33.2% in 2009, but remained still below the EU27 average (40.1% in 2009). The share of scientists and engineers in total employment was 4.7% in 2009, compared to 5.8% as the EU27 average. (Eurostat)

Given the nature of individual decisions whether to pursue a research career, long-term trends need to be considered to identify the major factors. Changes in the size of this segment of the job market had not been favourable for a rather long period. 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), it first reached the 1990 level in 2006 (17,547), and then exceeded that level in 2009 (20,064). (KSH)

As already mentioned in Section 2.1.3 *the business sector* became the largest employer of researchers in 2006 with 6,248 full-time-equivalent (FTE) scientists and engineers, and continued to expand every single years since then, reaching 8,972 in 2009. Its share in total FTE scientists and engineers stood at 44.7% in 2009.

The *higher education* sector has employed the second largest number of FTE scientists and engineers since 2006, growing modestly to 6,164 by 2009 (that is, 30.7% of total FTE scientists and engineers).

The *government sector* employed 5,226 FTE scientists and engineers in 2006, decreasing to 4,928 in 2009, with a corresponding share of 24.6% in total FTE scientists and engineers.

As most Hungarian universities are public, the largest employer of scientists and engineers is still the public sector (higher education and government sectors combined).

To pursue a research career is less attractive for young talents than becoming a professional (medical doctor, lawyer, manager in large public or private organisations, etc.), which can be achieved in many cases without a PhD degree, i.e. better paid jobs can be taken up even earlier, and thus life-time earnings would be definitely higher. Further, general working conditions for a researcher, e.g. access to funding, journals, books, and modern equipment – especially in the public sector – are not satisfactory, either.

The impacts of these unfavourable factors are reflected in several indicators. First, the ratio of tertiary education graduates (ISCED levels 5-6) among people aged between 20 and 29 years was 4.67% in 2008 in Hungary (fluctuating between 4.5-5.0% since 2005), below the EU27 average (6.55%). Second, this ratio for science and engineering (S&E) graduates was a mere 0.63%, while 1.43% for the EU27, i.e. the gap in this respect is much wider. Third, the same ratio for those who earned a PhD degree in the reference year (ISCED level 6) was just above the half of the EU27 average (0.08% vs. 0.15% in 2007), while an even larger difference can be observed for S&E PhD degree holders (0.02% vs. 0.06%). (Eurostat) Finally, brain-drain is still an important threat: the highly qualified, young workers, especially those with S&E degrees are overrepresented within the group of Hungarians working abroad. (Csanádi *et al.*, 2008)

The low share of S&E graduates is often mentioned in policy discussions as a major challenge. What also need to be considered is that a 'desirable' ratio of S&E students cannot be achieved in the short-run: it is not a question of mechanically – and forcefully – increasing the number of enrolled students at the relevant faculties.[18] First, as a basic precondition, S&E education has to build on high-quality primary and secondary education. Second, more attractive job prospects are needed to lure young talents towards S&E careers. Government policies alone can create these prospects in the public research sector only. When economic development, education, employment and STI policies are pooled together, devised and implemented in an orchestrated and effective way, they can also induce businesses to create this type of jobs, but the actual decisions and investment should be made by businesses. Thus, a much wider policy perspective is needed, as well as concerted public and private efforts, sustained for a longer time-horizon, to deal with this complex challenge.

[18] The number of S&E students (all levels) has slightly increased in recent years, from 76,217 in 2005 to 80,400 in 2009, while that of S&E graduates from 7,227 to 10,018 in the same period. (KSH)

Another challenge is that a mere 3.1% of the population aged 24-65 years participated in life-long learning[19] in 2007, i.e. less than one-third of the EU average (9.6%). (EIS, 2009)

Entrepreneurship and innovation management courses are widely available from private training companies, and also included in the curricula of some universities.

Finally, heated debates started again in 2010 if education curricula put too much emphasis on creativity, critical thinking, problem solving, teamwork, and communication skills at the expense of learning facts and memorisers, or on the contrary, more time and efforts should be devoted to develop these skills.

2.3 Knowledge demand

This section focuses on knowledge demand drivers. A major driver of knowledge demand is the economic structure itself. The services sector has become the predominant one in many economies, and that is the case for Hungary, too. Agriculture, hunting, forestry, and fishing accounted for 4.2% of the Hungarian GDP in 2008, manufacturing for 21.7%, energy supply for 3.0%, construction for 4.4%, while services for 66.5%. (KSH, 2010) As for services, the most important sectors were trade and repair (11.9%), transport, storage and communications (7.9%), financial intermediation (4.1%), real estate and business services (18.7%), while public administration, education, and health accounted for 17.9%.

Until recently, however, data collection and analyses on RTDI processes have been concerned mainly with manufacturing industries in most countries, including Hungary. Further, manufacturing industry has been the most important recipient of foreign direct investment (FDI) with 35.4% of the total FDI in 2008, followed by real estate and business services (22.4%), trade and repair (13.5%), and financial intermediation (12.4%). The importance of FDI in manufacturing is also reflected by the fact that 62.4% of manufacturing value added was produced by firms with at least 10% foreign ownership. From a different angle, manufacturing accounted for 52.0% of the value added produced by firms with at least 10% foreign ownership. (KSH, author's calculation) Hence, this sub-section is focussing on manufacturing.

The most important subsections of manufacturing (using NACE Rev. 1.1) are described in Table 3, indicating their share in manufacturing value added, as well as their "foreign intensity", that is, the weight of firms with at least 10% foreign-ownership in producing sectoral value added. In brief, six subsections account for almost three quarters of manufacturing value added, and firms with foreign interest have a substantial weight in these segments of manufacturing.

[19] Life-long learning is defined as participation in any type of education or training course during the four weeks prior to the survey. Hence, it is a somewhat 'fortuitous' or 'haphazard' indicator, results may vary depending on the timing of the survey.

Table 3: Major subsections of Hungarian manufacturing industry, 2008

	A	B
Manufacture of electrical and optical equipment (DL)	20.1%	76.6%
Manufacture of transport equipment (DM)	15.1%	86.8%
Manufacture of basic metals and fabricated metal products (DJ)	10.5%	50.9%
Manufacture of food products, beverages and tobacco (DA)	9.7%	48.1%
Manufacture of chemicals, chemical products and man-made fibres (DG)	8.9%	28.5%
Manufacture of machinery and equipment n.e.c. (DK)	7.6%	41.7%

Source: author's calculation based on KSH data

A: share in manufacturing value added; B: "foreign intensity", that is, the weight of firms with at least 10% foreign-ownership in producing value added in a given subsection

Several sectors belonging to these manufacturing subsections – e.g. manufacture of office machinery and computers; manufacture of lighting equipment and electric lamps; manufacture of electronic valves and tubes and other electronic components; manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy; manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods; manufacture of motor vehicles, trailers and semi-trailers; manufacture of machine tools; manufacture of pesticides and other agro-chemical products; manufacture of pharmaceuticals, medicinal chemicals and botanical products – are classified by the OECD as high-tech or medium-high-tech industries. That sectoral structure of the economy and FDI would suggest a strong demand for R&D-based knowledge.

But exactly the dominant role of FDI in these sectors makes it possible to turn to parent companies or their partners based outside Hungary for knowledge. Foreign trade statistics on R&D services capture only a part of this type of knowledge transfer,[20] but available data clearly show the significance of knowledge inflow. The overall value of imported R&D services stood at 83% of BERD in 2009, and two sectors accounted for a lion's share of these imports (automotive industry: 59.0%, pharmaceuticals: 8.4%). (author's calculation based on KSH data)

Foreign-owned firms do spend on R&D in Hungary, too, moreover, as already stressed, they account for the bulk of BERD (66.6%, 59.2%, and 58.2% in 2007-2009, respectively).[21] However, the overall amount of BERD, that is, €610.8m, is rather small when compared to the R&D budget of large firms. Alstom spent slightly more on R&D (€613.0m) in 2009, and thus Hungary would rank 44 on the list of top R&D spending EU firms.[22] (IRIS, 2010)

[20] These figures obviously cover only reported activities, and obviously exclude knowledge transfer when the price of R&D services is included in the price of imported components.

[21] Foreign firms, besides conducting intra-mural R&D activities, also co-operate with Hungarian universities. Inzelt [2010] show that they have a significant impact on the internationalisation of research, e.g. there are more joint publications involving foreign than domestic companies, and the citation value per publication is significantly higher with the former.

[22] At least sixteen of the top 50 R&D spending EU firms have operations in Hungary, including: Volkswagen (ranked 1), Nokia (2), Sanofi-Aventis (3), Siemens (4), GlaxoSmithKline (6), Robert Bosch (7), AstraZeneca (8), Ericsson (13), Finmeccanica (16), Philips Electronics (17), SAP (21), Continental (24), Merck (25), Unilever (28), ZF (45), Solvay (46). Their combined R&D budget would be EUR41.9b, and almost all of them R&D operations, too in Hungary. Yet, almost any of them would dwarf the total Hungarian BERD as they only spend a tiny bit of their R&D investment in Hungary.

Furthermore, several of the sectors classified as high-tech or medium-high-tech ones, only spend tiny amounts on R&D in Hungary. (Table 4)

Table 4: Business enterprise R&D expenditure (BERD) by economic activity, selected sectors, 2002-2007 (million €, current prices)

	2002	2003	2004	2005	2006	2007
Total	250.4	254.6	296.6	361.6	434.7	492.0
of which						
Manufacturing	186.5	196.0	238.6	285.8	331.7	360.5
of which						
Mf of food products, beverages and tobacco	4.0	4.9	3.6	4.4	6.4	7.3
Mf of pharmaceuticals, medicinal chemicals and botanical products	94.1	87.1	115.9	161.3	192.4	166.3
Mf of machinery and equipment n.e.c.	7.5	8.2	13.4	13.2	15.7	31.4
Mf of office machinery and computers	1.1	1.0	0.4	0.6	2.0	0.7
Mf of electrical machinery and apparatus n.e.c.	13.6	22.4	32.4	22.5	19.1	16.4
Mf of radio, television and communication equipment and apparatus	25.8	25.1	24.8	30.5	30.9	41.7
Mf of medical, precision and optical instruments, watches and clocks	4.4	4.9	4.5	8.0	8.1	11.6
Mf of motor vehicles, trailers and semi-trailers	11.1	21.8	22.7	21.6	25.9	49.9
Services	56.2	51.0	52.1	68.3	93.1	119.4
of which						
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	27.8	27.2	27.8	39.2	49.3	61.2
Computer and related activities	8.7	5.7	6.7	7.1	14.8	17.5
Software consultancy and supply	6.3	4.1	5.3	5.3	12.3	15.1
Research and development	3.1	1.5	2.0	2.8	5.7	5.8
Other business activities	8.6	9.9	8.5	9.7	11.1	21.5
Architectural and engineering activities and related technical consultancy; technical testing and analysis	7.6	8.8	7.1	8.4	8.9	14.6

Source: Eurostat, following NACE_R1

These trends continued more recently, too (although sectors have been somewhat re-classified in NACE Rev.2): R&D expenditures in manufacturing of computers and peripheral components amounted to €0.4m in 2009, and €34.5m in manufacturing of communication equipment.

In sum, demand for either R&D or other types of knowledge is fairly moderate in Hungary, given the low level of knowledge-intensive activities. In other words, most Hungarian manufacturing firms perform relatively simple assembly activities, and the products of these activities are exported inside big multinational automotive and electronics groups or global production networks. From a different angle, the OECD classification of sectors by their R&D intensity can be rather misleading from a policy point of view, given the significant deviation between the weight of 'high-tech' sectors in the economic structure and their actual knowledge-intensity.[23]

The total government budget appropriations or outlays on R&D (GBAORD) increased from €390.7m in 2007 to €453.5m in 2008, and then contracted to €429.5m in 2009. Its allocation to socio-economic objectives has only changed slightly, e.g. industrial production and technology has gained importance. General advancement of knowledge had the highest weight throughout 2007-2009, but reduced from 57.2% in 2007 to 53.7% in 2009. The high share of this objective is most likely due to the fact that the majority of the Hungarian STI policy schemes are meant to advance broad objectives (e.g. enhancing competitiveness), as opposed narrowly defined themes.

2.4 Knowledge production

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section focuses on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

2.4.1 Quality and excellence of knowledge production

Total funds for R&D (GERD) has significantly increased since 2004 up to 2008, and practically stagnated in 2009. A closer look at the composition of GERD reveals major differences across the three research performing sectors. Funds have hardly changed in the government sector since 2004 (€213.1m in 2004, €214.0m in 2009 with some fluctuation in between), increased by 25 % in the higher education sector (from €177.3m in 2004 to €223.4 m in 2009), and doubled in the business sector (from €296.6m in 2004 to €610.8 m in 2009). (Table 5)

Table 5: GERD by sectors of performance, 2004-2009 (m €, current prices)

	2004	2005	2006	2007	2008	2009
All sectors	721.3	837.6	900.5	977.5	1059.2	1067.2
Business enterprise sector	296.6	361.6	434.7	492.0	556.8	610.8
Government sector	213.1	234.5	228.5	236.1	247.8	214.0
Higher education sector	177.3	210.6	219.3	228.2	233.4	223.4

Source: Eurostat

The Hungarian research infrastructure (RI) landscape can be characterised as dispersed. Only a small fraction of the Hungarian RIs can be regarded as large RIs, mainly in physics. Given the size and level of economic development of the country,

[23] The Hungarian case is not an 'exotic' exception, on the contrary, these features characterise many other countries. (Srholec, 2006) The Hungarian data simply confirm a more general observation: to analyse a link between economic structures and the level of demand for knowledge one should take into account the actual activities performed, and especially the knowledge content of these activities. This more demanding task cannot be spared by simply applying the OECD classification of sectors. Firms belonging to the same statistical sector might possess quite different capabilities. Further, they are unlikely to produce identical goods, e.g. in terms of skills and investment requirement, quality, market and profit opportunities. Finally, they perform different activities, especially in terms of their knowledge-intensity. These dissimilarities are likely to be even more pronounced when we analyse sectors, firms, products and activities across different national systems of innovation and production. In brief, one should make a clear distinction between high-tech sectors and knowledge-intensive activities. (Havas, 2006)

not much funding is available to invest in expensive RIs. Capital investments in instruments and equipment dropped from 13.6% of GERD in 2000 to 9.5% in 2007. (author's calculation based on Eurostat data; see also Section 3.2.1)

The inflow of human resources for research is below the EU27 (expressed as the ratio of graduates in the age group of 20-29 years old), as already mentioned in Section 2.2.3.

Hungarian researchers are fairly productive in terms of scientific output, especially if their low number and the low level of research expenditures (compared to the EU averages) are taken into account. Output per researcher is close to the EU15 average (85%), while funding is much lower: 40% of EU15 R&D spending per researcher and 47% of funding per publications. The quality of publications, as suggested by the citation-related indicators, is also much closer to the EU average than the level of funding. (Havas and Nyiri (eds), 2008)

Schubert (2007), relying on Web of Science data, has analysed the performance of Hungarian researchers by scientific fields, using three indicators: the number of publications (output) in 2001-2005, the impact factors of journals for publications (publication strategy) and the citation rate (impact of publications). First the deviations from the world average have been calculated for the surveyed journals' impact factors, as well as the citation rates of Hungarian publications. Then four categories have been defined: *outstanding* performance (at least 150% of the world average), *fair* (110-150%), *average* (90-110%) and *moderate* (less than 90%).

Hungarian researchers have shown *outstanding* performance in 3 scientific fields in terms of the **number of publications**, namely chemistry, clinical medicine and physics, while no field of science has been labelled as *moderate* in this respect. Only a single field has achieved an *outstanding* performance in terms of **citation rate**, namely space science, whereas none in terms of **impact factor**. As for **citation rate**, 3 fields have shown a *fair* position: physics, engineering, computer science, while 12 fields achieved a *moderate* position. As for **impact factor**, 4 fields have achieved a *fair* performance, namely physics, engineering, materials science, and pharmacology and toxicology, while 9 fields only a *moderate* performance. Combining these two criteria, researchers working in the fields of physics and engineering have reached a *fair* ranking.

Hungarian researchers are far less successful in terms of producing directly exploitable knowledge; in fact, this particular aspect has been often identified as the major weakness of the research system. The number of patents (EPO, USPTO or Triad[24]), community designs and trademarks per million population are a mere 11.9-22.5% of the corresponding EU averages, but these indicators show a modest improvement. (EIS 2009) However, at least two arguments should be recalled here as to why one should interpret these figures with a pinch of salt. First, when assessing the performance of NIS in general, one should bear in mind that a wide array of other means can be – and indeed, are – utilised by firms to protect intellectual property, many of which are not captured by measurable or readily available indicators.[25] Moreover, propensity to patenting is highly varied across sectors, and hence the sectoral distribution of a national economy might heavily influence the intensity of patenting activities. Thus, a low level of patenting activities

[24] A patent is a triad patent if, and only if, it is filed at the European Patent Office (EPO), the Japanese Patent Office (JPO) and is granted by the US Patent & Trademark Office (USPTO).
[25] CIS results compellingly confirm this argument.

does not necessarily indicate that researchers are not capable of producing exploitable knowledge, or a poor innovation performance.[26] Second, concerning specifically a catching up economy and its NIS, at that stage of development it might not be a meaningful (or feasible) target at all to produce as many patentable R&D results as possible. It seems to be more relevant to concentrate on (a) fostering the diffusion of knowledge and all forms of innovation; and (b) enhancing learning capabilities for a more efficient absorption and exploitation of new knowledge, wherever it is produced. These activities, contrary to widely held beliefs, still require fairly developed R&D and innovation skills, in order to identify the most suitable pieces and types of knowledge to be acquired (often imported), and 'assemble' those in an appropriate way, suited to the new context.[27]

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

There have been intentions to apply more thorough scrutiny to large-scale research projects, including both traditional criteria of excellence (mainly at the institutes of the MTA), but more recently also societal relevance and economic viability (e.g. the National Technology Programme). Similarly, in the case of research units located at HEIs, financed by the MTA, proven excellence, international recognition and economic aspects are to be given more emphasis when allocating extra resources to these research groups on a competitive basis. Furthermore, international expertise is planned to be utilised more widely, e.g. as part of the peer-reviews for selecting projects for public RTDI funding, or international competition for the positions of director at the institutes of the MTA.[28]

In recent years, increasing emphasis is placed on aspects of exploitability when allocating public resources for RTDI. In the case of most measures funded by the Research and Technological Innovation Fund or the Operational Programmes, the project selection criteria include economic and/or societal relevance and sustainability. Further, ex-ante indicators should be defined, such as the expected or desired growth of profits or revenues, the number of new products, patents, and the like. As for the National Technology Programme, the applicants are required to justify the socio-economic relevance and economic viability of their proposed projects to an expert committee, as an obligatory part of the selection process.

In sum, the institutes of MTA are evaluated externally, on the basis of their publication and citation performance, and large projects are evaluated by the scientific quality and socio-economic relevance of the proposals, assessed by external evaluators. Decision-makers, however, are not always obliged to follow the assessment made by external evaluators.

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences,

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[26] This, of course, is not to suggest that the Hungarian NIS performs fabulously, in spite of the picture shown in the mirror of patenting activities.

[27] In other words, adoption always requires adaptation, too, and thus it is a gross simplification to speak of 'imported' innovations (assuming that no local RTDI efforts and knowledge are needed by those firms introducing these types of innovations).

[28] Language barriers and low income in international comparison are likely to hamper this latter intention, except for Hungarian nationals leaving in the neighbouring countries.

e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Several STI policy measures have been launched to foster innovation co-operation in Hungary. As discussed in Section 2.2.2 in relation to the specific "policy routes", many schemes supporting 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. The most important policy development in this respect has been the financing of joint university-industry research centres. There are 38 such centres, each located at a university.

The intensity of industry-academia co-operation can be assessed by analysing the funding flows, CIS, and bibliometrics data. These different methods point to somewhat mixed conclusions. It also should be stressed at the outset that besides STI policies, aimed at supporting collaboration, several other factors influence the behaviour of NIS players, including their willingness to co-operate.

Firms fund research activities both at HEIs and PROs to a noteworthy extent. While only 4-5% of the total higher education expenditures on R&D (HERD) had been financed by firms in 2000-2001, this ratio jumped to 11-13% in 2002-2006, and continuously increased since then, reaching 15.7% in 2009, more than double of the EU27 average (6.8% in 2008). This high ratio of business funding might be attributed to the low level of the Hungarian HERD (€210-233m in 2005-2009, Table 6). Thus, a few projects commissioned by firms, with a relatively small budget by international standards, can lead to a relatively high weight of business funding in HERD.

The financial links between firms and PROs show a more varied picture: the share of firms in funding Government Intramural Expenditure on R&D (GOVERD) was 11-13% in 2000-2001, dropped by around 50% in 2002-2004, and then exceeded 10% again in 2005. Its peak was achieved in 2006 (14.3%), followed by a slight decline in 2007-2009 (standing between 12.4% and 13.3%). The share of GOVERD financed by industry is higher than the EU27 average (8.2% in 2008). Again, the low volume of GOVERD (€214-248m in 2005-2009, Table 6) is likely to be an important explanatory factor. The large yearly variations in industry-funded GOVERD hint to a more general hypothesis: incentives provided by various policy tools are just one element of a bigger, more complex system influencing innovation behaviour of the major actors.

The frequency of innovative firms' co-operation with higher education organisations first declined significantly (from 21.6% in 1999-2001 to 14.6% in 2002-2004), and then improved (17.3% in 2004-2006, 18.7% in 2006-2008). As for their co-operation with public labs, it had originally been at a lower level, and became even less frequent (8.6%, 6.4%, 6.5%, and again 6.5%, respectively). (Eurostat, CIS data)

Firms regard other firms as *most valuable co-operation partners* for innovation: 12.7% of them indicated suppliers; 7.5%-7.5% mentioned other firms in their own business group and universities as most valuable partners, while only 0.7% selected PROs.[29]

Different types of firms are also perceived as *the most important information sources* of innovation: other firms in their own business group (selected by 50.3% of innovative firms), clients or customers (38.9%), suppliers (26.3%), other enterprises of the same sector (20.9%), while HEIs are mentioned by 10.2% and PROs by 4.2%. Several other sources of information – besides firms – also regarded as more important than universities or PROs: consultants, commercial labs (15.0%), conferences, trade fairs, exhibitions (12.7%), scientific journals and trade/ technical publications (8.1%).[30] (CIS 2006-2008)

Bibliometric analyses suggest a low intensity of industry-academia co-operation.[31]

The evaluation report on the operation of the Research and Technological Innovation Fund claims that industry-academia collaboration has improved over the period of 2004-2009. (Ernst & Young and GKI, 2010a, 2010b)

2.5.2 Cross-border knowledge circulation

Besides the obvious scientific benefits of international collaboration, the scarcity of domestic funds for RTDI is also a strong 'push' factor for Hungarian researchers to actively seek co-operation opportunities. Hungary has been among the top three Candidate Countries/ new Member States with respect to the number of project participation and the size of funds awarded by the various RTD Framework Programmes of the EU (since FP4). (Havas and Nyiri, 2008) Active Hungarian participation can be observed in other programmes, too, such as EUREKA, COST and bilateral intergovernmental ones. These and other bilateral and multilateral R&D programmes are important vehicles for the Hungarian RTDI community to benefit from, and contribute to, knowledge circulation.

Several measures have facilitated Hungarian participation in EU and international research projects and networks. These schemes are certainly useful, but would not be sufficient on their own: scientific excellence is a precondition to be accepted as a member in an international R&D consortium.

Most Hungarian STI policy schemes are open to foreign researchers, too. As a general rule, foreign researchers can join a consortium submitting a project proposal, but in most cases without being eligible for Hungarian funding. Their participation can

[29] Hungarian HEIs fare well in international comparison: their score (7.5%) is the highest in CIS 2006-2008, followed by 6.9% in Austria. This figure is around 5 % in Germany and Belgium, and stands just at 3% or below in all the other countries participating in CIS 2006-2008. (Havas, 2010)

[30] This is in line with CIS 2006-2008 data for practically all countries. In most countries conferences, trade fairs, exhibitions are ranked first in the group of "non-business" sources, scientific journals and trade/ technical publications are ranked second – in a few exceptional cases ranked first – followed by HEIs and PROs. In contrast, HEIs are ranked second in Hungary. The only other similar case is Finland, but there HEIs are mentioned only by 4.6% of firms as the most important sources of information, compared to 10.2% in Hungary. (Havas, 2010)

[31] A study on 12 Hungarian universities has found that 73% of total publications have been co-publications with other experts outside the university of the lead author. The vast majority of co-authors are either from other universities (57%) or from public research organisations (29%), and only 4% from businesses. There are, however, significant differences across scientific fields. The proportion of business co-authors is the highest at the Semmelweis University (in life and medical sciences) and at the Budapest University of Technology and Economics (mostly in engineering). (Inzelt *et al.*, 2009)

be another major source to profit from access to international knowledge. Yet, it is unusual to have foreign partners in nationally funded projects.

Hungarian researchers also use regularly large, international research facilities, relying on the budget of specific projects, mobility grants, etc. There is no specific scheme dedicated to finance these missions. In several cases, however, membership fees to gain access to these large RIs are paid by the government.

Individual mobility of researchers is also supported by grants offered by several funding organisations or bilateral exchange programmes.

National measures have also supported cross-border co-operation in areas with European value added, especially Health, Food, ICT, as well as Nanosciences, nanotechnologies, materials & new production technologies.

2.5.3 Main societal challenges

Main societal challenges are complex in nature, and hence would require co-operation in addressing these challenges, between various domestic research performers or across borders. This requirement is not reflected yet in the current Hungarian STI policy measures as those had been devised prior to the identification of the so-called grand societal challenges in various EU policy documents.

As mentioned just above, biotech, ICT and nanotech have been prioritised as specific themes for cross-border knowledge circulation. Enhancing competitiveness is a major rationale for both EDOP schemes, and other ones financed by domestic funds. Further societal challenges are addressed e.g. by the Social Infrastructure OP and the Social Renewal OP schemes of the New Hungary Development Plan (the National Strategic Reference Framework of Hungary for 2007-2013).

2.6 Overall assessment

The main overarching policy opportunity, covering several areas, and potentially exerting a significant impact on resource mobilisation is the efficient use of the Structural Funds for RTDI. The available funds constitute a major chunk of public RTDI funding and the range of challenges and bottlenecks to be tackled is rather wide. (section 3.3.1 of the 2009 ERAWATCH Country Report)

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 'status' of STI policies at the highest political level. However, the STI governance structure has been fundamentally reorganised several times since 2000, and major changes occurred in 2008-2009, too. A new government took office after the general elections in 2010, and another reorganisation of the STI policy governance system started in December. Therefore, a potential risk is that the governance structure will not be stabilised in the coming years, either.

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 – and that has happened rather frequently in recent years).

Given the large number of STI policy measures, well-targeted efforts are needed, 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, 2008)

STI policies received hardly any attention from politicians in 2010, given the two elections held in the same year (general elections in April, followed by local elections in October). Hence, no STI policy changes occurred. The new government, however, suspended disbursements from the Research and Technological Innovation Fund in June 2010, and neither new project proposals have been accepted, nor have new schemes been launched since then. As a consequence, several small companies and bridging organisations, for which revenues from government support schemes are crucial sources, already face severe financial difficulties, and major decision-preparatory projects, e.g. the one to underpin the national RI development strategy, have also been put on halt. More generally, this abrupt measure – still effective in December, that is, lasting for already half a year – undermines the shaky relationship between the research community, firms active in RTDI and politicians. Highly effective new measures would be needed to start building trust again, and re-energise the devastated, demoralised researchers. What can be destroyed overnight, might take years to rebuild. Experienced, highly skilled scientists and engineers may leave for other countries where they can continue their research activities. Hampering RTDI activities when those would be crucial to be prepared for a new, post-crisis era is particularly harmful, no doubt.

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 by the Hungarian Academy of Sciences) to repatriate qualified Hungarian researchers, Western European and U.S. researcher positions are far more attractive for them.

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).

Table 6: Summary of main policy-related opportunities and risks

Domain	Main policy 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	• 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 resource mobilisation • 'Isolated' measures aimed at tackling brain drain and attracting foreign researchers may be ineffective • Recent cuts in public RTDI funding might lead to unfavourable consequences in the mid- and long-term, too (bankruptcy of R&D-intensive SMEs, down-sizing or closure of public R&D units, loss of skilled and experienced researchers and support staff to other sectors or other countries, loss of overall confidence in public policies, etc.)
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)
Knowledge production	• Introducing stronger incentives for PROs and HEIs to exploit research results	• Modernisation of the research infrastructure (RI) and improvement of RI polices might be significantly delayed as a national RI development strategy might not be even completed (let alone implemented), given lack of funding
Knowledge circulation	• Improving absorption capacities of domestic SMEs • Benefiting from intense international RTDI co-operation	• Some measures promoting industry-academia co-operation might induce 'rent-seeking' strategies, leading to superficial and temporary collaboration, instead of facilitating knowledge circulation and exploitation sufficiently and in a sustained way

From a rather low level, BERD almost doubled in real terms in 2004-2009, while GERD grew by 33.5% in the same period. It is most likely due to a wide range of potentially adequate policy measures and incentives, a large number of which is co-financed by the EU SF. Yet, BERD and GERD are still way below the EU27 average, as well as the Lisbon-Barcelona targets. It seems unlikely that the ambitious R&D investment targets, especially those set for 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. The bulk 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 7: 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 effective unless framework conditions for RTDI improve significantly.
Overall unfavourable framework conditions, especially macroeconomic pressures, exacerbated by the global economic crisis	Given the macroeconomic tensions and lack of meaningful dialogue among the major political parties it is uncertain if fundamental reforms, needed to create more favourable framework 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 to reform the public research sector, placing more emphasis on exploitability of knowledge when evaluating research performance. Existing schemes provide incentives for strengthening industry-academia co-operation.
As for future R&D investments, the supply of HRST might become insufficient in the coming years	A 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, and sustained, concerted public efforts and actions by businesses.

3 Interactions between national policies and the European Research Area

3.1 Towards a European labour market for researchers

The communication on Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas:

- Open recruitment and portability of grants;
- Meeting the social security and supplementary pension needs of mobile researchers;
- Providing attractive employment and working conditions;
- Enhancing the training, skills and experience of researchers

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced ‘brain circulation’, with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the ‘brain drain’ rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

Despite the detrimental effects of the global economic crisis on the Hungarian economy in general, the number of researchers kept steadily increasing both in 2008 and 2009: the total number of FTE researchers in Hungary increased from 17,391 (2007) to 20,064 (2009). (KSH 2010) Thus, the share of researchers in total employment also grew from 0.44% in 2007 to 0.53% in 2009. Yet, Hungary still lags behind the EU27 average (0.66% in 2007). University enrolment data for natural sciences faculties show that science and engineering are still not among the most popular career paths, and this has been identified as one of the key challenges of the Hungarian innovation system.

Researcher mobility has been permanently at a low level, with regards to both inter-sectoral and cross-border mobility. Hungary has one of the lowest shares of inward researcher mobility among the surveyed EU countries. (MORE, 2010, p. 35)

International mobility of researchers has stagnated since 2006. The number of foreign researchers employed in Hungary was 625 in 2009, and accounted for only about 2% of the total number of researchers. (KSH) The vast majority (67%) of foreign researchers were EU citizens, 18% came from other European countries, and 15% from other continents. An additional 323 foreign researchers stayed in Hungary for shorter periods as grant holders (as opposed to staff members), half of them from other EU countries. Outward mobility has also been relatively stable. In 2009, 454 Hungarian researchers stayed abroad for more than six months (of which 323 with employment contracts, the rest as grant holders). Four hundred and fifty one foreign citizens were registered as PhD and DLA students at Hungarian HEIs in 2009/2010 (corresponding to 6.6% of all doctoral students), though the vast majority of them were Hungarians from neighbouring countries. (NEFMI, 2010, p. 148)

Several STI policy measures promote inward and outward mobility, some of them directly, as their main objective. The long-standing Mobility Programme has three sub-programmes: the first one supports Hungarian researchers carrying out research at outstanding foreign research institutes or universities; the second one aims to attract foreign researchers to Hungary, whereas the third sub-programme invites Hungarian researchers currently working outside Europe to return to Hungary.

3.1.2 Providing attractive employment and working conditions

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 for PROs.

The average gross wage for employees performing "professional, scientific and engineering activities" in the private sector was ~€1,042 (HUF292,274) a month in 2009. (KSH)

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 research and/or consultancy projects or even other (not research-related) activities.

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.[32] (OECD, 2007b) Unemployment figures also show a much more favourable position compared to lower qualifications: 2.6% among ISCED 5-6 vs. 16% for ISCED 0-2 level. (KSH)[33] This difference is smaller in many other countries.

The demand for PhD degree holders is strongest in the HE sector.[34] (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 OECD's *Review of Innovation Policy in Hungary* (OECD, 2008).

Inward mobility is of almost negligible importance. As already mentioned in Section 3.1.1, foreign researchers employed in Hungary accounted for only about 2% of the total number of researchers. Most of them are likely to be of Hungarian origin from the neighbouring countries where overall working conditions and earnings are roughly at the same level or slightly less favourable. Regulation does not allow flexibility in wages paid by PROs, and hence researchers from countries with better working conditions and significantly higher salaries are not attracted to take up positions in Hungary. As for the private sector and private non-profit research organisations there are no such restrictions, it is up to their budget if they can pay higher wages for foreign researchers coming from more affluent countries.

As of 2010, 11 organisations have signed the Charter for Researchers: 8 HEIs, 1 research centre at the Budapest University of Technology and Economics, and 2 private non-profit research centres. The National Office for Research and Technology promotes the uptake of the Charter.

The restoration of the same position after maternity leave is safeguarded by the general provisions of the Labour Code. However, the employer is not obliged to extend the employment period of a fixed-term contract.

There are no specific provisions for female researchers. Gender quotas have been discussed in various areas in order to reduce the gap between the representation of men and women in various professions and bodies, but have not been introduced.

In sum, relatively low salaries, 'patchy' research infrastructures, and unsatisfactory overall working conditions generate brain-drain to foreign countries and professional shift to other, more attractive sectors in Hungary.

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[32] These data refer to the 25-64 years old age group of the population in 2004.

[33] One also has to bear in mind that Hungarian employment rates are significantly below the EU average in all qualification groups.

[34] 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.

3.1.3 Open recruitment and portability of grants

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 prevents foreign nationals from applying for these positions (except the ethnic Hungarians coming from neighbouring countries).

The equivalence/validation of foreign academic degrees, i.e. the recognition of foreign certificates and degrees are carried out by the Hungarian Equivalence and Information Centre (Hungarian ENIC, a member of the European Network of Information Centres) within the Educational Authority, while the nostrification of scientific degrees is done by the Hungarian higher education organisations. The only exception is the recognition of the foreign Candidate of Science and Doctor of Science degrees under international agreements.

Just as in other new EU Member States, Hungarian research institutes advertise very few (a mere 3 in October 2010) vacancies (for researcher positions) on the EURAXESS website.

Grants awarded by the various Hungarian research funding schemes are generally not transferable to other (national and foreign) research institutes.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

Hungary was among the first countries to implement the 2005/71/EC Directive concerning the employment of researchers from third countries. There is no tailoring of Article 17 based on bilateral agreements. 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.[35] As of September 2010, 76 organisations have been accredited: the vast majority being MTA institutes and universities, and only a handful of private (mostly non-profit) research units. These institutes employed a total of 56 researchers based on the accreditation process. (NKTH)

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.[36]

3.1.5 Enhancing the training, skills and experience of European researchers

Since 1993, according to the Law on Higher Education, only universities are entitled to provide doctoral training and grant doctoral degrees (PhD, DLA). Doctoral education is carried out by the doctoral schools, accredited by the Hungarian Accreditation Committee. As of 2010, there are 168 accredited doctoral schools in the country. In 2007, a new Government Decree on doctoral training was issued pursuant to the Higher Education Act, containing a number of new, quality-based

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

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

elements and regulating the rules of the procedure governing the establishment of doctoral schools and the requirements of obtaining a doctoral degree. HEIs that provide second cycle training in a given field of science or art may obtain the rights to launch a doctoral training in the same field. The organisation of doctoral trainings, the assessment of the activity of supervisors and doctoral students, as well as the actual awarding of the doctoral degree falls within the rights of the doctoral council of the HEI in question and the doctoral council working in the respective area of science.

There are a number of doctoral schools offering programmes in English for foreign candidates. However, these programmes are not sufficiently attractive for financial 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 (6.6% in 2009; NEFMI, 2010), compared to the OECD average (21.1% in 2008; OECD, 2010a)[37] 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)

3.2 Research infrastructures

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in their National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe by joint efforts. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. The European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on specific initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

No explicit research infrastructure (RI) development strategy has been devised in Hungary yet. Some dedicated schemes have provided funding specifically for purchasing R&D equipment in all the three research performing sectors, while other, more general ones also supported purchasing research equipment, e.g. as parts of strengthening business R&D units.

[37] 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, 2007b, p. 45)

Given the size and level of economic development of the country, not much funding is available to invest in expensive research infrastructure (RI). Capital investments in instruments and equipment amounted to €113.2m in 2006 (at its peak in the 2000-2007 period, up from €55m in 2000), and then contracted to €92.6m in 2007. One should bear in mind the fairly low level of these investments in absolute terms, and thus a certain pace of growth is almost a must. Probably the main driver behind the observed growth in 2000-2006 was the launching of the several support measures mentioned above.

In relation to GERD, a different dynamics can be observed, as investment in instruments and equipment has not kept up with the growth of GERD. The share of these expenditures was the highest in 2000: 13.6% of GERD, dropping to the lowest weight, that is, 9.5% in 2007.

The business sector had spent a significantly higher share of BERD on investing in instruments and equipment until 2006: this ratio used to be between 14.1-21.3% in 2000-2006, and then plunged to 12.2% in 2007. The government sector devoted the lowest share of its R&D funds to RI, that is, 5.9% of GOVERD in 2007.

As for the sectoral composition, it has varied widely since 2000. The business sector accounted for 69.5% of total capital investments in instruments and equipment in 2000, shrinking to 40.2% in 2002, at its lowest point, and then recovering to 66.9% and 64.9% in 2006, and 2007, respectively. The share of the government sector stood at 37.3% at its peak in 2002, diving to 14.9% in 2006-2007. The weight of the higher education sector fluctuated in a somewhat narrower range, between 12.8% (2000) and 26.5% (2005), and stood at 20.1% in 2007. (author's calculation based on Eurostat data)

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.[38]

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). 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). It would propose a roadmap for building new RIs and upgrading existing ones in Hungary, as well as those areas of specialisation where participation in new transnational infrastructures is favourable.

Around 80 researchers and business people have participated directly as members of the project's three panels and its Steering Committee, and a broader set of experts has been involved via various channels of wider consultations. The project – devising and following a very detailed assessment method, and relying on a two-round on-line survey to collect data from individual RIs – has identified some 80 Hungarian RIs of strategic relevance (strategic RI, in short). Given the strict assessment criteria, altogether hundreds of RIs have formed networks to be qualified as strategic RIs. Hence, the ~80 strategic RIs are actually composed of over 400 individual RIs. A web-based, bi-lingual register presents all the relevant data of these RIs for potential users and co-operation partners, while other types of data pertinent to STI policy-makers would be made available only for them.

[38] "The institute operates the 10 MW Budapest Research Reactor, providing the scientific community of Europe (…) with research possibility for neutron physics and its applications." (http://aekiweb.web.kfki.hu/index.php?page=&contentid=77&lang=en)

The project used to be financed from the Research and Technological Innovation Fund until June 2010. As already mentioned, unused funds were frozen by the incoming government in June 2010, and thus a new decision is needed if the project is to be completed, i.e. to keep the register alive and up-to-date, and devise the RI development roadmap (covering national RIs as well as transnational ones relevant for Hungarian researchers).

3.2.2 National participation in the ESFRI roadmap: Updates 2009-2010

Hungary has participated in preparing the European Strategy Forum on Research Infrastructures (ESFRI) roadmap, and has announced its intent to host the European Spallation Source[39] or ELI, the Extreme Light Infrastructure.[40] Eventually Lund has been selected as a site for the ESS, while Szeged together with Prague and Bucharest would host the ELI. Although the latter decision was made on 1 October 2009, the preparatory work is delayed in Hungary. Until 1 January 2011 it was uncertain if the new government would approve co-funding for the preparatory phase.[41] Any further delay is likely to jeopardise this investment in Hungary, given the rules on the use of the EU SF. The research community has been shocked by this indecision.[42]

Besides, several Hungarian research units have expressed their interest to participate in over a dozen ESFRI projects, in which cases RIs are (or would be) located in other EU countries.

3.3 Strengthening research organisations

The ERA green paper highlights the importance of excellent research organisations engaged in effective public-private co-operation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. Universities and research institutes should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, as well as the dominant governing and funding models.

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[39] 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)

[40] 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)

[41] The former prime minister gave his full support to the project, even attended the press conference in Szeged, when the decision was announced. (http://www.u-szeged.hu/hirek/fokusz/siker-eli-palyazaton) Journalists already speculate that political reasons are likely explain the lack of support from the current government: the mayor of Szeged – a leading figure in the party supporting the previous government – was re-elected in October 2010, although the current government party achieved a land-slide victory in all the big cities, and also won lots of local councils. (http://www.szegedkurir.hu/cikk/szeged/3585/a_lezerkozpontot_nem_lehet_)

[42] http://index.hu/tudomany/2010/11/17/veszelyben_a_szegedi_szuperlezerprojekt/; http://index.hu/tudomany/2010/12/07/elveszithetjuk_a_szegedi_szuperlezert/;

3.3.1 Quality of the National Higher Education System

There were 70 accredited HEIs in Hungary in the 2009/2010 academic year, including 18 state-run universities, 7 non-state (2 private and 5 church-owned) universities, 11 state colleges and 33 non-state colleges. The total number of students enrolled at HEIs in the academic year 2009/2010 was 370,331 (full time and part time), which corresponds to 3.7% of the total population. (Statistical Yearbook of Education, 2009/2010)

R&D expenditures of the HE sector (HERD) have been steadily increasing until 2008, and slightly declined in 2009: from €233.4m to €223.4m. (Table 6) The relative weight of HERD has shown a somewhat different dynamics: as GERD has increased faster than HERD in recent years, the share of HERD in GERD declined from 25.2% in 2005 to 20.9% in 2009. Businesses financed 15.7% of HERD in 2009.

The number of tertiary graduates (ISCED levels 5-6) in 2008 was 63,331 (Eurostat), and this has been decreasing for years due to the shrinking age cohort. Two-thirds (66.8%) of them were women, which is basically identical to the EU27 average (67.9% in 2008). A mere 5.9% of degrees were awarded in “Science, mathematics and computing” (vs. 9.7% EU27 average in 2008), compared to 41% in “Social sciences, business and law”. In 2008 there were 1,141 PhD-level graduates, and 42.7% of them were women. In 2009, the tertiary attainment level within the 30-34 age group was 23.9% (vs. 32.3% in EU27), which is a modest increase since 2008 (22.4%). Both the inflow and the outflow of students in higher education are smaller than the EU27 average: roughly 7,400 Hungarian students studied in another EU, EEA or associated country in 2007,[43] that is, 1.7% of all students (ISCED 5-6), while the EU27 average was 2.7%. The number of foreign students studying in Hungary (from EU, EEA and associated countries) was 9,400 in 2007, i.e. 2.2% of all students (vs. 3.1% EU27 average).

Traditionally, the main mission of the Hungary HE education sector focussed more on teaching than on research activities. Apart from a few large and prestigious universities (and especially their certain faculties and institutes), which carry out the bulk of HERD, the large majority of smaller universities and colleges (especially in the countryside) have negligible R&D activities. The mission statements of the larger universities stress the importance of both multidisciplinary education and R&D of the highest quality according to international standards.[44]

The Hungarian HE landscape is characterised by the huge gap between a number of relatively competitive and traditionally “elite” universities (which nevertheless have also undergone the effects of the transition to mass education), and a large number of lower quality, less competitive colleges, especially in smaller towns of the country.

In general, the access procedures at the Hungarian HEIs are competitive. However, there are significant differences among the Hungarian HEIs in this respect, too: a few of them enjoy a high esteem among the future employers, and thus it is markedly more difficult to enter those HEIs, compared to those, which are less popular among the students, given the less promising employment prospective they offer.

Only a few Hungarian universities are listed among the most prestigious ones in the world by the most widely used ranking systems. On the Shangai HE index, the

[43] 2007 is the latest year for which comparable Eurostat indicators are available.
[44] This group of universities include e.g. the Budapest University of Technology and Economics [BME], University of Debrecen [DE], Eotvos Lorand University of Sciences [ELTE], Semmelweis University [SOTE], University of Szeged [SZTE].

University of Szeged and the Eotvos Lorand University of Sciences (ELTE) are ranked 301-400 (124-168 in Europe) in 2010, partly due to the relatively high number of Nobel Laureates among their alumni. None of the Hungarian universities are among the top 200 in the Times Higher Education Supplement (THES). The Leiden ranking allows for a rough assessment of the universities' publication activities. According to the "yellow" ranking (the sheer number of publications), the four most prestigious Hungarian universities (ELTE, Univ. of Szeged, Semmelweis Univ., and Univ. Debrecen) are ranked relatively close to each other, between 450 and 477. The so-called "green" and "orange" rankings (which take into consideration the impact factors of the publications) show more or less the same results, with the Eotvos Lorand University of Sciences exhibiting the best overall scores.

The number of authored or co-authored publications by researchers affiliated with the most prestigious universities was as follows in 2004-2008: Szeged 2426; ELTE 2208; BME 2037. (Web of Science)

An implicit general "external" assessment exercise by the government was launched in 2007. Since then, a HEI may receive additional public funding in case it enters a so-called three-year maintaining agreement with the (then) Ministry of Education and Culture. Based on the agreement, the Ministry can monitor (and assess) capabilities of a given HEI for setting and performing strategic targets in various fields during the contracted 3 years. A detailed list of measures for monitoring and assessment include alternative indicators regarding all three aspects of universities' missions, namely "basic activity (Education and Research)", "supporting activity (guiding and management and collaboration and co-operation)" and "Social linkages (regional role and participation in performing social targets)". The HEIs had to select relevant indicators, set targets in each of these obligatory fields, and elaborate these in their so-called "Institutional Development Plans" (i.e. strategic documents), which can be monitored during the three-year period and evaluated at the end.

There are a number of national ranking exercises, mostly carried out by prestigious weekly newspapers. These rankings of universities, their faculties, and degree programmes are based on significantly diverging methods. Therefore, their results are ambiguous and are not used as a basis for national funding. However they are important sources of information for both employers and secondary school graduates for selection. These rankings also confirm the predominance of the aforementioned universities, with some of the faculties of the Corvinus University of Budapest also appearing in the "top league".

The significance attached to these universities within Hungary is also reflected in the so-called "Research University" title that was awarded to five Hungarian universities (ELTE, SOTE, DE, SZTE, BME) by the government in 2010. Although the title is meant to symbolise the prestige of these HEIs in terms of their high-quality research potential and does not automatically mean additional financial support, these are the universities which attract the most public (national and EU) and private funding. There are, however, plans that normative funding should in part be contingent upon the "research university" title.

3.3.2 Academic autonomy

The autonomy of higher education and scientific research is one of the key principles of the Hungarian legal framework, entrenched in the Constitution,[45] as well as in the Law on Higher Education, which stipulates that “the freedom of teaching, research and artistic creation shall be maintained by means of the autonomy of higher education institutions”. This general principle applies to all three aspects of autonomy, namely “academic”, “political” and “financial/ managerial”, within certain boundaries set out by the law. In particular, as discussed in more detail below, HEIs have a high degree of autonomy in organisational issues, namely the selection of candidates for academic positions by the governing bodies of the HEI, in devising their curricula and research agendas/ strategies, and budgeting processes (infrastructure development, tuition fees, etc.). However, a number of legal requirements, e.g. pertaining to wages of public servants, limit HEIs’ autonomy. Asset management is also 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 (e.g. involving businesses in HEIs’ governing bodies), 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.

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 composed of mainly 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 (then) 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.

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[45] 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).

3.3.3 Academic funding

Hungarian HEIs are entitled to normative support from the central budget for education/ training, scientific research, and maintenance purposes. However, these are calculated on a set of quantitative criteria, such as the number of students and professors, and are not related to R&D performance/ excellence criteria. Furthermore, universities receive the total amount of normative support as a lump sum, and its use is not monitored closely.

As for funding research activities of HEIs, there are two main channels: 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.

As noted above, the three-year “maintenance agreements” and the “research university” titles are a step in the direction of applying performance-based criteria for determining state funding.

HEIs can also apply for various types of national or foreign grants. 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.[46] The EU RTD Framework Programmes are also gaining significance as a source of income for HEIs (see below).

There is no readily available data to offer a general picture regarding the distribution of research funding sources. As normative support is not directly related to R&D activities (i.e. it is provided on the basis of simple headcounts), not the full amount of this funding is actually spent on R&D. Therefore, for some universities (e.g. BME) competitive grants and industry-financed projects are probably more important.

Finally, 13.7-15.5% of HERD was financed by businesses since 2007, but presumably a handful of HEIs account for the bulk of industry-funded HERD. For example, in the case of the Budapest University of Technology and Economics (BME) industry-financed R&D expenditures are roughly 20% of the total budget.

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

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the trans-national dimension of knowledge transfer. This section will assess the national policy efforts aimed at promoting the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

Attempts have been made to create a more favourable regulatory environment and incentives for PROs to accelerate their IPR activities and produce exploitable knowledge. The Law on Research and Technological Innovation (effective as of 2005) has introduced the notion of spin-offs into the regulatory framework. Publicly financed HEIs and PROS (henceforth, publicly financed research units) are obliged to have their own internal regulation on IPR issues (since 2006), which contains instructions on valuation, reporting, rights and obligations, as well as levels of responsibility, and devise an IPR management strategy. Furthermore, in order to be eligible for funding, beneficiaries of the Research and Technological Innovation Fund are obliged to submit the applicable IPR rules (regarding IPR utilisation and procedures, researcher motivation, licensing) to the funding agency. The National Office for Research and Technology, in co-operation with the Hungarian Patent Office and the Hungarian Academy of Sciences devised guidelines, which the individual organisations could (and in most cases did) use as a blueprint.

In many cases, technology transfer offices have been established at publicly financed research units to deal with these obligations. Some of them are part of the university's organisation (e.g. at the University of Debrecen it is supervised by the Rector), whereas in other cases these tasks are carried out by an organisation set up jointly by the university and a number of other regional players, such as PROs and regional authorities (e.g. Biopolisz in the case of the Univ. Szeged). The budget of these TTOs is a fraction of €0.5m (the threshold used in surveys). An international workshop on this topic, held in Hungary in 2010, concluded that the internal resources and the competence of TTO staff is still generally inadequate, mainly due to the fact that there are still no MBA programmes focusing on innovation management or technology transfer. The system of TTOs seems quite fragmented and therefore inefficient, exacerbated by the lack of critical mass of inventions at most universities.

Furthermore, the incentives provided by the internal regulations for researchers at PROs and HEIs are still not sufficient to achieve a fundamental transformation of prevailing attitudes, which is also reflected in the fact that only approximately 6% of patent applications are filed by Hungarian universities and only 10% of patents are owned by them. The vast majority of TTOs have heavily relied on public support (the "Innotett" Programme).

In order to facilitate the establishment of spin-offs, the Parliament amended the Law on Higher Education in June 2007. From September 1, 2007 higher education institutes can establish business entities for commercialising their intellectual assets without any formal consent of government authorities. The Act CVI. of 2007 (25 September) on State Property amends the Law on Research and Technological Innovation: it stipulates that, as opposed to the general regulations of the Act, publicly financed research units shall be the owners of acquired IPR and be entitled to a share of the spin-off firm emanating from it. IPR regulation has become more favourable for the exploitation of R&D results by giving property rights to the publicly financed research units and by allowing the establishment of business entities (spin-offs) for the commercialisation of HEIs' intellectual assets.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Spin-offs

There have been a number of policy measures in recent years providing public funding for promoting knowledge transfer in general (partly through supporting to set up TTOs), and the creation of spin-offs in particular. In fact, some experts even claim that the knowledge transfer and IP commercialisation activities of HEIs are driven by the availability of public funding, and not by market pressures and opportunities.

For a long time, the lack or insufficient level of available venture capital has been a serious challenge, hindering the emergence of innovative start-ups and spin-off companies. (OECD, 2008) Therefore, in recent years more attention has been given to this challenge. The government launched the New Hungary Venture Capital Programme in 2009, establishing 8 private-public funds, allocating ~€166m venture capital until 2013, from the pre-seed stage.

Inter-sectoral mobility

Inter-sectoral mobility of Hungarian researchers has been identified as one of the key weaknesses of the Hungarian STI system. Only 6% of Hungarian researchers at HEIs had previously been employed in both the private and the public sector, which is roughly one third of the EU27 average. (MORE Report, 2010, p. 71) This is probably strongly related to the structural/ institutional characteristics of the Hungarian public research sector: the overwhelming majority of Hungarian researchers (85% vs. 59% EU27 average) at HEIs are employed under open-ended contracts, and that 70% of them have been employed by their principal employer for more than 10 years. (MORE Report, 2010, p. 55) The administrative framework is not prohibitive in this respect, but does not provide incentives, either. Researchers in the public sector are relatively well protected by law, however, are not particularly well paid. The low level of mobility can probably be better explained by the relatively low level of interaction between the sectors in general and as a consequence of the diverging incentive structures.

Promoting research organisations - SME interactions

The INNOCSEKK (Innovation voucher) scheme offers vouchers for SMEs, with which they can pay for innovation services, including those offered by PROs.

EU cohesion policy

Schemes funded by EU cohesion policy, i.e. the Structural Funds, have been among the most important vehicles for fostering knowledge transfer through the creation and development of incubators and science parks in Hungary. The Economic Development Operational Programme of the New Hungary Development Plan (2007-2013) included such measures, e.g. the "Promotion of Technology and Innovation Parks". Furthermore, most of the seven Regional Operational Programmes include measures for supporting technology parks and/or business incubation.

Involvement of private sectors in the governance bodies of HEIs and PROs

The governance bodies of HEIs are constructed in such a way – by law – that decision-making processes are controlled by the academic staff. (section 3.3.2) The Economic Councils are often dominated by business people (chief executives of large corporations, banks, etc.), but these bodies only have consultative rights in the HEIs' economic affairs, and no influence on research agendas.

3.5 Co-operation, co-ordination and opening up national research programmes within ERA

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of co-ordination, synergies, efficiency and simplification. The policy fragmentation at EU and national levels, and between EU and national policies can hinder the development of critical masses of research excellence, leads to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the co-ordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

The National Office for Research and Technology serves as the Hungarian COST Secretariat. Hungarian researchers have been involved in 140 COST actions in June 2010.[47]

Hungary – as the first country from Central- and Eastern-Europe – was admitted to EUREKA in May 1992. The Déri Miksa Programme co-finances the Hungarian EUREKA project participants, including cluster project participants. This Programme has had a budget of €2m per year for 2007-2010. Seventy four EUREKA projects with Hungarian participants have been completed by June 2010, and at that time there were 16 projects involving Hungarian researchers, 6 of which were co-ordinated by Hungarian organisations.

The National Office for Research and Technology has continuously made efforts to increase Hungarian participation and the success rate since the 4th EU RTD FP.

[47] For the complete list, visit http://www.nkth.gov.hu/english/hungarian-participation/10; for the distribution of actions by fields: http://www.nkth.gov.hu/english/cost/hungarian-cost-activity-080519-1, and for data on Hungarian participation in previous years: http://www.nkth.gov.hu/english/cost/hungarian-participation.

Currently a specific scheme supports consortium building for FP7 participation of Hungarian firms, PROs and universities.

From 2007 up to 26 October 2010 €125.9m was committed to FP7 projects with Hungarian participants. The distribution of these grants by priority areas has been as follows: ICT projects 19.5%; Health 8.2%; Nanosciences, Nanotechnologies, Materials and new Production Technologies 6.7%; Energy 5.9%; Food, Agriculture and Fisheries, and Biotechnology 5.8%; Transport (including Aeronautics) 4.8%; Environment (including Climate Change) 4.6%; Socio-economic sciences and Humanities 4.4%; European Research Council grants 14.4%; Research infrastructures 8.8%; Research for the benefit of SMEs 5.5%, while the share of supported projects in the field of the remaining priorities has been around or well below 2%. (eCORDA [Common Research Data Warehouse], information retrieved by the NKTH)

Hungary has performed relatively well concerning the Community financial contribution obtained for FP7 projects until 26 Oct 2010: the only new Member State slightly ahead of Hungary is Poland (with an almost four times larger population). Greece, however, is far ahead of Hungary, and Portugal has also obtained a significantly larger amount (both countries have a comparable size of population as Hungary). (information retrieved from eCORDA by the NKTH)

As for research infrastructures (RI), Hungary has joined several inter-governmental agreements, organisations and large RIs, including EMBO, European Molecular Biology Organization; GMES, Global Monitoring for Environment and Security; EFDA, The European Fusion Development Agreement; ESA, European Space Agency (as an observer); CERN, European Organization of Nuclear Research; ITER, Internatonal Fusion Energy Organisation; ECMWF, European Centre for Medium-Range Weather Forecasts (as observer); EUMETSAT, European Organisation for the Exploitation of Meteorological Satellites; ESRF, European Synchroton Radiation Facility; ILL- Institut Laue-Langevin: Neutrons for Science.

Currently there is no comprehensive strategy underpinning and steering Hungarian participation in these inter-governmental agreements, organisations and large RIs. Decisions on joining them and paying membership fees are made in a case-by-case manner. There are several ways to finance access by Hungarian researchers to large international RIs, including the budget of particular research projects, and grants, e.g. offered by a joint scheme of OTKA and NKTH, called OTKA-H07.

Hungary also participates in the Science Programme of the NATO.

3.5.2 Bi- and multilateral agreements with other ERA countries

The Hungarian government has signed bilateral STI co-operation agreements with 37 countries by September 2010. In addition to the EU members with Argentina, Brazil, China, Croatia, Egypt, India, Israel, Japan, South-Korea, Malaysia, Mexico, Russia, Serbia, South-Africa, Thailand, Turkey, Ukraine, USA, and Vietnam with the primary objective to promote mobility and international co-operation, and organising S&T seminars and workshops.

The number of supported applications to promote bilateral co-operation is between 500 and 600 in a year. In most cases grants can be used to cover travel and subsistence costs. Full costs of bilateral collaborative projects are covered in the case of five countries, with which so-called co-funding agreements have been signed, that is, China (technologies supporting competitiveness and sustainable development), France (biotech), India, Israel (industrial technologies) and Singapore (medical instruments, bioinformatics, life sciences, pharmaceuticals, and related chemical research). (http://www.nih.gov.hu/nemzetkozi-tevekenyseg/ketoldalu-kapcsolatok/ketoldalu-tudomanyos)

3.5.3 Other instruments of co-operation and co-ordination between national R&D programmes

Hungary has been involved in 46 ERA-NET projects (as of 2010, for the thematic focus and further details of these projects, consult http://netwatch.jrc.ec.europa.eu). Hungary also contributes to Joint Technology Initiatives (JTIs), such as ARTEMIS, ENIAC, and IMI, as well as to joint programmes: Eurostars and AAL. 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.

3.5.4 Opening up of national R&D programmes

One of the objectives of the government's mid-term STI policy strategy (2007-13) 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 programmes, and scholarships)." (Government, 2007, p. 18)

The dominant approach is, therefore, to provide more favourable conditions, as well as financial support to foreign researchers who are willing to relocate their research activities to Hungary. Most STI policy measures are open to non-nationals, and some of them, e.g. the second sub-programme of the Mobility scheme, or the a joint OTKA-NKTH scheme for the development of human resources for basic research, explicitly identify foreign researchers as one of the target groups. The supported research project should be carried out at a Hungarian facility (and the grant holder should be employed by that organisation).[48]

In spite of these opportunities, the share of foreign researchers working in Hungary is rather modest (approximately 2% of the total; section 3.1.1). Possible obstacles include the relatively low calibre 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.

3.6 International science and technology co-operation

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Co-operation to strengthen science and technology co-operation with non-EU countries. The strategy identifies general principles which should underpin European co-operation with the rest of the world

[48] As a general rule, Hungarian funding can be used abroad only by Hungarian researchers who are supported by a mobility scheme.

and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic co-operation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international co-operation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international co-operation in S&T.

3.6.1 International co-operation

Hungary has concluded a number of bilateral R&D co-operation agreements with non-EU countries, including (a) leading countries in S&T, e.g. the USA, Israel, Japan; (b) the so-called BRIC countries (Brazil, India, Russia, China), which are globally perceived as emerging S&T players; as well as (c) developing countries in various continents, e.g. Argentina, Egypt and Vietnam. In spite of the large number of bilateral R&D co-operation agreements, with a broad geographical coverage, there is no standalone, publicly available strategy document to steer these co-operations.[49]

3.6.2 Mobility schemes for researchers from third countries

No mobility scheme specifically targeting researchers from third countries has been launched in Hungary. There are bilateral R&D co-operation agreements with non-EU countries (see Sections 3.5.2 and 3.6.1), however, which include provisions and financial support to joint R&D projects involving mobility in both directions.

Hungary was among the first countries to implement the 2005/71/EC Directive concerning the employment of researchers from third countries. Accredited research units are entitled to employ researchers from third countries with simplified procedures. As of September 2010, 76 organisations have been accredited: the vast majority being MTA institutes and universities, plus a handful of private (mostly non-profit) research units. These institutes employed a total of 56 researchers based on the accreditation process. (NKTH)

4 Conclusions

4.1 Effectiveness of the knowledge triangle

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, which only worked intermittently, in certain periods were 'dormant' for years. Hence, policies affecting RTDI process – notably education, STI, macroeconomic, industrial, investment promotion and regional development policies – could not possibly be designed and implemented in a strategic, coherent and integrated framework.

Further, the implementing agencies have also been frequently reorganised. These permanent changes in governance structures prevent organisational learning of policy design and implementation bodies, and this lack of stability also hampers the efficient functioning of these bodies. Moreover, the ensuing frequent changes in

[49] As mentioned in section 3.5.2, most of these agreements support short short-term staff exchanges; i.e. grants cover travel and subsistence costs. (see that section for further details of, and information sources on, bilateral R&D co-operation agreements)

policies and support measures put a significant administrative burden on research performers.

Public expenditures on research increased from €373.7m in 2004 to €448.0m in 2009. (Eurostat) Public funding for research is allocated via the Research and Technological Innovation Fund; the Operational Programmes of the New Hungary Development Plan (these two funds provide support for innovation activities, too, besides R&D); as well as the Hungarian Scientific Research Fund (OTKA). The vast majority of these funds are distributed on a competitive basis, but HEIs and PROs receive institutional funding, too. As a rule, projects are selected by the quality of proposals and subject to external peer review. Concerning the nationally funded STI policy support schemes, the State Audit Office, the recent multi-annual evaluation of the Research and Technological Innovation Fund, as well as professional associations have pointed to recurring anomalies.

The framework conditions for RTDI activities play a decisive role: the macroeconomic situation, the 'two-tier' structure of the economy, the intensity and type of competition, standards and regulation, the overall entrepreneurship culture, the quality and directions of projects conducted by the publicly financed R&D units have so unfavourable impacts on innovation activities of firms that the incentives provided by STI policy schemes cannot counterbalance those effects.

In general, no major changes have occurred since 2009 in terms of the national STI policy mix described in the previous ERAWATCH Country Report. The most likely explanation for this is that STI policies received hardly any attention from high-level decision-makers in 2010 as both the general and local elections were held in that year. Further, the 84-page government programme, approved in May 2010, devotes 8 lines to R&D and innovation. A new technology and innovation policy document, underpinning the policy measures to be launched in 2011, would be finalised in January 2011.

The most influential decision of the new government was blocking HUF16b (~€58.2m) from the Research and Technological Innovation Fund, that is, 36.6% of the 2010 budget of the Fund. Further, the Research and Science Policy Council was dissolved on 15 December 2010, to be replaced by the National Research, Innovation and Science Policy Council. The previous Council only met once before the April 2010 general elections, and the new Council has not started its operation yet.

Table 8: Effectiveness of knowledge triangle policies

	Recent policy changes	**Assessment of strengths and weaknesses**
Research policy	• The Law on Higher Education was amended in December 2008 to facilitate a more entrepreneurial approach to knowledge production • The Law on the Hungarian Academy of Sciences (MTA) was amended in April 2009 to increase the financial autonomy of the MTA	• High quality of research in a number of scientific fields • Research is not an attractive career, brain drain is a severe threat • Mismatch between the incentive structures of academic researchers and the interests of businesses

	Recent policy changes	Assessment of strengths and weaknesses
Innovation policy	• Withholding HUF16b (~€58.2m) from the Research and Technological Innovation Fund; June 2010	• Significant resources allocated to RTDI in multi-year programming documents, disconnected from the annual budgeting processes • Innovation performance is poor in international comparison
Education policy	• Higher quota of publicly financed students enrolled at S&E faculties; • Schemes aim at raising the level of qualified human resources	• Internationally respected S&E education system in several fields • The level of qualified human resources for an enlarged research system would be inadequate
Other policies	• No major changes in those policy domains, which affect RTDI performance	• STI policy measures cannot counterbalance unfavourable framework conditions for business RTDI activities

4.2 ERA 2020 objectives - a summary

This section is aimed at summarising the main characteristic of the national measures supporting the strategic ERA objectives in a concise, table format. As already stressed above, the STI policy mix remained basically the same.

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 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.

Given the size of the Hungarian economy and the level of public funding for R&D, Hungary cannot be a major player in the ERA initiatives listed below.

Table 9: Assessment of the national policies/ measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• Higher quota of publicly financed students enrolled at S&E faculties • Simplified visa procedures for foreign researchers introduced in December 2007 • Full compliance with the 1408/71 regulation concerning social security policies	• The share of S&E graduates is less than half of the EU average • Small difference between male and female researchers' salary • The same position after maternity leave is safeguarded • Several mobility schemes for Hungarian researchers, with scarce funding, though • Research positions at PROs are open to non-nationals, yet the share of foreign researchers is 2% in the total number of researchers

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
2	Increase public support for research	• Public funding for R&D increased from €373.7m (0.45% of GDP) in 2004 to €448.0m (0.48% of GDP) in 2009 • HUF16b (~€58.2m) "blocked" from the Research and Technological Innovation Fund	• Low level of public R&D expenditures, around three quarters of the EU27 average (0.65% of the GDP in 2008)
3	Increase European co-ordination and integration of research funding	• Hungarian participation in 46 ERA-Net projects (as of 2010), and several Joint Technology Initiatives (JTIs)	• Given the size of the Hungarian economy and the level of public funding for R&D, Hungary cannot be a major player in these initiatives
4	Enhance research capacity across Europe	• Measures to create R&D jobs in the business sector, and make HEIs and PROs more attractive	• The number of FTE researchers increased from 17,391 (2007) to 20,064 (2009), in spite of the crisis
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• Measures to modernise RI are in place for a long time • A strategy-building process to underpin RI policies launched in 2008 • Participation in devising the ESFRI Roadmap, commitment to host one of the ELI sites	• A few large RIs, all open to foreign researchers • An uneven technical level of RIs: a mix of up-to-date and outdated facilities • Lack of a comprehensive RI investment strategy, suboptimal use of public funds
6	Strengthen research organisations, including notably universities	• Several schemes to modernise education and research facilities at universities, incl. the "Research university" title awarded for elite universities in 2010	• Uneven performance of HEIs • Only a few Hungarian universities are listed among the most prestigious ones in the world
7	Improve framework conditions for private investment in R&D	• Tax incentives for private R&D investment for long time	• Volatile macroeconomic environment for businesses • High interest rates and crowding out effect of the fiscal deficit • Market conditions are not conducive to RTDI activities
8	Promote public-private co-operation and knowledge transfer	• Several STI policy measures foster industry-academia collaboration	• Some improvement in the intensity of industry-academia collaboration
9	Enhance knowledge circulation across Europe and beyond	• Various schemes promoting Hungarian participation in EU FP and EUREKA projects are in place for a long time	• Hungarian STI support schemes are open to non-nationals, but funding is limited for them
10	Strengthen international co-operation in science and technology and the role and attractiveness of European research in the world	• Bilateral STI co-operation agreements with 37 countries (on four continents) • Participation in multi-lateral STI co-operation agreements and organisations	• Active participation in FP, EUREKA, and COST projects

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• The Research and Science Policy Council, set up after a long 'interval' in September 2009, was dissolved on 15 December 2010 • Decision on 15 Dec 2010 to establish the National Research, Innovation and Science Policy Council • The Government's mid-term STI policy strategy calls for evidence-based policy-making practices	• STI policy governance structures have been frequently reorganised • The highest level co-ordination body has worked intermittently • Policies affecting RTDI processes could not possibly be designed and implemented in an integrated framework • An S&T Observatory should have been set up originally by June 2008, then by the end of 2010, but it is not working yet
12	Develop and sustain excellence and overall quality of European research	• A number of measures to improve conditions required for excellence are in place for several years	• High quality of research in a number of S&T fields in international comparison
13	Promote structural change and specialisation towards a more knowledge-intensive economy	• No structural policies, strictly defined • Key technologies and related industries are identified in the New Hungary Development Plan and the Government's mid-term STI policy strategy	• Strong performance in high and medium-high-tech related EIS indicators • The difference between statistical classification of sectors and the actual knowledge-intensity of activities performed in Hungary is not taken into account when devising policy measures
14	Mobilise research to address major societal challenges and contribute to sustainable development	• Most Hungarian STI policy schemes had been devised prior to the identification of the grand societal challenges in various EU policy documents	• Enhancing competitiveness is a major objective of several STI policy schemes • Various other societal challenges are also addressed
15	Build mutual trust between science and society and strengthen scientific evidence for policy-making	• No specific measure to build mutual trust between science and society	• The MTA gives its expert opinion to the government on major issues

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List of Abbreviations

BERD	Business Research and Development Expenditures
CECWYS	Central European Centre for Women and Youth in Science
CERN	European Organisation for Nuclear Research
CIS	Community Innovation Survey
COST	European Co-operation in Science and Technology
EDOP	Economic Development Operational Programme
EIS	European Innovation Scoreboard
ERA	European Research Area
ERA-NET	European Research Area Network
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU RTD FP	European Framework Programme for Research and Technology Development
EU27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	Framework Programme, European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
FTE	Full-time-equivalent
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Research and Development Expenditures
GUF	General University Funds
HE	Higher education
HEI	Higher education institutes
HERD	Higher Education Research and Development Expenditures
HRST	Human resources for science and technology
IP	Intellectual Property
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
NEFMI	Ministry of National Resources
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
S&T	Science and Technology
SF	Structural Funds
SIOP	Social Infrastructure Operational Programme
SME	Small and Medium Sized Enterprise
SROP	Social Renewal Operational Programme
STI	Science, technology and innovation
VC	Venture Capital