NATIONAL SYSTEM OF INNOVATION IN HUNGARY

BACKGROUND REPORT

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PROJECT TEAM

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ABBREVIATIONS

As shown below, in the report the abbreviations are used in their original language (if the source of the expression is English or international, we use English abbreviations, if the source is Hungarian, the original Hungarian abbreviations are used).

ÁSZ	State Audit Office (in Hungarian: Állami Számvevőszék)
BERD	Business Expenditures for Research & Development
CIS	Community Innovation Survey
EDOP	Economic Development Operational Programme (of the New Hungary Development Plan of 2007-2013) (in Hungarian: Gazdaságfejlesztési Operatív Programme - GOP)
EIS	European Innovation Scoreboard
ERDF	European Regional Development Fund
EUR	euro (currency of the Eurozone)
FIT	Development Policy Steering Committee (in Hungarian: Fejlesztéspolitikai Irányító Testület)
FTE	Full-Time Equivalent
GERD	Gross Expenditures on Research & Development
GKM	Ministry of Economy and Transport (in Hungarian: Gazdasági és Közlekedési Minisztérium)
GOVERD	Government Intramural Expenditures on Research & Development
HERD	Higher Education Expenditures on Research & Development
HE	Higher Education
HRST	Human Resources for Science & Technology
HUF	Hungarian Forint (the national currency of Hungary)
ICT	Information & Communication Technologies
IVSZ	Hungarian Association of IT Companies (in Hungarian: Informatikai Vállalkozások Szövetsége)
KSH	Central Statistical Office of Hungary (in Hungarian: Központi Statisztikai Hivatal)
KPI	Agency for Research Fund Management and Research Exploitation (in Hungarian: Kutatás-fejlesztési Pályázati és Kutatáshasznosítási Iroda)
KTIT	Research and Technological Innovation Council (in Hungarian: Kutatási és Technológiai Innovációs Tanács)
MAG	Hungarian Economy Development Centre (in Hungarian: Magyar Gazdaságfejlesztési Központ)
MBSZ	Hungarian Biotechnology Association (in Hungarian: Magyar Biotechnológia Szövetség)
MFB	Hungarian Development Bank (in Hungarian: Magyar Fejlesztési Bank)
MISZ	Hungarian Innovation Association (in Hungarian: Magyar Innovációs Szövetség)
MNB	National Bank of Hungary (in Hungarian: Magyar Nemzeti Bank)

MNC	Multinational Company
MSZH	Hungarian Patent Office (in Hungarian: Magyar Szabadalmi Hivatal)
MTA	Hungarian Academy of Sciences (in Hungarian: Magyar Tudományos Akadémia)
MTESZ	Hungarian Federation of Technical and Scientific Societies (in Hungarian: Műszaki és Természettudományos Egyesületek Szövetsége)
MVA	Hungarian Foundation for Enterprise Promotion *(*in Hungarian: Magyar Vállalkozásfejlesztési Alapítvány)
NFÜ	National Development Agency (in Hungarian: Nemzeti Fejlesztési Ügynökség)
NKTH	National Office for Research & Technology (in Hungarian: Nemzeti Kutatási és Technológiai Hivatal)
NUTS	The Nomenclature of Territorial Units for Statistics (NUTS) is a geocode standard for referencing the administrative divisions of countries for statistical purposes, developed and used by the European Union
OTKA	Hungarian Scientific Research Fund (in Hungarian: Országos Tudományos Kutatási Alapprogramok)
RFT	Regional Development Council (in Hungarian: Regionális Fejlesztési Tanács)
RFÜ	Regional Development Agencies (in Hungarian: Regionális Fejlesztési Ügynökségek)
RTD	Research & Technology Development
RTDI	Research & Technology Development and Innovation
SVSZ	Hungarian Association of Spin-off Companies (in Hungarian: Spin-off Vállalkozások Szövetsége)
STI	Science, Technology & Innovation
TBP	Technology Balance of Payments
TEP	Hungarian Technology Foresight Programme (in Hungarian: Technológiai Előretekintési Program)
TFP	Total Factory Productivity
TTPK	Science & Technology Policy Council (in Hungarian: Tudomány- és Technológia-Politikai Kollégium)
TTTT	Science, Technology Policy and Competitiveness Advisory Board (in Hungarian: Tudomány- és technológiapolitika és Versenyképességi Tanácsadó Testület)
USD	US dollars (the national currency of the United States)
VISZ	Association of Business Incubators (in Hungarian: Vállalkozói Inkubátorok Szövetsége)

EXECUTIVE SUMMARY

Objectives

On the request of the Hungarian government, the OECD has launched its second review on the Hungarian national system of innovation (NIS), following the first one, completed in the early 1990s. The objective of the current review is "*to evaluate the current level of R&D and innovation capabilities in Hungary, and to help the government determine how such capabilities as well as their performance could be increased*". This Background Report is aimed at assisting OECD's international experts in their work.

The report provides a comprehensive assessment of the Hungarian NIS by describing its key elements, linkages and dynamics that drive it; and offering a "rough guide" on the structure and operation of the system. The national system of innovation is comprised of "*all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations."* (Edquist, 2000) Various organisations (the actors) and institutions (norms, rules, regulations, social habits) are considered as the main components of the NIS.

It is based on a wide range of statistical data, and other types of information presented in publicly available Hungarian and international reports. A limited number of interviews have also been conducted with key policy-makers and top managers of large companies. The national steering committee for the OECD review, set up by NKTH, has been consulted several times during the preparation period.

Major findings of the report are summarised below.

Framework conditions

1. Hungary has made considerable progress in closing the gap with the EU since 1997 both in terms of GDP per capita and labour productivity, to a very large extent driven by FDI and foreign trade.

2. For several years expansionary fiscal policy has also been used to boost economic growth, eventually leading to severe macroeconomic imbalances. Thus, harsh austerity measures became inevitable in 2006, hampering growth and accelerating inflation yet again. This general policy approach is coupled with unpredictable government behaviour (e.g. the tax code has been rewritten frequently). The second half of 2007 is expected to remain weak in terms of economic growth, but modest improvements are foreseen in 2008, owing to a more stable environment free of great fiscal imbalances. A new round of European Union funds will be available in 2008, expected to boost R&D as well as innovation activities.

3. Further elements of framework conditions for innovation are mixed. Administrative costs incurred by businesses are high by international standards, and that is especially unfavourable for SMEs. Markets, however, work without major governmental distortions. The IPR legislation is also in line with international standards.

Main features of the Hungarian NIS

4. Hungary spends rather little on R&D in international comparison: the GERD/GDP ratio is around 42% of the OECD average, while GERD per capita is only one quarter of the OECD average. The number of researchers per thousand labour force has reached only 55% of the OECD average, in spite of a noticeable increase in the recent years. In light of that, Hungarian researchers are fairly productive in terms of publications.

5. The intensity of patenting by Hungarian inventors is weak. The same holds for other IPR indicators, too (industrial design and trademarks).

6. In the past decade Hungary had a negative technology balance of payments. This fact highlights that the rapid modernisation of the economy and catching up is mostly fuelled by imported technologies and knowledge.

7. Only one fifth of firms operating in Hungary are innovative. Using the Summary Innovation Index – developed for the EIS –, Hungary ranks 20 among the EU27. Companies claim that the main reason for not innovating is the lack of demand for new products and services. Financial constraints – high innovation costs and lack of own resources – also hinder innovation activities of firms. No major changes can be observed when comparing CIS3 and CIS4 results.

8. The regional distribution of resources and performance is highly skewed, with an excessive weight of Central Hungary by considering all relevant indicators.

The main actors in the NIS

9. The business sector became the largest employer of researchers (FTE) in 2006, with a share of 35.6%, and firms have the biggest share in performing GERD, too.

10. The share of businesses in R&D activities (either in terms of employing researchers or performing GERD) is still rather low in Hungary in international comparison. Hungarian firms use their own funds to finance BERD to a smaller extent than their counterparts do in the vast majority of the EU countries, while the share of funding from abroad is significantly higher.

11. Both R&D and innovation activities of firms are highly skewed by size, ownership and sector. Large firms tend to be foreign-owned, and the most R&D-intensive and innovation-active sectors are also dominated by foreign firms.

12. Innovative enterprises in Hungary more or less follow the European pattern in terms of the source of highly important information for innovation, and their collaboration network is wider than the EU27 average. While partnerships with higher education institutes are important, the government sector does not play a significant role in business innovation. Financial flow data reveal that business enterprises fund research activities both in the HE and government sectors to an extent exceeding the EU and OECD averages. This high weight of business funding, however, might be attributed to the low level of the Hungarian HERD and GOVERD in international comparison.

13. The number of students in higher education has grown since the early 1990s, and the threefold increase (coupled with the significant decline in the size of the corresponding age cohort) clearly indicates a shift from elite- to mass higher education. Public expenditures on higher education as a percentage of GDP declined steadily until 2000, since then it has stagnated or modestly increased. The HE system is under a constant reform since 1990. More than 6 thousand researchers (FTE) worked in the higher education in 2006 (35% of total researchers) and spent 25% of GERD. The higher education expenditures for R&D have doubled since 2000, while the number of researchers grow only by 4% in the same period.

14. Among the public research organisations the institutes of the Hungarian Academy of Sciences (MTA) are the most important ones. Their share is significant in the national total, too: around 17% of (FTE) researchers. The other public research organisations financed by various ministries play an important role in their own sectors, while their share is rather small in the national total.

15. Several dozens of venture capital funds operate in Hungary, but the overall amount of venture capital is rather small in international comparison, and only a small fraction of the total private equity was invested in innovative firms.

16. An impressive number of bridging organisations have been set up by international and domestic public funding, but the impact of their activities is not visible in the overall performance of the Hungarian NIS. It is also telling that none of these organisations has been evaluated yet; it would be timely to have detailed, sound analyses and assessments on their contributions to improving innovation performance.

Governance

17. The Hungarian STI governance system formally consists of all the organisational elements of an advanced NIS. But a high degree of instability can be observed: the frequent changes in the status, mandates and operation of critical elements of the governance system have obviously hindered organisational learning, and thus the establishment of good practices in policy planning, co-ordination and implementation.

18. Major new pieces of legislation have been approved recently. The Law on Research and Technological Innovation, approved in 2004, has stipulated the basic principles of public support for R&D and technological innovation. The newly established Research and Technological Innovation Fund helps re-orienting private sector resources towards innovative activities, assisted by matching public funds, and makes multi-year funding possible both. The new Law on Higher Education and its modifications, in line with the Bologna process, have made significant changes in the management and functioning of higher education institutes. One of the most visible outcomes is the growing activities in relation to commercialising their intellectual assets, including spin-off formations.

19. Lack of inputs prevents evidence-based policy-making, the processes are not sufficiently transparent. Modern decision-preparatory methods – technology foresight, technology assessment, benchmarking, monitoring, and evaluation, etc. – are rarely used. Policies might be influenced by pressure groups and short-term political considerations rather than by a sound understanding of the impacts of foregoing decisions and current (as well as foreseeable future) socio-economic needs.

20. The mid-term STI strategy (approved in 2007) – as reflected by its objectives and its declared performance indicators – seems to be extremely ambitious.

21. The present STI policy mix is comprised of around 40 measures, in some cases with considerable overlaps. Public support to RTDI cannot be efficient and effective given the irregular, *ad hoc* nature of co-ordination of various STI policy tools and measures, operated by different organisations. Since only a limited number of individual measures have been evaluated so far, it is impossible to assess the policy mix as a whole. The newly introduced monitoring and evaluation strategy of NKTH and the requirement of EU on monitoring the use of EU Funds, however, may change this situation.

Human resources for RTDI

22. The rapid and profound changes in the socio-economic environment during the past 15-20 years have resulted in a fundamental restructuring of the educational system, and led to major changes in the number of research personnel, and the demand for HRST by business enterprises.

23. Major challenges in relation to the existing or potential mismatch of demand and supply in the labour market include:

- Slow and inappropriate reaction of the education system to the fast changing market requirements
- Low share of natural science and engineering graduates in international comparison and absolute shortage revealed by RTDI labour market analysis
- Serious shortage of highly qualified researchers (with a PhD degree) is projected in the medium to long-run, which may hinder economic growth and the evolution of higher knowledge-intensive activities in the country
- Limited mobility between academia and industry
- Low level of life-long learning

24. Skills, values and knowledge that are increasingly recognised by the global labour market are becoming important requirements in the Hungarian labour market as well. Any efforts aimed at improving the supply of HSRT need to have a long-term approach and much wider perspectives than a narrow focus on HE; science & technology education can only rely on a strong elementary and secondary education system, and, in turn, appropriate training and remuneration of the teachers at those levels.

Internationalisation of R&D

25. FDI has been a significant driver of the internationalisation of R&D and innovation activities since the early 1990s. Their R&D and innovation activities (training, organisational innovation, technology transfer and innovation management) have oriented the evolution of the national innovation system. The worldwide MNC networks provide opportunities to further open up the Hungarian NIS. Foreign affiliates are active in integrating their Hungarian partners into international production and innovation networks by diffusing technological and organisational innovations, as well as by setting high performance and quality standards. The R&D centres of MNCs have become part of the Hungarian NIS by building up linkages with Hungarian research units, especially with those at universities.

26. The other driver of the internationalisation of Hungarian R&D is the expanding collaboration of the R&D community with foreign partners. The Hungarian research community has widened intensively its international co-operation network since the early 1990s. The collaboration culture of both academic and business research organisations have improved in the past 17 years.

Summary conclusions

The Hungarian NIS has gone through a significant transition process since the early 1990s. Rapid and widespread privatisation processes resulted in genuine owners. The expansion of business R&D, both in terms of total expenditures and the number business R&D units, indicates a stronger base relying on which innovation capabilities can be improved, albeit from a low level. But the low share of innovative firms and the huge difference between the foreign-owned and indigenous firms' innovation activities highlight major challenges of the NIS. These figures suggest that **Hungary continues to suffer from a dual economy syndrome: it is composed of highly productive and technologically intensive foreign-owned large firms, and fragile, financially and technologically weak indigenous SMEs**. The decreasing weight of medium-size enterprises compared to 2000 is a particularly worrisome phenomenon.

The period of 1990-2007 has not been long enough to find an appropriate position for science, technology and innovation (STI) in government policies and integrate this field effectively into an overall socio-economic development strategy. The low level of co-ordination and integration across policies result in *ad hoc* policy formation and implementation.

In spite of the impressive number and range of STI policy measures, for most innovation performance indicators Hungary is lagging considerably behind most other EU countries. A number of hypotheses can be put forward concerning the root cause of this major challenge. The most plausible one stresses the chief role of the so-called framework conditions. The macroeconomic situation, the structure of the economy, the level and type of competition, the overall entrepreneurship culture, and human resources have so unfavourable impacts on innovation activities of firms that the incentives provided by STI policy schemes cannot counterbalance those effects.

The Hungarian national innovation system is challenged by the pressing need that the country should move from the dominance of low cost economic activities towards an innovation-driven economy. Several weaknesses of the current NIS inhibit this fundamental strategic move: low demand for innovation and R&D, slow diffusion of innovations, poor co-operation capabilities, and ineffective governance.

1. INTRODUCTION

The ability to enhance the innovation capabilities generated by the creation, diffusion and utilisation of knowledge has become a major source of competitive advantage, wealth creation and improvements in the quality of life. The innovation capabilities of countries, regions, and firms may determine their competitive position both locally and globally.

Hungary, as a new member state of the European Union faces many challenges with respect to sustaining her growth and improving her competitiveness. The effectiveness of the national system of innovation (NIS) plays a critical role in shaping Hungary's economic performance and social development.

But how can the challenges be successfully tackled by public policies, in which way should the country tackle effectively the global challenges in the coming 20 years? The answers to these questions may determine the path Hungary is taking. Therefore, an independent survey on the Hungarian innovation system, with a particular attention to policy options would be especially useful. Based on an agreement between the government of Hungary and the OECD, the Hungarian national system of innovation is under review by the OECD. The purpose of this process is "*to evaluate the current level of R&D and innovation capabilities in Hungary, and to help the government determine how such capabilities as well as their performance could be increased*".

This is the second time when the OECD assesses the Hungarian innovation system. The first Science, Technology and Innovation review on Hungary was conducted in the early 1990s, when the country was going through an intensive transition period from central planning to market economy. The final report of that first OECD review was published in 1993, and a follow-up report in 1995. Further, in its regular economic review on the member states the OECD usually discusses innovation-related issues as well. The 2005 economic review report on Hungary included a chapter on innovation.

Approach

In this report innovation is understood as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. A new or improved product is implemented when it is introduced on the market. New processes, marketing methods or organisational methods are implemented when they are brought into actual use in the firm's operations.

Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Some innovation activities are themselves innovative, others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation. (OECD, 2005e)

The national system of innovation includes "*all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations.*" (Edquist, 2000) Various organisations (the actors) and institutions (norms, rules, regulations, social habits) are considered as the main components of the NIS. The links between these elements are equally important in determining the performance of a NIS. Research and development (R&D) is an important element of the system, but the scope is much wider when analysing innovation and NIS.

A clear distinction has to be made between science, technology and innovation policies. We follow the definition offered by Dodgson and Bessant (1996): science policy is "concerned with the development of science and the training of scientists", and technology policy aims at the development of technological knowledge and technologies, while innovation policy focuses on the complex innovation process, aims to facilitate interactions among firms and other actors of the innovation system.

The period of the last 10 years is analysed in the report, and a longer time-horizon is only considered in those cases when it is necessary to better understand the issues in question. The first period of transition (both in the economy and in the NIS) ended at around 1998, and the present phase of transition focuses much more on 'creative destruction' (and less on 'pure destruction' as happened between 1989 and 1998). The border between these two phases is blurred, but the selection of 1998 as a breaking point seems to be an acceptable option. (Inzelt, 2004)

Objective, focus and methodology

This Background Report has been prepared for the purposes of the OECD country review of 2007/2008 on the Hungarian national system of innovation (NIS) and to provide insights for international experts before their interviews with major stakeholders. Drawing policy recommendations is beyond the scope of this report. The recommendations will be devised by the OECD.

The main objective is to offer an independent and comprehensive assessment of the overall performance of the Hungarian NIS. The report describes its key elements, linkages and dynamics that drive it; and offers a "rough guide" on the structure and operation of the system. It also identifies strengths and weaknesses and key options for different stakeholders (businesses, academia, and in particular government decision-makers).

As requested by the agreement between the Hungarian government and the OECD, a special attention is paid to the improvement of the innovation capabilities of business enterprises, the role of private and public research organisations, the higher education system, and specialised intermediaries in the generation and diffusion of knowledge and its commercialisation through innovation. It is also assessed how these processes are influenced by public policies, especially by specific government initiatives and programmes to promote R&D and innovation.

The report is based on a wide range of statistical data (from national and international sources; in particular OECD and EU datasets), and results of publicly available Hungarian and international reports, surveys and analyses. A limited number of interviews have also been conducted with key policy-makers and top managers of large companies (which have a dominant weight in business R&D expenditures in Hungary). In sum, the report combines quantitative indicators with qualitative assessments.

In the three months when preparing this report, the project team has enjoyed strong support by government officials and other stakeholders. The team is indebted for all the contributions received from these actors. NKTH staff members deserve special thanks for their supportive attitudes and active contribution in collecting information and relevant official documents as inputs for this Background Report.

The Background Report is a stand-alone document, which hopefully will serve not only the OECD country review, but can be used by other stakeholders in their efforts to improve STI policy-making, governance, and hence the overall performance of the Hungarian NIS, as well.

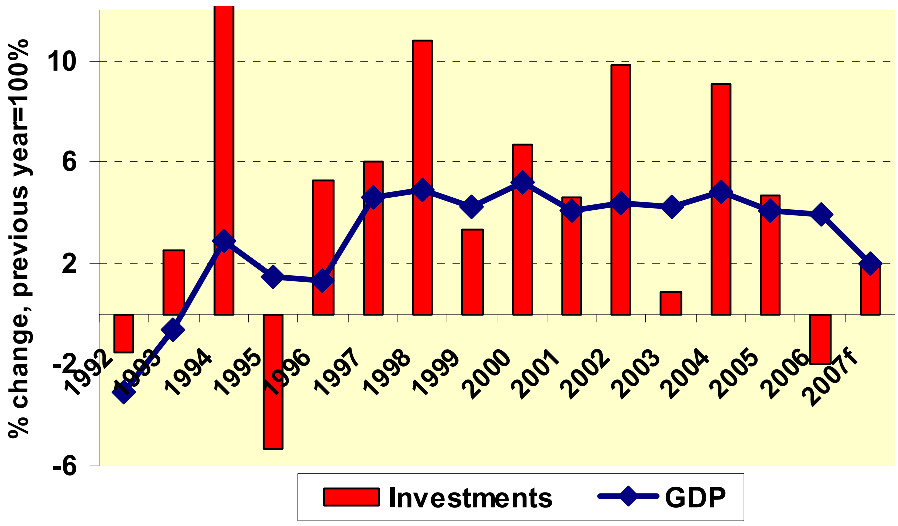
2. Macroeconomic performance and framework conditions for innovation

2.1. Drivers of macro-economic growth

Economic growth has contributed to gradually narrowing the gap between Hungary and the EU27: GDP per capita increased from 51.7% of the EU27 average in 1997 to 63.5% in 2006. Labour productivity has also improved significantly in the same period: from 62% of the EU27 average to 74.8%. However, economic growth in Hungary has been somewhat lower than its regional peers in recent years. During the 2001-2006 period, GDP growth averaged at 4.2%, compared with 6% or more in some regional peers. (Figure SA1 in the Statistical Annex) This lower growth rate in Hungary was achieved by expansionary fiscal policies of both the centre right and the centre left governments rather than excellence in innovation.

Investments have been fairly volatile since 2002. Fixed capital formation suffered a setback in 2006 due to a drop in both public and private activities. Investments in the private sector, especially in manufacturing have rebounded in early 2007 but the recovery seems fragile: overall fixed capital formation was actually close to zero in Q2 2007. The comparison to Hungary's peers underlines this weakness: capital formation soared in Slovakia in early 2006, as well as in Poland in late 2006-early 2007, and was around 5%-10% in other countries and other periods in time.

Figure 1 ***Investment and growth***



Source: KSH National accounts

Foreign direct investment (FDI) has significantly contributed to economic growth by various ways. Only considering manufacturing here, foreign-owned firms have had access to new exports markets – via their parent companies – and hence increased output considerably. Their behaviour has become decisive as they carry an extremely strong weight in the Hungarian economy: their share in manufacturing sales was 71.6% in 2002, second only to Ireland (79.5% in 2001), and well ahead of Belgium, ranked third in the OECD area with a figure of 57.2%. (OECD, 2005a) Their weight is similarly high as far as business R&D is concerned: 69.7% of BERD was financed by them in 2006. (KSH) Their presence also helps Hungarian firms learn from their superior knowledge and skills of production, finance and marketing techniques, and hence they contribute to improving economic performance in this indirect way, too. (Békés *et al.*, 2006, Halpern and Muraközy, 2007)

The stock of FDI has reached EUR 64.2bn in Q2 2007 or 70% of GDP. In per capita terms, Hungary (on a par with the Czech Republic), has one of the largest FDI stock in Central Europe.[1] (Figure SA2) As for the recent years, the inflow of new FDI halted, reinvested profit was mainly responsible for the rise in capital stock. Non-debt generating financing of the current account including FDI and portfolio transactions showed a EUR 2.5bn outflow in the first half of 2007 compared with half this size in 2005 and 2006. In 2006 and 2007, a larger share of profits was remitted abroad than in 2005. (Table SA1 in the Statistical Annex) In the second half of 2007, FDI to Hungary was actually negative, while outward FDI reached EUR 1.3bn suggesting that the unstable macroeconomic environment made foreign firms concerned and local firms look for opportunities in high growing neighbours such as Slovakia and Romania.[2]

As Hungary is a small and open economy, *foreign trade* is a key driver of growth. Exports (in euro terms) have grown by an average 17% annually between 1997 and 2007 (July). The most important engine of this expansion has been trade in machinery and equipment that has increased by an average rate of 25% per annum. For most part of the past ten years, external trade generated a deficit of about 3% of GDP. The gap has been fluctuating around 15%-20% of exports, but it shrank considerably in 2006 and 2007 to about 5% of export. (Figure SA3) Most likely, weaker domestic demand pushed imports down, and hence the improvement. A more balanced external position reduces the likelihood of a financial crisis and thus improves conditions of investment and the introduction of innovative goods and processes. (Hornok *et al*., 2006)

Productivity has been rising in the Hungarian economy at a 3-6% rate since 2000. Detailed data are available till 2004. TFP growth accelerated in the 1995-1997 period owing to a wave of FDI and restructuring. On the whole, TFP growth has been steady and positive between 1998 and 2004. Aggregate TFP growth has been the result of major reallocation of resources among industries with machinery gaining the most. In terms of sectors, motor vehicle and electronics industries have been the key drivers of TFP growth while chemical industry has shown a negative contribution for most years.

A recent study by Kátay and Wolf (2006) using firm level data suggests that the contribution of total factor productivity (TFP) to growth in Hungarian manufacturing is definitely higher then in advanced economies. The paper argues that while the production structure has already become similar to that in developed economies, transition economies can still gain by adopting „*new technologies and methods of production, privatization, infrastructural investments or the development and enforcement of laws, regulations and institutions*".

The 2007 Inflation Report of the Hungarian National Bank (MNB), based on macro-economic data, suggested that TFP productivity gains are realised in manufacturing (traded) sector, while in services no notable gains have been recorded. (www.mnb.hu) Between 2003 and the second half of 2006, productivity rose more rapidly than unit labour costs. (Figure SA4) In 2008, a moderate labour cost growth is expected as well as a modest acceleration in productivity growth.

[1] Broadening our perspective by considering all new EU member states, Estonia is well ahead of Hungary.

[2] Hungarian firms started investing abroad in the early 1990s, especially in the neighbouring countries. In 2007, the stock reached EUR 9 bn. It should also be added that other reasons might have also contributed to the growing level of outward FDI: a general observation is that a country's net outward direct investment position is systematically related to its level of economic development.

2.2. Major structural features of the Hungarian economy

Agriculture accounted for 4.2% of the Hungarian GDP in 2006, manufacturing for 22.6%, construction for 4.8%, while services for 65.6%. (KSH, 2007c) As for services, the most important sectors are wholesale and retail (11.5%), transport, storage and communications (7.6%), financial intermediation (4.5%), real estate and business activities [consulting] (17.9%), while public services account for 18.5%.

Industrial output growth has been steady of late at around 8% and this was the case in the first half of 2007. At the same time, agriculture shrank by 8% in Q2 2007 – continuing a trend of gradual loss of importance since 2001. The output in services stagnated in the January-June 2007 period, compared to a steady growth since 2001. (Figure SA5)

Table 1 ***Output growth in selected sectors (% annual change)***

	2001	2002	2003	2004	2005	2006
GDP	4.1	4.4	4.2	4.8	4.1	3.9
Industry	0.9	1.8	5.8	3.8	3.6	8.6
of which						
Manufacturing	2.6	3.8	7.2	4.1	5.4	9.6
Construction	6.3	12.9	-3.6	3.3	3.3	-3.2
Services	3.8	5.3	4.1	2.6	4.8	3.2

Source: KSH

Looking at the demand side, domestic use has been declining since early 2006, but high (net) export growth kept the 2006 growth rate close to 4%. Interestingly, trade did not contribute to growth: in Q2 2007 exports growth fell on par with imports growth. More importantly, there was a further drop in consumption in 2007, both household and government. Household consumption actually declined in Q2 2007 and social transfers fell 6% and 14% in Q1 and Q2, respectively. Government consumption dropped about 5% in H1 2007. All this suggest that the austerity measures are mostly responsible for the recent slowdown of economic growth. (Figure SA6)

2.3. Innovation and economic growth

To assess past policies, identify pertinent lessons, and thus be able to devise more effective policies, it would be crucial to establish the current and prospective contribution of innovation to economic growth. All the data needed for this exercise are available in Hungary: data on R&D and innovation activities, as well as on economic performance of firms are collected regularly, following the relevant methodological standards. These data, however, are collected via different surveys and thus stored in different data sets, which cannot be linked for legal restrictions. Hence, the way in which firm level data protection is understood and implemented in Hungary hampers any quantitative analysis on the contribution of innovation to economic growth. As a major first step to dismantle this severe obstacle, Act No. CI 2007 on "*Access to data needed for preparing decisions*" was approved by the Parliament in June 2007. This law may pave the way towards evidence-based policy-making across the government: it facilitates policy-preparatory studies serving public interest by obliging the organisations possessing the relevant pieces of information to hand over anonymised micro-level data requested by policy-making government bodies.

Until those quantitative analyses can be conducted, one can only speculate, e.g. by considering data on the composition of output, and especially that of exports. The latter suggests a quick restructuring both in terms of export markets and exported goods. (see Chapter 3.5 for further details) In other words, new products and processes have been introduced rapidly, improving efficiency considerably and thus making it possible to enter new markets. These developments are mainly due to the strong presence of foreign-owned firms and the thorough restructuring of their indigenous suppliers.

2.4. Framework conditions for innovation

There are several 'working definitions' of framework conditions for innovation, the main difference being the breadth of this concept. The broadest understanding includes the following elements: macroeconomic situation and dynamics (especially growth prospects and access to capital); the overall entrepreneurial culture; conditions for doing business (entry and exit, the nature of competition and the intellectual property rights regime); the publicly financed R&D organisations and physical infrastructure for R&D; human resources; standards and regulation. The first three sets of these factors are addressed below, while others in Chapters 4-6.

2.4.1. Macroeconomic performance

Macroeconomic developments have crucial bearings on the behaviour of businesses and on their innovation activities, specifically. As the 2005 OECD Economic Survey on Hungary pointed out: "*Healthy general business conditions are the precondition for Hungarian innovation to take off. This should be a key consideration in overall thinking on innovation policy.*" (OECD, 2005d, p. 15)

Macroeconomic performance has been rather disappointing since the end of 2001, and thus the main features are summarised here in some details.[3] The ratio of general government expenditures to the GDP grew from 46.5% in 2000 to 52.9% in 2006. General government deficit as a percentage of GDP peaked in 2006 reaching 9.2%, while general government debt as a percentage of GDP peaked at 66%. (European Central Bank Statistics, October 2007) That has lead to 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 brief, government spending in 2001-2006 undermined the fiscal stability of the country – without major achievements in terms of underpinning long-term, sustainable socio-economic development.[4]

The cost of loans and capital increased due to monetary policy measures, namely the high level of real interest rates. Price competitiveness was weakening by 20-30% in 2001-2005. Businesses, especially small and medium-sized enterprises (SMEs) serving the domestic market also had to face the inflow of competitive import goods due to the strong Hungarian currency.

Economic policy changes have been hardly predictable since the end of 2001. The tax code has also been rewritten frequently. Uncertainties generated by economic policy measures have not been reduced yet. The lack of stability – even in the short-run – in the institutional system and regulations has undermined business confidence and hence prompted many Hungarian firms to focus on short-term issues, i.e. on day-to-day survival, rather than pursuing long-term strategic goals. The weakening propensity to invest is one of the most important signs of the growing risk aversion. The annual growth rate of fixed capital investments in the business sector has been slowing down even at current

[3] Many important issues, however, are not covered here, notably the major elements of government spending, and its sustainability; inflation and the recently tense relationships between fiscal and monetary policies; the socio-economic and policy repercussions of the goal to join the euro zone; the low activity rate compared to the EU average, etc.. These issues are addressed e.g. in the recent OECD Economic Surveys on Hungary.

[4] For more details on Hungary's "*strong electoral spending cycle*", see OECD, 2007c.

prices. The investment/GDP ratio has been stuck at around 11% since 2002, while it was over 14% 1998-2000.[5] (MNB, 2006)

Elementary economics suggest that activities with long-term returns require a stable, or at least, predictable environment. Innovation and R&D are such activities: they expand in times of political, macroeconomic stability, low and stable finances and steady external assistance. This observation has been confirmed by a recent OECD study: robust output growth, stable inflation and low real interest rates are all found to be important drivers of innovation. (OECD, 2005c)

In contrast, Hungary has traditionally opted for a boom and bust policy since the 1970s, where the budget deficit soared in good times, leading to a close-to-crisis level, followed a string of austerity measures. This general tendency for instability has affected the 2000-2007 period, too: a rising budget deficit led to a harsh austerity programme in 2006-2007 altering taxation again, and cutting government spending.

In brief, the macroeconomic environment in 2006 and 2007 is unfavourable for innovation activities of firms: growth is slow, the domestic market is weak, government investment is falling, inflation has been on the rise and net foreign direct investment inflow was small or negative. The second half of 2007 is expected to remain weak. In 2008, improvements are foreseen owing to a more stable environment free of great fiscal imbalances. Successful attempts to reduce the level of indebtedness would imply the medium-term potential of establishing a more business-friendly macroeconomic environment. Significantly larger amount of European Union funds will become available form 2008, and that is likely to boost R&D as well as innovation activities.

2.4.2. Entrepreneurial culture

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",[6] (MVKA, 2004) while among the motives for opting for a self-employed status „*a business opportunity*" is ranked only fourth. (EC, 2004)

A further sign indicating weakening entrepreneurial drive is the decreasing enterprise birth rate: from 13% (2001) to 9% (2005). The number of new enterprises decreased by 24.4% in the same period. The rate of decrease has been even more dramatic in the manufacturing industries, which suffered a 46.5% setback. The birth/death ratio decreased from 1.26 (2001) to 0.98 (2004). In he same period, the birth/death/ increased from 0.85 to 0.94 in the group of medium-sized firms. (KSH, 2007b)

The size distribution of firms was heavily biased towards large businesses in the centrally planned economy era, but then it was changed rapidly and fundamentally by the transition process towards market economy. Now it resembles the European Economic Area (EEA) average. The share of SMEs in the Hungarian economy is fairly similar to that in the EEA (52.6% vs. 51%, respectively), while the share of medium-sized enterprises is higher (18.3% vs. 15.7%). In manufacturing, electricity, gas & water supply, transport, postal services & communication large firms dominate the market, while micro-firms (usually a single person "enterprise") are particularly active in education and health & social services. (Table SA2)

The weight of small firms might suggest a high degree of entrepreneurship. Both CIS3 and CIS4 data are sobering in this respect: 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. (Chapter 3.6)

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[5] The deteriorating macroeconomic framework conditions can be synthesised by recalling the 2005-2006 Global Competitiveness Report: using the macroeconomic environment index, Hungary has been ranked 63 among the 117 countries covered by the Report.

[6] It is usually referred to as "forced entrepreneurship".

2.4.3. Conditions for doing business

A key factor hampering businesses to enter the market is the high level of **administrative costs** businesses incur at various stages of their operation. It takes just a little bit longer in Hungary to register a new company than the OECD average (16 vs. 14.9 days), but costs are around 3.5 times higher (17.7 vs. 5.1% of GNI per capita), and the capital requirement is two times higher (65.1 vs. 32.5% of GNI per capita). As for closing down an operation, it takes double amount of resources, and 8.4 months longer compared to the OECD average. The **tax system** is also putting significantly higher administrative burden on companies, and the total tax rate is significantly higher than the OECD average (55.1% vs. 46.0% of profit).[7]

As for **competition**, recent OECD reviews have concluded that "*Hungary has caught up with typical OECD practice in terms of competition legislation and oversight. Progress has been spurred on by entry to the European Union and policy is backed by EU legislation and institutions*." (OECD, 2007c, p. 31) The Competition Office applies harsh penalties when cartel practices are noticed and can be proved, e.g. in the recent case of road construction. The government has not sheltered industry through standard protectionist measures.

The Hungarian **IPR legislation** is in accordance with the EU legislation and international treaties. The respective industrial property acts[8] are suitable to comply with the requirements of a market economy and offer an adequate protection for the innovators.

In summary

Hungary has made considerable progress in closing the gap with the EU since 1997 both in terms of GDP per capita and labour productivity, to a very large extent driven by FDI and foreign trade. For several years expansionary fiscal policy has also been used to boost economic growth, eventually leading to severe macroeconomic imbalances. Thus, harsh austerity measures became inevitable in 2006, hampering growth and accelerating inflation yet again. This 'boom and bust' policy has actually had a rather long tradition in Hungary: it has been applied since the 1970s, and hence it might be rather difficult to change this attitude. This general policy approach is coupled with unpredictable government behaviour (e.g. the tax code has been rewritten frequently). Elementary economics suggest, however, that activities with long-term returns, notably R&D and innovation activities, require a stable, or at least, predictable environment.

In brief, framework conditions for innovation have been mixed:

- *The second half of 2007 is expected to remain weak in terms of economic growth, but modest improvements are foreseen in 2008, owing to a more stable environment free of great fiscal imbalances.*
- *A new round of European Union funds will be available in 2008, expected to boost R&D as well as innovation activities.*
- *Administrative costs incurred by business are high by international standards, and that is especially unfavourable for SMEs.*
- *Markets work without major governmental distortions.*
- *The IPR legislation is in line with international standards.*

[7] For further data, as well as details of the methods, see http://www.doingbusiness.org/economyrankings.

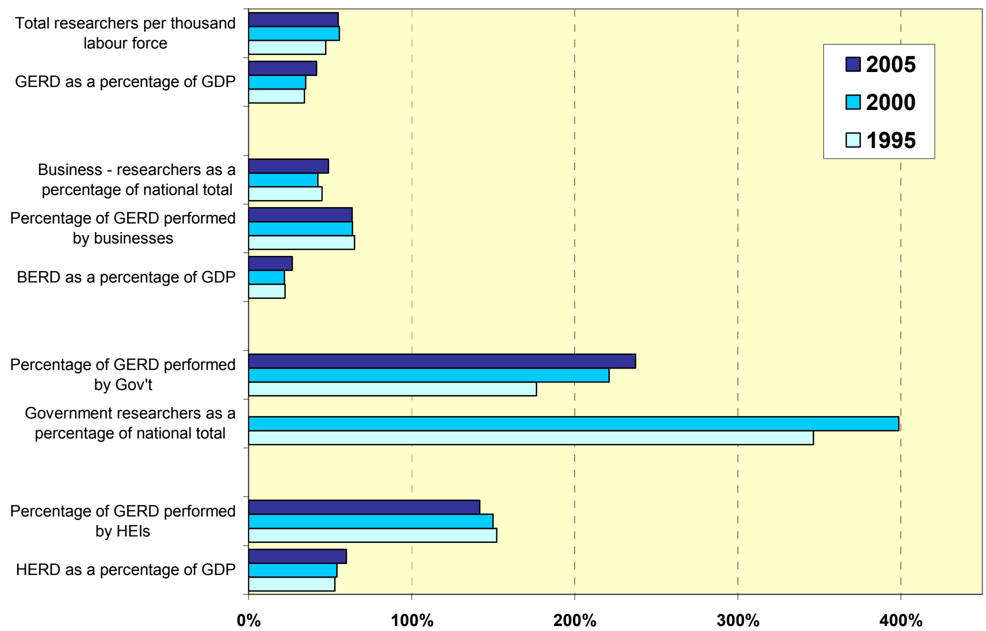
[8] Act No. XXXIII of 1995 on the Protection of Inventions by Patents, Act XXXVIII of 1991 on the Protection of Utility Models, Act XI of 1997 on the Protection of Trademarks and Geographical Indications, Act No. XLVIII of 2001 on the Legal Protection of Designs

3. HUNGARY'S R&D AND INNOVATION PERFORMANCE

Hungary's performance in R&D and innovation (RTDI) is assessed in this chapter, combining quantitative indicators with qualitative assessment. This analysis covers the performance of the three major RTDI performing sectors, capturing the dynamics in performance, and putting it into comparative perspective. First a broad brush international comparison is offered, and then a more detailed analysis is provided, based on standard input and output indicators, that is, R&D expenditures and personnel, publications and citations, patenting, industrial design and trademarks, and innovation performance of businesses.

At a first glance, Hungarian RTDI activities lag considerably behind the OECD average by most indicators. While the individual indicators will be dealt with in the relevant sections of this report, some general patterns are already apparent in Figure 2. The first general observation is that the overall level of R&D activities is still way below the OECD average. Second, R&D activities of businesses – measured by any relevant indicator – are significantly lower than the OECD average. From a different angle, the government and higher education sectors account for a much higher share of R&D activities. (Table SA3)

Figure 2 ***Hungarian R&D activities relative to the OECD average, selected years (OECD=100%)***



Source: Calculation based on the OECD MSTI 2007 online database

3.1. Volume and composition of GERD

Gross R&D expenditures (GERD) fluctuated between 0.7-0.8% of GDP until 2000, and between 0.9 and 1% since 2001.[9] (Table 2 and Table SA3) GERD, however, grew significantly in absolute terms in 2005 and 2006, that is, by 14.5% in both years, and reached HUF 238 bn (approx. EUR 0.95 bn).

[9] Table 2 provides GERD/GDP figures, as calculated by the Hungarian Statistical Office (KSH), while Table SA3 is using OECD data. The data in these two tables differ; sometimes significantly, due to the fact the two organisations use slightly different GDP figures as the bases for their calculations.

Table 2 ***Gross R&D expenditures (GERD) in Hungary, 1998-2006 (current prices)***

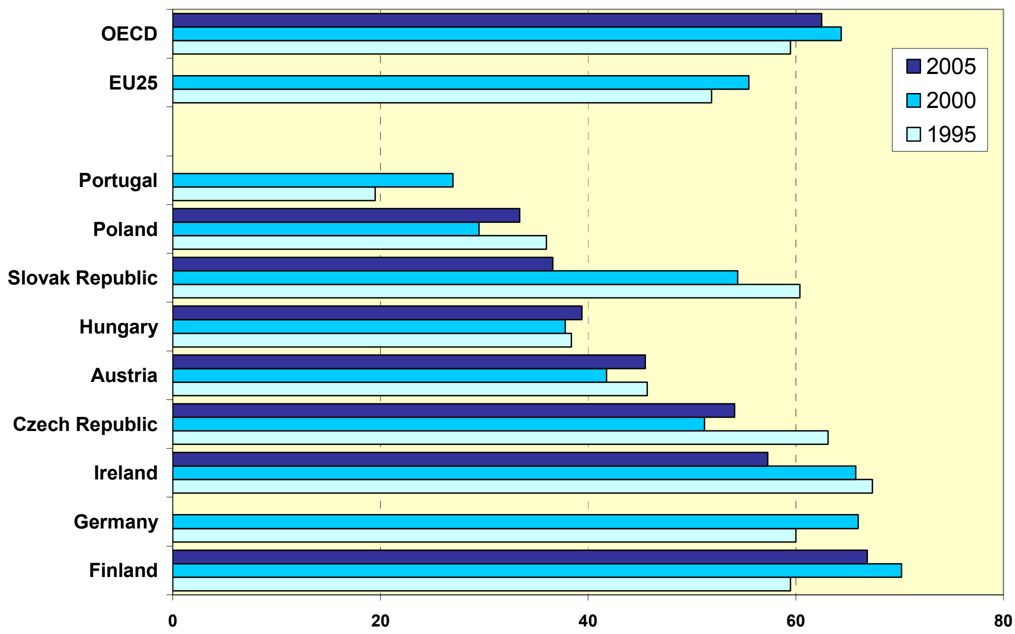
	1998	1999	2000	2001	2002	2003	2004	2005	2006
GERD (bn HUF)	71.2	78.2	105.4	140.6	171.5	175.8	181.5	207.8	238.0
GERD/GDP (%)	0.70	0.68	0.82	0.94	1.01	0.95	0.89	0.95	1.00
GERD per capita (USD)*	72.2	76.4	96.2	125.6	147.1	145.1	144.8	164.9	..

Source: KSH, Research and development (various years), GERD per capita: OECD, Main Science and Technology Indicators (various years)

* Current prices, PPP

As for the financial sources of GERD, the central budget has clearly played a dominant role in the 1990s. (Table 3) The share of businesses stagnated at around 38% in the late 1990s, followed by a temporary setback in 2001-2003. A considerable improvement has occurred since 2004, and hence this share reached in 43.3% in 2006. This is still a relatively modest figure, as the OECD average is above 60%. (Figure 3)

Figure 3 ***GERD financed by industry, selected OECD countries (%)***



Source: OECD Main Science and Technology Indicators, 2007 online database

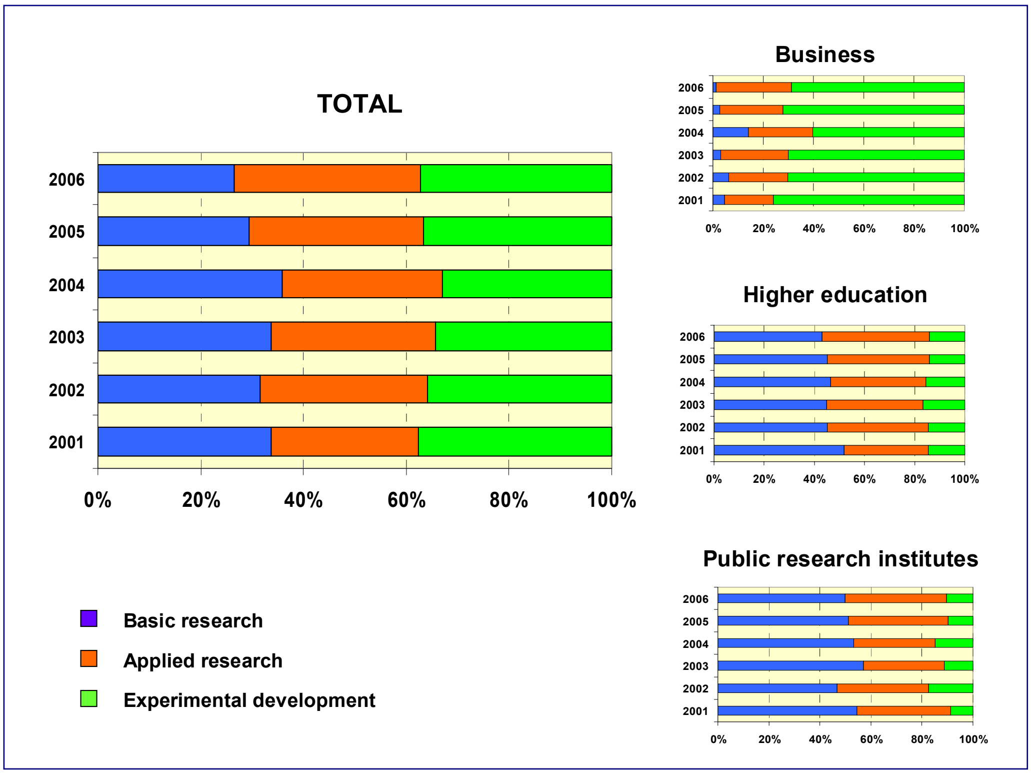
Table 3 ***Gross R&D expenditures (GERD) by financing sources, Hungary, 1998-2006 (%)***

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Business enterprises	36.1	38.5	37.8	34.8	29.7	30.7	37.1	39.4	43.3
Government	56.2	53.2	49.5	53.6	58.5	58.0	51.8	49.4	44.8
Other national source	0.4	2.7	2.1	2.4	1.4	0.6	0.7	0.3	0.6
Funds from abroad	4.9	5.6	10.6	9.2	10.4	10.7	10.4	10.7	11.3

Source: KSH, Research and Development (various years)

The share of basic research was fluctuating in 2001-2004, and has decreased since then, accounting for 26.6% of GERD in 2006. This type of research is the most important activity in the portfolio of public research institutes, while the importance of application-oriented R&D activities is slowly increasing both for higher education and public research institutes. (Figure 4)

Figure 4 ***Share of R&D expenditures by the types of activity, Hungary, 2001-2006 (%)***



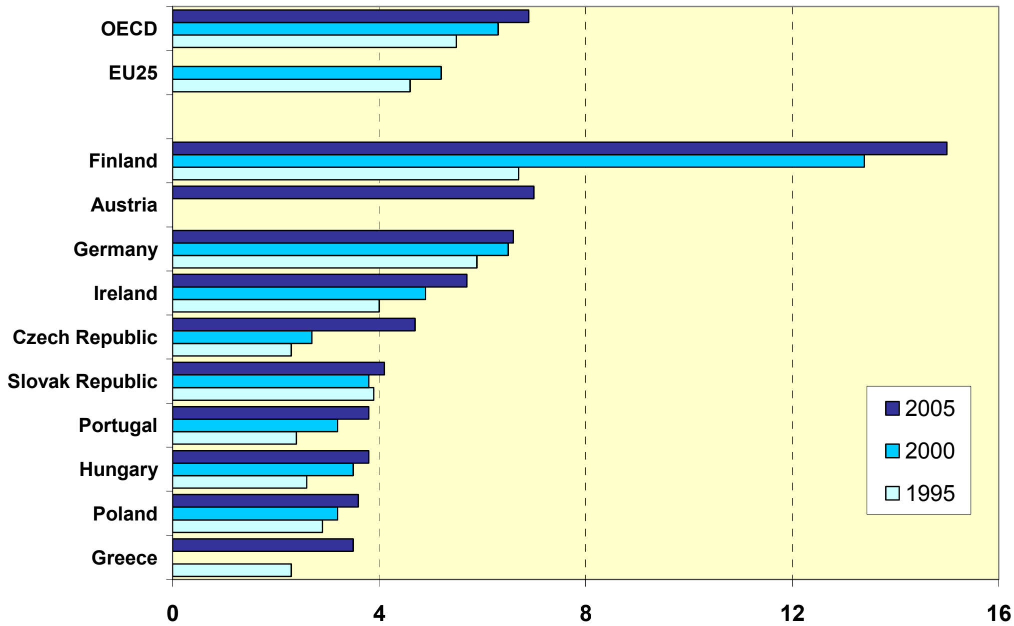
Source: KSH, Research and Development, 2006

Public research organisations and higher education institutes spend much less and lower share of their total R&D expenditures as capital investment, than companies. Businesses spent more than HUF 30 bn (26.2% of their total) on capital investments, five times more than HE, and 6 times more than public research organisations. (KSH, 2007) These figures point to the need of improving physical research infrastructure at public research and higher education institutes. (Table SA6)

3.2. Number and composition of research personnel

The number of (full-time-equivalent - FTE) researchers per 1000 workforce in Hungary barely exceeded half of the OECD average in 2005 (3.8 vs. 6.9), and the country is among the laggards in the OECD area. (Figure 5)

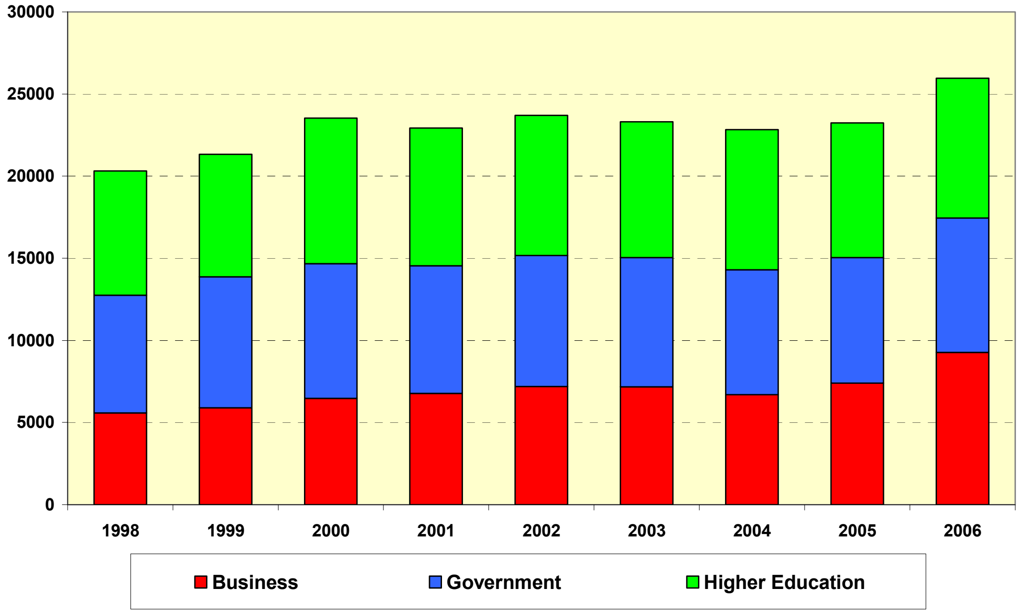
Figure 5 ***Number of researchers (FTE) per 1000 workforce in selected OECD countries***



Source: OECD, Main Science and Technology Indicators 2007 online database

The number of (FTE) researchers has increased almost every single year since 1998. However, this rise has only been sufficient to reach the 1990 level (17,550) in 2006 (17,547), that is, to compensate for the heavy losses suffered in the early 1990s. (Figure 6 and Table SA15)

Figure 6 ***R&D personnel in Hungary by sector of employment, 1998-2006 (FTE)***

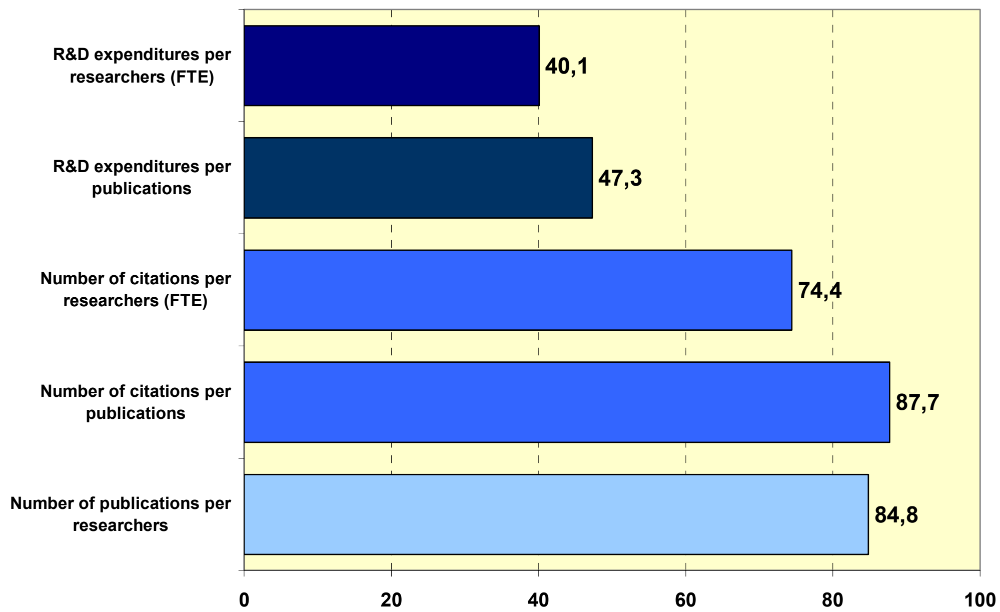


Source: KSH, Research and Development (various years)

3.3. Publications and citations

The performance of Hungarian researchers compares favourably with the EU average, following a cost/benefit approach. The 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% 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. (Figure 7)

Figure 7 ***Relative position of Hungarian scientific performance by selected indicators, 2004* (EU15=100)*****



Source: Eurostat for GERD and research personnel (FTE); Web of Science (Thomson Scientific) for publications and citations

* Citation period: 2004-2006

** The Figure follows the methodology and approach of Tolnai (2006)

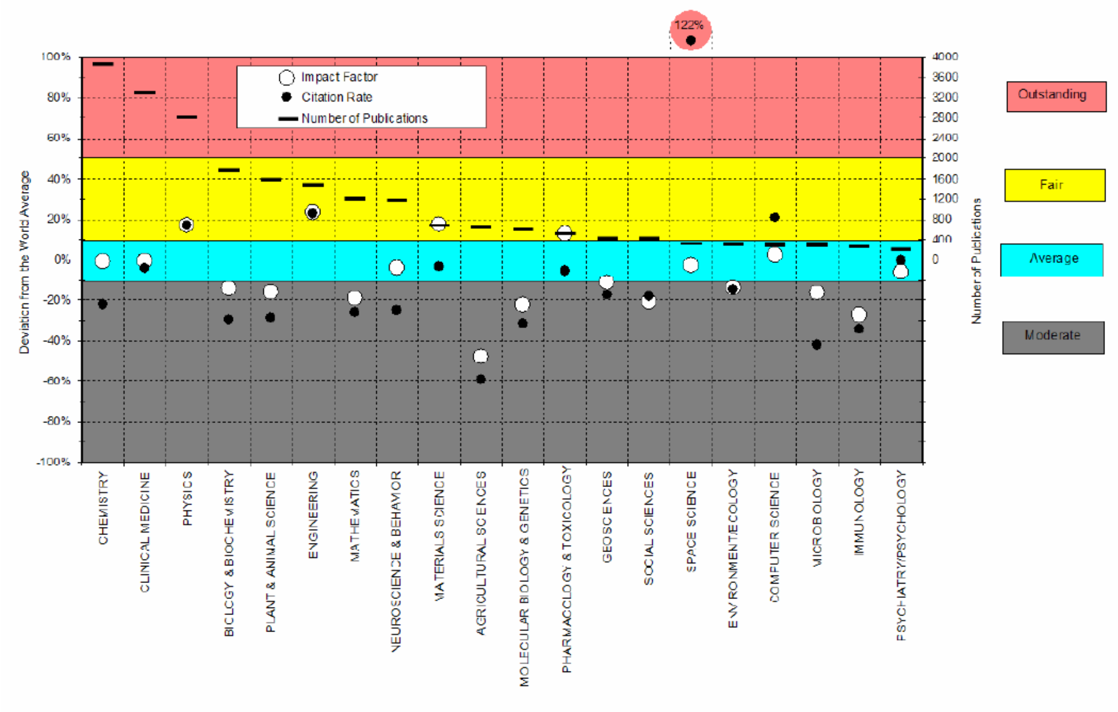
A recent study, relying on the Web of Science database, has analysed the performance of Hungarian researchers by scientific fields, using three indicators: the number of publications (output) in 2001-2005, the impact factors of journals for publications (publication strategy) and the citation rate (impact of publications). These indicators might indicate certain strengths in international comparison. 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%). Some results are highlighted below, while the details are presented in Figure 8.

Hungarian researchers working in 3 scientific fields have shown outstanding performance in terms of *the number of publications*, namely chemistry, clinical medicine and physics, their colleagues' results have been fair in 11 further fields, and average in the remaining 6 fields. In other words, no field of science has been labelled as moderate in this respect.

Only a single field of sciences has achieved an outstanding performance in terms of *citation rate,* namely space science, whereas none in terms of *impact factor*. As for citation rate, only 3 fields have shown a fair position: physics, engineering, computer science, 4 have delivered average results, while 12 fields 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".

Obviously, these results can only be taken as a starting point for a more detailed assessment of the performance of Hungarian researchers. In other words, it would be a mistake to rush into any policy conclusion, especially to base funding decisions solely on this analysis.

Figure 8 ***Hungary's position in scientific publications by selected indicators, 2001-2005***



Source: Schubert, A: Scientometric indicators of Hungarian scientific research based on the Web of Science database between 2001 and 2005

3.4. Patenting, industrial design and trademarks

Hungarian firms are far less active in filing applications for patents, industrial design and trademarks than their counterparts in advanced and EU25 countries. (Figure 9 and Table SA24)

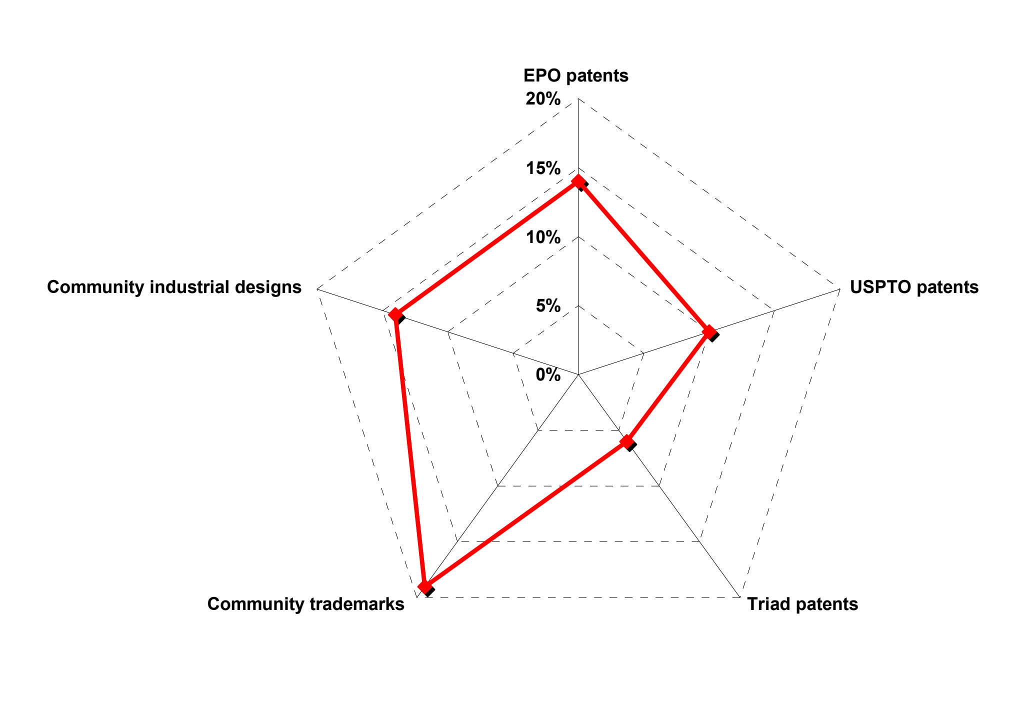
Table 4 ***Patenting activities in Hungary***

	2001	2002	2003	2004	2005	2006
National patent applications	5,451	5,906	4,810	2,657	1,275	924
Number of granted patents	1,306	1,555	1,379	977	1,126	1,089
Valid patents	10,927	10,784	10,385	9,525	9,224	9,338
Of which validated national patents	10,927	10,784	10,385	9,513	9,125	8,408
European patents validated in Hungary	-	-	-	12	99	930

Source: MSzH data, 2007

The number of national patent applications has even decreased significantly since 2003. (Table 4) This sudden drop is due to the fact that Hungary joined the European Patent Convention on 1 January 2003, and thus foreign inventors have filed their applications with the EPO. The number of domestic patent applications has been stagnating at around 700-800 in recent years. This low patenting intensity reflects the level of indigenous RTDI activities, and also suggests a low level of IPR awareness.

Figure 9 ***Hungarian IPR position in relation to EU25 averages (EPO, USPTO, Triad patents,[10] community trademarks and industrial design per million population (EU25=100)***



Source: EIS, 2006

3.5. Export performance

Export figures are frequently used as 'proxy' variables to assess innovation and economic performance. The composition of Hungarian exports is highly skewed by size of firms and sectors. Large firms accounted for 77.3% of total exports in 2003, while the share of SMEs was 22.7%, with a very low proportion of micro-firms (1.1%) and a modest contribution of medium-sized enterprises (13.9%). The weight of two sectors, manufacture of electrical and optical equipment and automotive industry was almost excessively high, namely 58.6%. Combining these two aspects (size and sector), the share of large firms from the latter sectors was 54.6% in the total Hungarian exports. In comparison with the EU, Hungarian large firms have much higher, while the micro-firms a much lower share in total exports. (KSH, 2006b)

[10] 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). (EIS, 2006)

Table 5 ***Composition of exports in four Central European countries, 2000-2006 (%)***

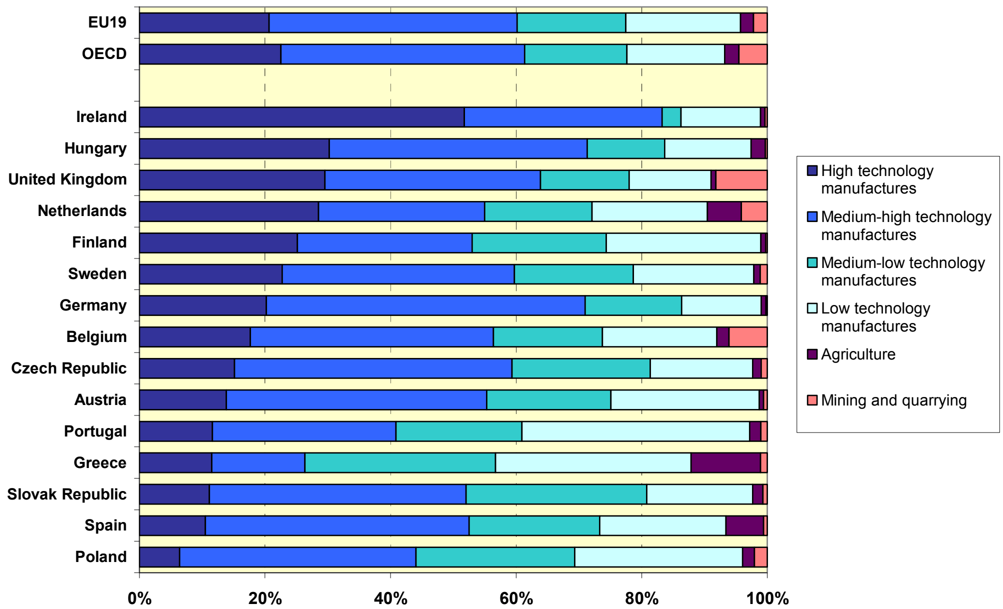
	Hungary		Czech Rep.		Poland		Slovakia	
	2000	2006	2000	2006	2000	2006	2000	2006
High-tech	27.2	27.0	5.6	14.1	4.3	6.1	3.7	13.3
Medium-high tech	39.6	45.6	47.2	46.3	37.3	42.0	43.9	41.5
Medium-low tech	11.0	11.8	24.8	21.6	24.0	23.5	29.2	26.7
Low-tech	14.0	8.7	18.5	14.1	26.4	19.2	19.0	14.1

Source: MNB, Inflation Report 2007

Hungary performs fairly well in terms of the share of goods produced by high and medium-high tech sectors compared to her Central European peers. In Hungary, 27% of exported goods were produced by high-tech sectors in 2006, compared with 14.1% in the Czech Republic and just 6.1% in Poland. (Table 5) Given the high share of technology-intensive products already in 2000, only a modest technology upgrading can be observed in Hungary: a 6 percentage point rise in the products of medium-high tech industries at the expense of those manufactured by low-tech ones.[11]

When broadening the geographical scope of this comparison, Hungary is still among the leading countries. (Figure 10)

Figure 10 ***Composition of manufacturing exports in selected OECD countries, 2005***



Source: OECD Science, Technology and Industry Scoreboard, 2007
Note: EU19 consists of countries with both EU and OECD membership

Hungary's relative share in total OECD manufacturing exports has been growing between 1998 and 2004. The growth rate of the relative high-tech export exceeded that of the average trade. (Figure

[11] The share of high-tech products in the peer countries rose substantially between 2000 and 2006 – albeit from a much lower level.

SA7) According to the European Innovation Scoreboard, Hungary over-performs the EU25 averages by several relevant indicators.[12]

A number of factors should be considered when appraising these figures from a policy point of view. First, one should keep in mind the very high share of FDI in Hungarian manufacturing (Chapter 2), coupled with the weight of foreign-owned firms active in sectors that are classified as high-tech ones by the OECD, given their R&D intensity. Second, although these sectors are regarded as "engines of growth", a number of recent theoretical and empirical analyses refute this widely held, uncritically accepted view. (Hirsch-Kreinsen *et al.*, 2005; Smith, 2002, 2003; Szalavetz, 2005; von Tunzelmann and Acha, 2005) Third, R&D-intensive industries (or services), as classified by the OECD, are not necessarily R&D-intensive ones in all countries.[13] Thus, it would be a gross mistake to regard these sectors as 'technology leaders' – with all the assumed positive impacts on growth and competitiveness – in Hungary (and several other countries). In other words, one should make a clear distinction between high-tech sectors and knowledge-intensive activities. (Havas, 2006a) The level of local knowledge content is rather low in those high-tech sectors of the Hungarian economy that are major exporters.

Further, these favourable exports figures can cause a significant policy problem, if decision-makers do not realise the close links between domestic R&D efforts, innovation and economic performance. Economic development can indeed be maintained, or even accelerated, without indigenous R&D and innovation efforts for several years, thanks to foreign direct investment. Yet, in a longer run it might grow to a significant challenge: a country opting for this 'development' path is likely to become overly dependent on foreign technologies. Moreover, in an extreme case, when not only R&D activities, but also non R&D-based innovation activities – technological upgrading and organisational innovations – are ignored, it could also lose its former attractiveness based solely on low factor costs, notably wages: there are always locations at a lower cost level for simple assembly jobs, characterised by low knowledge intensity.

3.6. Innovation performance of businesses

Internationally comparable data clearly suggest that Hungarian enterprises innovate to a significantly lower degree than businesses in most EU member states. (CIS3 and CIS4) Only about every fifth Hungarian enterprise (with more than 10 employees) reports some kind of innovation activity. (23.3% vs. 44% in the EU15 in 1999-2001, and 20.9% in 2002-2004) This figure puts Hungary to the last but one among the EU25 countries. (Table SA25)

The majority of companies (59%) did not innovate due to the lack of demand for new products and services. Similarly to the other countries, Hungarian enterprises mentioned "innovation costs too high" and "lack of own resources" as the two main obstacles hindering innovation activities. (CIS4)

In contrast to businesses in the EU15, a majority of innovative Hungarian enterprises only introduced product innovations without process innovations in 1999-2001. CIS4 data show a modest improvement in this regard: a relative majority (38.1%) of firms combine these two basic types of innovations, but the Hungarian rate is still lagging behind the practice of advanced countries.[14]

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[12] Employment in medium-high and high-tech manufacturing in Hungary was 23% above the EU25 average; while the share of exports of high-tech products exceeded the EU25 average by 18%.

[13] In fact, R&D intensities of the so-called ICT high-tech industries were way below the OECD high-tech threshold in 1995-2000 in a large number of OECD member states: all the four Central European member states, as well as Denmark, Italy, Korea, Mexico, Portugal and Spain. What is even more striking, the R&D intensity of the high-tech ICT sectors was below the average R&D intensity of manufacturing industry in the four Central European countries. (Srholec, 2006)

[14] Both theoretical considerations and empirical analyses suggest that combining product and process innovations (a) reduce the chance of failed innovation efforts; and (b) increase the economic impacts of innovation. (Cefis and Marsalis, 2005, Mohnen *et al*., 2006, Tang, 2006)

With regard to innovation expenditures (including R&D spending as well as expenditures on machinery, equipment, licences and know-how for the introduction of new products and processes), innovative Hungarian manufacturing companies spent only slightly less in relative terms (as a percentage of turnover), than the leading countries (Belgium, Great Britain, Greece, Germany and Slovakia) in 2000.[15] According to the most recent data (2004), Hungary fell back to the bottom third of the 'league' with 3.1%. (Figure SA20) Innovative Hungarian firms spent almost three-quarters of their innovation expenditures on obtaining external knowledge embodied in machinery and equipment. Thus, spending on both in-house and external R&D activities was significantly lower (13% and 7%, respectively), just as in the less developed countries of the EU. (Table SA29)

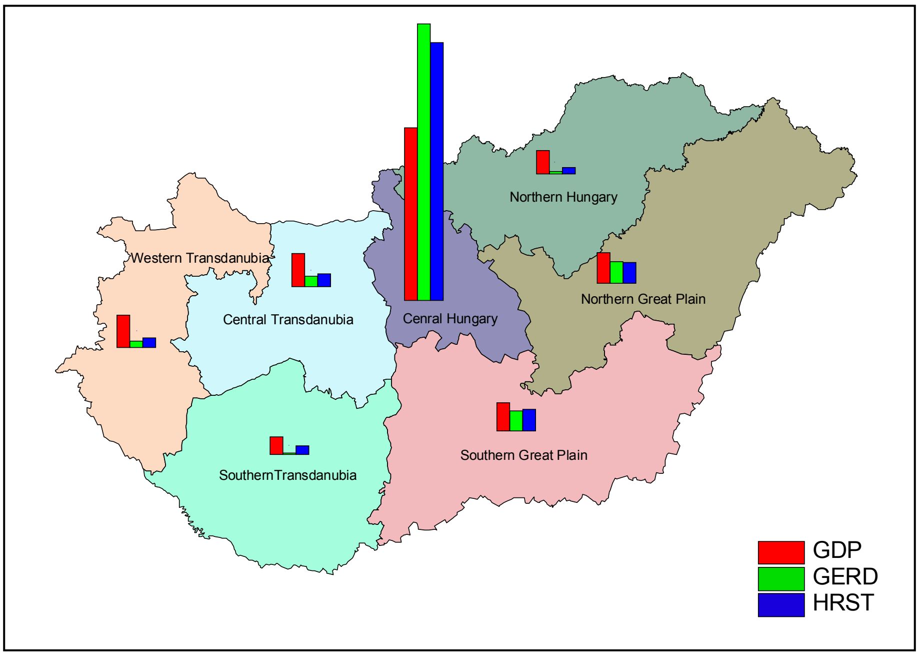
In terms of the share of new products within the turnover of enterprises, Hungary performs around average. (Figure SA21)

3.7. Innovation at a regional level

Hungary is composed of seven statistical-planning regions. The regions have been defined following the guidelines of the EU in order to form planning entities, which could be recipients of the EU Structural, Cohesion and other Funds.

Central Hungary has an excessively high share in terms of GDP, GERD and human resources for science and technology (HSRT). (Figure 11) GDP/capita and GERD/GDP are about 1.5 times higher than the national average, and around two thirds of GERD and more than 70% of BERD is spent in this region. The share of GERD per total highly skilled labour force is about 1.6 times of the Hungarian average. (Table SA30)

Figure 11 ***Share of NUTS-2 regions in Hungary's GDP, GERD and HRST, 2006 (HU=100)****



Source: Eurostat

* See data in Table SA33

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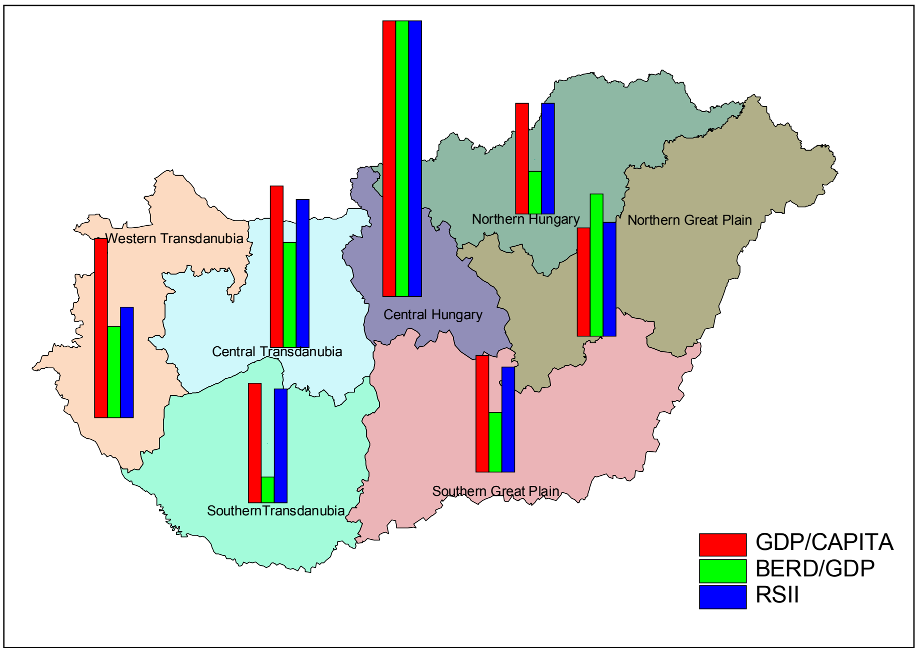
[15] The KSH (the Hungarian Central Statistics Office) has had severe concerns as to the reliability of these data, due to the very low response rate for CIS3. Thus these data are only available at the Eurostat website.

By the Regional Innovation Index of the EIS Central Hungary ranks 34 among the 203 EU regions – only Prague and Bratislava have better position among new member states. (EIS 2006) All the other regions are close to the bottom of the list.[16]

As for the geographical concentration of international patenting, Hungary had the highest level in all OECD countries in 2004, indicating that innovation is very much centred in and around the capital of Budapest. (OECD, 2007b)

Input indicators (share of R&D expenditures and share of research personnel), as well as public RTDI funding statistics suggest that Northern and Southern Great Plain have relatively strong science bases. (Table SA31, Table SA32, Table SA35 and Table SA36) Economic performance and the level of BERD, however, are modest in these regions. These facts suggest that the regional science bases are not utilised by companies in these two regions.

Figure 12 ***Relative performance of NUTS-2 regions in Hungary by selected indicators, 2006 (Central-Hungary=100)****



Source: Eurostat for GDP/capita and BERD/GDP; EIS2006 for RSII (Regional Summary Innovation Index)

* See data in Table SA34

Two other regions, Central and Western Transdanubia, show relatively good economic performance, but lower level RTDI activities. Their position in basic research activities, reflected by OTKA statistics (Table SA35), indicates that the development of the regional knowledge base should be considered as high priority in their catching up strategies. Their positions are somewhat better in close-to-market RTDI activities, such as applications and commercialisation. (Table SA36)

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[16] Central Transdanubia ranks 144; Northern Great Plain 173; Southern Transdanubia 175; Western Transdanubia 176; Northern Hungary 178; while Southern Great Plain 179.

In summary

Hungary spends rather little on R&D in international comparison: the GERD/GDP ratio is around 42% of the OECD average. Given the difference in the level of GDP, absolute figures show a much wider gap: GERD per capita is a mere one quarter of the OECD average. The number of researchers per thousand labour forces has reached only 55% of the OECD average, in spite of a noticeable increase in recent years. In light of that, Hungarian researchers are fairly productive in terms of publications. The intensity of patenting by Hungarian inventors, however, is very weak. The same holds for other IPR indicators, too (industrial design and trademarks).

Innovation data also confirm an overall poor performance. Using the Summary Innovation Index – developed for the EIS –, Hungary ranks 20 among the EU27. Only one fifth of firms operating in Hungary are innovative, and thus the country is the last but one among the EU25 countries. Companies claim that the main reason for not innovating is the lack of demand for new products and services. Further, financial constraints – high innovation costs and lack of own resources – also hinder innovation activities of firms. (CIS4) By comparing CIS3 and CIS4 results no major changes can be observed.

The regional distribution of resources and performance is highly skewed, with an excessive weight of Central Hungary by considering all relevant indicators.

4. ORGANISATIONAL PROFILE OF HUNGARY'S NATIONAL INNOVATION SYSTEM (NIS)

4.1. Overview of major actors and other elements of the Hungarian NIS

Hungary has all the major elements of a potentially successful national innovation system (NIS): a fully fledged education system; internationally recognised research units both at universities and the institutes of the Academy of Sciences; an increasing number of business R&D units, several of them operated by multinational firms and thus integrated into international networks; a number of government bodies engaged in STI policy-making and a considerable number of policy schemes in place; various types of professional associations and chambers; a functioning capital market, complete with venture capital funds; a legal infrastructure up to international standards; norms and values compatible with the requirements of a market economy based on private property; creative people; etc. Yet, performance is far from satisfactory. In brief, two major reasons can be identified. First, although these 'nodes' of the NIS are set up, a number of them do not work satisfactorily, or still fledgling. Second, as innovation studies stress, the major factor determining the overall innovation performance is not the performance of the individual organisations, but the intensity and quality of linkages and co-operation among them. (Fagerberg *et al.* (eds), 2005; Lundvall *et al.,* 2002; Niosi, 2002)

This chapter is briefly characterising the major sectors engaged in RTDI activities and the links among them, while Chapter 5 describes the main policy-making actors of the Hungarian NIS.

Research organisations and research staff

The number of R&D organisations has nearly doubled since 1995, due to a significant expansion in the higher education (HE) sector, especially up to 2004, but more recently given the boost in the business sector: from 226 R&D units in 1995 to 1,027 units in 2006. The largest number of research units are still operated in the HE sector: 1,552 of the total 2,787 in 2006. (Table SA5)

The business sector became the largest employer of researchers (FTE) in 2006, with a share of 35.6% (up from 31.6% in 2005), followed by the higher education sector (HE) with 34.6% (down from 37.2%) and the government sector[17] with a weight of 29.8% (down from 31.2%). (For further details, see Table SA16 and Table SA17)

The share of businesses has also increased in the employment of researchers with scientific degrees since 2003. However, this ratio is still the lowest, staying well below 10%, with the HE and the public research sector employing roughly 70% and 20%, respectively. (Table SA23)

R&D spending

The business sector has spent the largest amount of funds on R&D already in 1999, followed by the government sector and higher education, and this ranking has not changed since then. (Table 6)

[17] In the Hungarian statistical nomenclature the "government sector" – as it is defined by the OECD – is called „R&D institutes and other research units"; i.e. these two terms are equivalent. The second part of the Hungarian term, namely "other research units" refers to R&D units operated at/by national and regional archives, libraries, museums, hospitals and ministries. In brief, the following three notions should be understood as synonyms in this report: the government sector; R&D institutes and other research units; R&D institutes.

Table 6 ***Distribution of GERD by research performers, 1999-2006 (m HUF)***

	1999	2000	2001	2002	2003	2004	2005	2006
R&D institutes and other research units	25,247	27,494	36,391	56,328	55,091	53,640	58,171	60,373
Higher education	17,472	25,310	36,193	43,135	46,972	44,615	52,246	57,943
Business enterprises	31,458	46,704	56,372	60,828	64,566	74,641	89,703	114,872

Source: KSH, Research and Development, 2006

4.2. R&D and innovation activities in the business sector

The structure of the economy has changed significantly since 1990. The number of firms increased sharply, especially that of the micro-enterprises. The density of companies is higher than the EU average, while their average size is smaller.[18]

One of the most worrisome performance indicators of the Hungarian NIS is the low level of business expenditures on R&D in international comparison, measured either as a percentage of GDP or that of GERD. The Hungarian BERD/GDP ratio was a mere 37% of the EU25 average (0.41% vs. 1.11%) in 2005, and only 27% of the OECD average (1.53%). (Figure SA9)

As for the evolution of business R&D expenditures, a steady growth can be observed since 1999, and an especially fast one from 2004 on. (Table SA7) Although BERD has doubled between 1998 and 2005, the BERD/GDP ratio only grew by 60%, given the dynamic economic growth recorded in those years.

The compound growth rate of Hungarian BERD (in constant prices) significantly exceeded the corresponding figures both for the EU25 and the OECD since 1999, with the exception of 2002 and 2003.[19] (Table SA8)

The R&D activities of Hungarian firms are financed by three main sources. The most significant one is their own funds: 75.6% in 2006, that is slightly below the EU average of 82.0% (2003). Funds from abroad accounted for 15.9% of the Hungarian BERD, well above the EU average (10.0% in 2004). Finally, the weight of public funds was 8.4% in 2006,[20] that is, just above of the EU average (7.9% in 2004). (Figure SA10)

As for the share of (FTE) researchers employed by businesses, Hungary lags considerably behind the EU and the OECD averages. (Figure SA17) As already mentioned, the number of R&D units operated by enterprises has grown significantly – albeit from a very low figure. (Table SA13) Hence, the average size of these units (measured by the number of researchers per units) has dropped to 8.2 in 2000, and then to a mere 6.1 in 2006. This value roughly corresponds to the national average, but is way below the figure for public R&D institutes, namely 25.1.

The R&D expenditures of businesses are heavily skewed: large enterprises (i.e. those with at least 250 employees) account for 70 to 80 percent of BERD. (Figure 13 and Table SA10)

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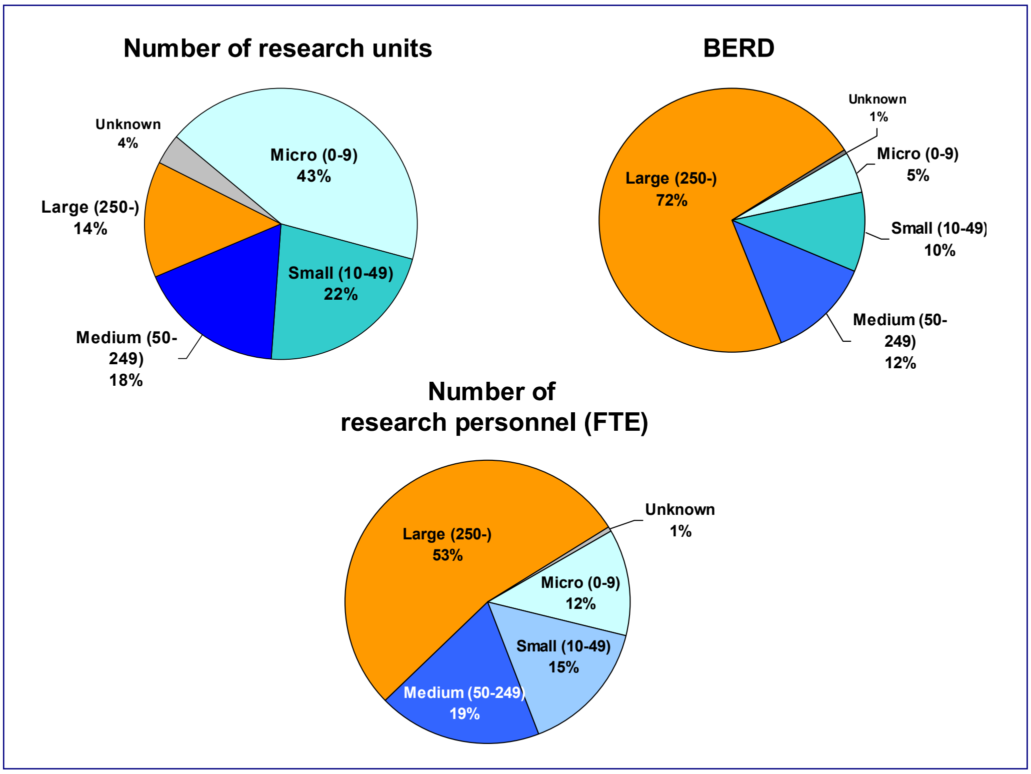
[18] In 2003 the number of enterprises per 1000 inhabitants was 61 in Hungary and 49 in the EU15, the average size of firms was 5 employees in Hungary, while 7 in the EU15. (KSH, 2006b)

[19] The Hungarian performance in this regard is by no means exceptional when compared to “peer” countries, i.e. CEE countries. With the exception of Slovakia, these countries performed equally or even more successfully.

[20] Tax holidays for R&D, in line with international practice, are not included in this figure.

Figure 13 ***The distribution of Hungarian business R&D activities by size, 2006***



Source: KSH, Research and Development, 2006

With regard to the number of enterprises undertaking R&D activities, and the research personnel employed, the picture is more balanced, with micro enterprises and SMEs having gained a larger share in recent years. (Table SA11 and Table SA12)

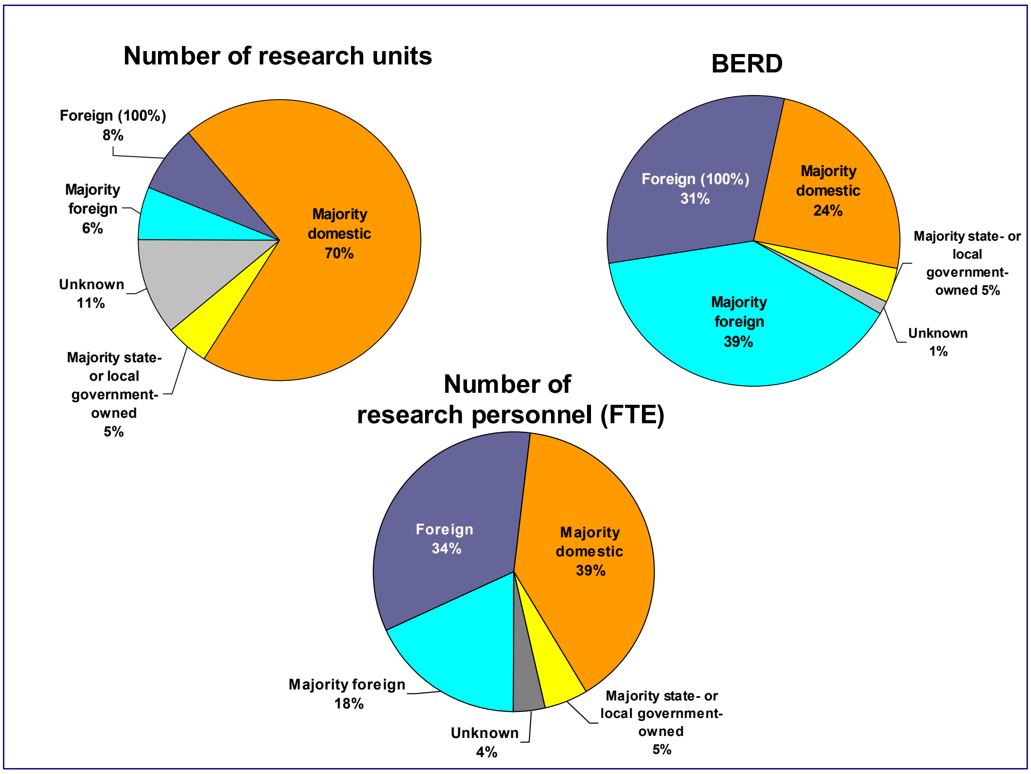
Innovation survey data offer a fairly similar picture: the share of innovative firms among the large ones was 52.4%, while this ratio was 16.9% for small ones (with 10-49 employees) in 2002-2004. (Table SA26)

As large firms tend to be foreign-owned, businesses with majority or full foreign ownership spend disproportionately more on R&D than indigenous ones. Though the share of business R&D units operated at foreign-owned businesses has remained below 15%, these firms account for about 70% of BERD. (Figure 14 and Table SA9)

Again, innovation data are in line with R&D figures: CIS3 results clearly show that indigenous firms innovate to a much smaller extent (15.1%) than foreign (21.5%), and especially jointly owned ones (34.2%). The distribution of innovative firms by ownership is not available for 2002-2004 (CIS4), but there is no reason to assume that it has changed to a significant extent since 2001, that is, the year for which CIS3 data are available.

Business R&D expenditures as well as innovation activities are concentrated to large, foreign owned companies in a limited number of sectors. The chemical industry (mainly related to pharmaceuticals) accounted for 60.4% of total R&D spending by manufacturing companies in 2006. (KSH) That means that practically 5-6 large companies account for 35-40% of total Hungarian BERD. Several sectors perform way above the national average in terms of the share of innovative firms: chemicals, due to pharmaceuticals firms (51.9%), financial service providers (47%), automotive (37.2%), as well as electrical machinery and instruments (33.8%). A significantly higher share of large firms is innovative in these sectors, too, than that of small and medium-sized ones.

Figure 14 ***The distribution of Hungarian business R&D activities by ownership, 2006***



Source: KSH, Research and Development, 2006

The above figures suggest that Hungary continues to suffer from a dual economy syndrome: it is composed of highly productive and technology-intensive firms (most of which are large and foreign-owned), and fragile, financially and technologically weak indigenous SMEs.

4.3. Higher education

In the early 1990s, the Hungarian higher education system faced the challenges of double transformation. It had to (i) move away from the (reformed) 'socialist' system towards the traditional European one, as well as (ii) catch up with the wave of modernisation of European higher education, including changes in governance. Since the early 2000s, and especially with the new Law on Higher Education passed in 2005, the Hungarian higher education system clearly became aligned with EU structures by fully complying with the Bologna process.

The most marked change in the Hungarian higher education since 1990 is clearly the explosion of the number of students, and graduates. The number of full-time students in higher education has grown every year, and the threefold increase (coupled with the significant decline in the size of the corresponding age cohort) clearly indicates a shift from elite- to mass higher education. Accordingly, the number of graduates has also doubled between 1990 and 2006.

Higher education organisations are financed by various sources: normative support from the central budget ;[21] as well as further state support distributed via competitive schemes or agreements.

[21] The main forms of normative state support are as follows: a) for transfers received by students; b) for education activities; c) for R&D activities; d) general support; e) for performing specific tasks. Support for R&D activities is allocated according to two criteria, each having a 50% weight: i) previous scientific achievements; and ii) the number of staff members – including PhD students whose studies financed by the state – performing education and research tasks.

As for the state-run HE organisations, a 3-year contract, signed by the Ministry of Education and Culture and the given university or college, stipulates the amount of state support. The supported HE organisation should proclaim its performance targets in three fields of activities: (1) basic activity (education and research); (2) supporting activities (management and use of resources; as well as collaboration and co-operation); (3) social linkages (regional role and participation in achieving social targets). These HE organisations will be evaluated by taking into a set of indicators, including those concerning PhD courses, publications, patents and revenues raised by R&D projects. The minister of education and culture signed these contracts with all state-run HE organisations in December 2007.

HE organisations can also apply for further grants offered by national or foreign funding organisations. Tuition fees and other payments by students are becoming significant sources of revenues.

The expenditures on higher education have not kept pace with the rapidly growing number of students. Although public expenditures on higher education have increased by a factor of 14 in nominal terms, and public expenditures per student have also tripled, expenditures in real terms have decreased given the exceptionally high inflation in the mid-1990s. Correspondingly, public expenditures on higher education as percentage of GDP had declined steadily until 2000, since then this ratio has stagnated or modestly increased.

In line with the exploding number of students, and the growing demand for new areas of competence, several new institutes and faculties were established in the early 1990s. Their number stayed at around 90 until 1998, when a new structure was introduced to create large-scale integrated higher education organisations instead of the prevailing dispersed ones. The main objectives included to accommodate the increasing number of students, broaden curricula, reach critical mass for research, and improve financial efficiency. Therefore, universities – formerly compartmentalised and strongly specialised with usually rather narrow profiles – were transformed into integrated, multidisciplinary universities. This process was backed by legal requirements as to the accreditation of universities: only those higher education organisations were entitled to be accredited as universities, where at least two fields of science were present. Furthermore, the need for also led to the integration of several colleges, especially in Budapest. Currently there are 72 HE organisations in Hungary, run by the state, churches or private founders. (Table 7)

Table 7 ***The number of higher education organisations in Hungary, 2006***

	Universities	**Colleges**
State	18	13
Church	5	22
Private	-	14
Total	**23**	**49**

Source: Ministry of Education and Culture

The adjustment and modernisation of Hungarian HE have been on-going processes since the first years of transition, which have led to enormous changes both within HE organisations and in the environment of higher education. The Senates and Economic Councils have been set up and begun functioning at all HE organisations. Anecdotal evidence suggests that there are important differences between the activities of various Economic Councils. Some of them have become increasingly passive, as they only have an advisory role, and little attention has been paid to their advice. Some others have been active owing to the openness of their respective HE organisations, and even initiated further changes in governance and legal forms.

The management of these large organisations has remained in the hands of academics. Hungary has not yet found the right balance between the educational and research autonomy of HE organisations, on the one hand, and sound management of public resources, on the other. The half-hearted reform of higher educational governance structures leaves plenty of room for further improvements and new legislation.

As for the weight of the HE sector as a research performer, the largest number of Hungarian research units was operated in this sector: 1,552 of 2,787 in 2006. Their average size is rather small, however: less than 4 FTE researchers. The weight of HE (FTE) researchers in the national total has been fluctuating between 37-40% since the mid-1990s, currently standing at 34.6%. (Table SA16 and SA17)

There is a huge diversity among the OECD countries as far as the weight of the HE sector is concerned, but in general this sector is dominant in the less developed countries, while the business sector is the major player in the advanced countries. (Figure SA8 and Figure SA13, Table SA17)

R&D expenditures per researcher have been the lowest in the higher education sector for years in Hungary, currently about half of the amount spent per business enterprise researcher. (Table SA4)

New university governance system

The new law on higher education (2005) provided the legal framework for the modernisation of university governance systems.

The *Rector*, as head of the HE organisation, has remained the traditional academic leader, while two new boards were introduced: the Senate and the Economic Council.

The *Senate* is the most important body in controlling the HE organisations, including strategy implementation. It is the decision making, advisory, executive and monitoring body of universities and colleges. The president of the senate is the rector. The Senate helps define the education and research tasks, and monitors the execution thereof. It is also responsible for the creation of R&D and innovation strategy, and it approves the HE organisations' Development Plan. (Members of the Senate are elected from among the employees of a HE organisation and persons contracted by as teachers, researchers or in any other position; representatives of the student union and trade unions.)

An entirely new and unprecedented body is the *Economic Council* (variously translated as Financial Council; Financial Board) that was originally supposed to make financial decisions and supervise their implementation. The Constitutional Court rejected the latter role. The Economic Councils, thus, only have an advisory and monitoring role. For publicly financed HE organisations it is compulsory to set up an Economic Council, while for the private ones it is optional.

4.4. Public research organisations

The third major sector carrying out research activities is composed of public research organisations (PROs).

The number of PROs has almost doubled since 1995: from 107 in 1995 to 208 in 2006. (Table SA5) The number of (FTE) scientists and engineers in this sector has not increased with the same pace, but is still about one third higher than in 1995 (5,226 vs. 3,905). Its share in the total number of (FTE) scientists and engineers has fluctuated between 30.9-33.6% since 1995 (Table SA16), falling to 29.8 percent in 2006. (Table SA17)

In international comparison the number of public R&D personnel per 1000 inhabitants in Hungary is lagging behind the advanced OECD countries. (Figure SA19) The weight of PROs in the Hungarian NIS, however, is rather high in terms of the (FTE) researchers, as compared to the vast majority of OECD countries. The Hungarian indicator was the highest one among the OECD countries in 2005; the only other country with a similar share is the Czech Republic (25.3% in 2005). For most OECD member states this share is below 20%, and the EU27 average was 13.9% in 2004. (OECD, 2007e)

Two organisations, namely the MTA and the Ministry of Agriculture and Rural Development are the most important players in the Hungarian NIS to run publicly financed research organisations.

The research institutes of Hungarian Academy of Sciences

The *Hungarian Academy of Sciences (MTA)* has the right to establish and operate research institutes, libraries, archives, etc. The mission of the MTA is to expand and enrich the knowledge accumulated by its institutes and public bodies in order to advance and promote the progress, growth and rise of the nation. As a public body, it has around 13,000 members: all researchers with a Ph.D. degree can join this public body on a voluntary basis.

As of 2007 – having merged several smaller institutes in the late 1990s – the MTA had 39 research institutes and dozens of research units attached to universities. Its institutes have a substantial weight in the Hungarian research system: with 2,935 (FTE) scientists and engineers its share was 16.7% in the total number of researchers in 2006. Its role is particularly decisive in the field of natural sciences: almost 60% in terms of total expenditures for those disciplines. In terms of "output", 26.1% of books, book chapters and 37.1% of articles published in scientific journals by Hungarian authors abroad in 2006 have been written by MTA researchers. (KSH)

The MTA's budget (excluding the funds earmarked for the Hungarian Scientific Research Fund, OTKA) was HUF 34.5 bn (approx. EUR 138 m) in 2006, i.e. 14.3% of Hungarian GERD; or 32.4% of public expenditures on R&D. The biggest share of this amount, HUF 33.4 bn was provided by the central budget for operational costs, HUF 0.8 bn was for renovation and modernisation, and a further HUF 0.3 bn for investment purposes.

A reform process is underway. Its concept covers the following issues: institutes' management; new networks of MTA institutes; research assessment and related issues of financing and employment; the public body and the scientific sections and committees of MTA; links between MTA and universities; salaries, special fees (to the members of the Academy) and career path of researchers; IPR and technology transfer.

Other research facilities

The other major actor in this sector is the Ministry of Agriculture and Rural Development: 440 scientists and engineers (FTE), that is, 8.4% of the researchers employed by the government sector, or 2.5% of the national total, worked for institutes supervised by this ministry in 2006. Further, there are dozens of research units operated at/by hospitals, museums, libraries, national and regional archives, etc.

4.5. Non-profit research organisations

This sector, just as in most OECD countries, is rather small in Hungary: its share is below 1% of GERD. The most noticeable actor in this sector is the **Bay Zoltán Foundation for Applied Research.** It was established by the government in 1993, following the German example of the Fraunhofer Institute.

The main activities of the Bay institutes include: transfer of technology and provision of R&D service to SMEs in the area of material and laser technology, nanotechnology, biotechnology, information and communication technology, and logistics and industrial production technologies. Assets amount to about EUR 12 m, and the annual revenues were nearly EUR 6 m in 2006. The Bay institutes have 200 employees, three-quarter of them are researchers. The Foundation has active co-operation with partner universities: researchers lecture at universities, provide consultation for theses (both graduate and PhD students), involve students in research, etc.

4.6. Intermediary organisations and professional associations

Financial intermediaries, general innovation services, technology transfer organisations, IPR and related legal services, as well as professional associations are also crucial elements of national innovation systems, as they build linkages and networks, and promote co-operation by facilitating financial, knowledge and information flows. The most important activities are described in this sub-section, and several major players and schemes are also listed. (Table 8) Further details on these organisations are presented in Annex 1.

Table 8 ***Major intermediary organisations in the Hungarian NIS***

Financial intermediaries	Innovation services and technology transfer organisations
Corvinus First Innovation Capital Fund	HunASCO
JEREMIE	Hungarian S&T Foundation (TéT)
Hungarian Venture Capital Association	INNOSTART
INNOSTART Business Angel Club	Institute of International Technology (NETI)
Hungarian Development Bank	Regional Innovation Agencies

Interest organisations	Professional associations
Association of Business Incubators (VISZ)	Hungarian Chamber of Patent Attorneys
Hungarian Association of IT Companies (IVSZ)	Hungarian Federation of Technical and Scientific Societies (MTESZ)
Hungarian Association of Spin-off Companies (MSVSZ)	
Hungarian Innovation Association (MISZ)	
Hungarian Biotechnology Association (MBSZ)	

Source: Authors' compilation

Dozens of **venture capital funds** exist in Hungary, but the overall amount of venture capital is rather small in international comparison: its share in GDP is only 6% of the EU average. (EIS) Moreover, most of these funds are invested in non-innovative activities: just as in many other CEE countries, most players of the private equity and venture capital industry are biased towards late(r) stage, commercially proven ventures. Some investors, however, have moved towards early stage investments in technology-based firms. This is a promising sign, although the number of investments is still small.

A recent survey, conducted by the Hungarian Venture Capital and Private Equity Association, reveals that only 7.4% of the total private equity invested in 1989-2004 funded innovative firms. Altogether 34 enterprises introducing new products, services or processes, have been assisted by venture capital. (Karsai, 2006a, 2006b) One explanation for this low level investment is that there seems to be a misalignment between the prospective partners: (potential) innovators complain about lack of capital, while fund managers blame the other party for not submitting viable and attractive business plans worth funding. Another type of mismatch exists between the investors' and inventors' intentions in terms of the amount to be invested: due to the significant managerial and project assessment costs, investors would prefer to invest much higher volumes of capital than the potential projects would require. (Karsai, 2003)

Classical **business angels** are rare in Hungary: in Innostart Business Angel Club there are no more than 40 people, and the estimated number of business angels is below 2000.

Several organisations offer **general innovation services**, but the impacts of their activities have not been evaluated thoroughly.

A dozen university **liaison offices** operate at large universities. Their main task should be to keep contacts with businesses and help the university researchers to reach the business sector, however, often their main day-to-day activity is to monitor domestic and international calls for project proposals and assist university staff member in getting their proposals in shape.

The number of **larger bridging and technology transfer organisations** that offer R&D services for companies is estimated between 15 and 20. More than half of them are situated in Budapest, the others are found in the larger university cities of Debrecen, Miskolc and Szeged. Many of them operate in a science or technology park. Additionally, there are about ten industrial/ business parks, which have a high scientific profile and give home to successful companies that often co-operate with academic partners.

The Association of Business Incubators (VISZ) estimates that there are 40 **incubation facilities** in the country. Most of them operate as an industrial zone for SMEs and start-up firms. The majority of the incubation facilities have no links with universities or other research organisations. However, they often provide proposal-writing assistance and management to firms.

About two dozens of **different other organisations** are estimated to have some bridging role in the Hungarian economy. Half of them are situated in Budapest. They usually facilitate networking between companies, provide training and consultancy and occasionally connect researchers and companies.

Upon the initiative of the **Hungarian Patent Office** (MSzH) a national intellectual property information network was set up and has been operated successfully since 2003. This network includes industrial property information centre established in 21 towns within the framework of chambers of commerce and industry, info-points operating in 3 towns with the participation of experts of the Federation on Technical and Scientific Societies, as well as the 5 patent information (PATLIB) centres established in regional university knowledge centres. These centres can provide in-depth information and customised services for researchers, students and entrepreneurs.

4.7. Linkages in the national system of innovation in Hungary

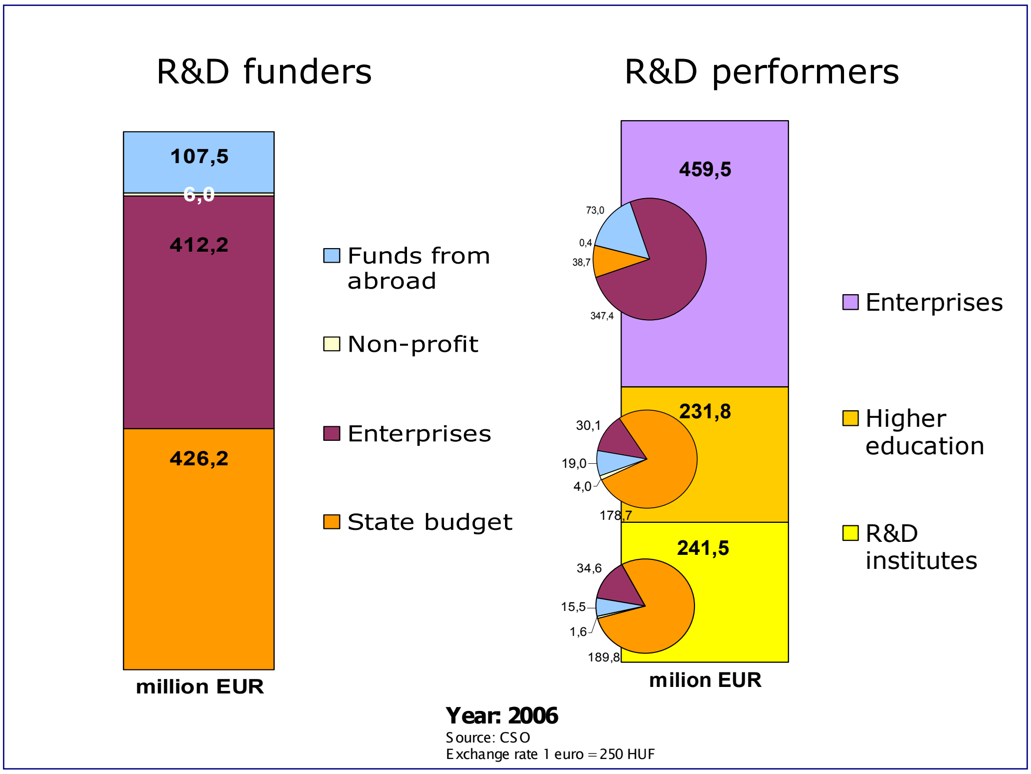
A wide variety of knowledge and skills are required for innovation processes to be successful, and these different types of inputs are distributed among various actors. Thus, their co-operation is vital. CIS data, however, reveal a low intensity of innovation co-operation in Hungary. Several STI policy measures have been devised to tackle directly this challenge. Further measures, facilitating international co-operation are also of relevance, and co-operation is promoted by a number of other schemes, too, as a complementary objective.

The role and involvement of firms in devising STI policy strategies and actual policy measures is described in Chapter 5. As for the links between businesses and intermediary organisations lack of evidence prevents any discussion on this important issue.[22] Finally, external linkages of the Hungarian NIS, that is, internationalisation of RTDI processes, and implications for the various types of co-operations among the main actors (businesses, academia, intermediary and service providers, policy-makers at various levels) are discussed in Chapter 6.

[22] However, GKI Economic Research Co. attempts to survey this question again – after 7 years – in its December round of regular surveys in 2007. Thus, results are likely to be available in time for the OECD review on the Hungarian NIS.

Several striking features can be identified by analysing **R&D funding flows**.[23] The first one is the very high share of funds from abroad, the bulk of which goes to business enterprises.[24] Second, business enterprises fund research activities both at HE institutes and in the government sector (R&D institutes) to a noteworthy extent. (Figure 15)

Figure 15 ***Funding flows***



Source: KSH; Exchange rate: EUR 1 = HUF 250

A closer look at the sources of Hungarian R&D expenditures even indicates improving co-operation among the research actors. While only 4-5% of the total higher education expenditures on R&D (HERD) were financed by firms in 2000-2001, this ratio jumped to 11-13% in 2002-2006 (13% in 2006). (Figure SA12) This is much higher than the EU or OECD average, the only OECD member country with a higher share is South Korea. This high ratio of business funding might be attributed to the low level of the Hungarian HERD in absolute terms ($320-370 million[25] in 2002-2005): a few projects commissioned by firms, amounting to relatively small funds by international standards, can lead to a high weight of business funding in HERD.

The financial links between firms and publicly financed R&D institutes show a more varied picture in recent years: the share of firms in 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. 2006 saw a significant improvement: this indicator reached 14.3%. (for further details, see Figure SA11) These variations hint to a more general hypothesis: incentives provided by various

[23] Similar types of data on funding innovation activities are not readily available.

[24] It should be stressed here that financial support provided by the EU Structural Funds is accounted for as part of the state budget, i.e. it becomes "national" funding in statistics.

[25] This figure is reported in constant prices (for the year 2000) and using purchasing power parity. (OECD, 2007e)

policy tools are just one element of a bigger, more complex system influencing innovation behaviour of the major actors.

The share of GOVERD financed by industry is higher than either the OECD or EU25 average, but below the Finnish, Slovak, Czech and British data (in descending order). Still, it is a good position in international comparison. The low volume of GOVERD, most likely, is an important factor in explaining this rank.

The 3rd Community Innovation Survey (CIS3; 1999-2001) clearly shows, however, that the linkages between Hungarian innovative companies and other players of NIS were significantly less intense than those in the EU15 countries. (Table SA27)

CIS4 results (2002-2004) suggest some improvement in two types of co-operations, namely with other firms within the enterprise group, as well as other enterprises in their sector. (Table 9)

Table 9 ***Share of innovative enterprises indicating co-operation with specified partners (percentage of all innovative enterprises)***

<table>
<tr><th></th><th>1999-2001</th><th>2002-2004</th></tr>
<tr><td>Other enterprises within the enterprise group</td><td>5.1</td><td>10.1</td></tr>
<tr><td>Suppliers of equipment, materials, components, or software</td><td>26.8</td><td>26.2</td></tr>
<tr><td>Clients or customers</td><td>24.8</td><td>19.6</td></tr>
<tr><td>Competitors or other enterprises in sector</td><td>10.9</td><td>13.6</td></tr>
<tr><td>Consultants*</td><td>14.6</td><td rowspan="2">12.6</td></tr>
<tr><td>Private R&D organisations</td><td>13.7</td></tr>
<tr><td>Higher education organisations</td><td>21.6</td><td>13.7</td></tr>
<tr><td>Government or public research institutes</td><td>8.6</td><td>5.0</td></tr>
</table>

Source: KSH (for 1999-2001), Eurostat (for 2002-2004)

* Co-operation with consultancy firms and private R&D organisations has been merged in CIS4

When analysing CIS4 data on co-operation activities of innovative firms, the Eurostat changed the reference point for international comparison: while in the case of CIS3 data it was the EU15 average, it became EU27 for CIS4 results. In this type of comparison Hungarian data are above the EU27 average for all categories of co-operation partners, except for co-operation with public research organisations. (Table SA28); for further details, see also Chapter 6.1.2) Given this methodological change, it is not possible to establish if the intensity of co-operation activities of Hungarian innovative firms has improved or not since 1999-2001 in international comparison. What we know, however, is not encouraging: the level of co-operation activities was low compared to the EU15 average in 1999-2001, and it has improved only in two types of co-operations by 2002-2004.

Foreign firms integrate their Hungarian partners into **international production and innovation networks** by diffusing their technological and organisational innovations, as well as by setting high standards in terms of performance and quality of products. Hence, certain 'archipelagos' of the Hungarian NIS are created/ strengthened this way.

Certain types of business-to-business co-operations are formalised as clusters. The total number of **clusters** or cluster-like legal and company management arrangements is about 40, and one-fifth of them **offer university-based R&D** services to the companies linked with the cluster. The working practices in most of these clusters are estimated to be at a much lower level than in their counterparts in more developed economies.[26] Many of them are not even clusters in the true meaning of the word, whereas there are other groups of enterprises that run their business more like a cluster but do not call themselves clusters.[27]

In summary

The main features of the research performing sectors are as follows:

- *Businesses became the largest employer of (FTE) researchers in 2006, and firms have the biggest share in performing GERD, too. Yet, the share of businesses in R&D activities (either in terms of employing researchers or performing GERD) is still rather low in Hungary, compared to advanced countries.*
- *Both R&D and innovation activities of firms are highly skewed by size, ownership and sector. Large firms tend to be foreign-owned, and the most R&D and innovation-active sectors are also dominated by foreign firms. These figures suggest that Hungary continues to suffer from a dual economy syndrome: it is composed of highly productive and technologically intensive foreign-owned large firms, and fragile, financially and technologically weak indigenous SMEs.*
- *The largest number of research units is operated at higher education organisations, but the average size of these units is rather small, just below 4 FTE researchers.*
- *Among the public research organisations, the MTA institutes are the most important ones. Their share is significant in the national total, too: around 17% of (FTE) researchers.*

Several dozens of venture capital funds operate in Hungary, but the overall amount of venture capital is rather small in international comparison, and only a small fraction of the total private equity was invested in innovative firms.

An impressive number of bridging organisations have been set up by international and domestic public funding, but the impact of their activities is not visible in the overall performance of the Hungarian NIS. It is also telling that none of these organisations has been evaluated yet.

Theoretical and empirical research results clearly indicate the vital importance of co-operation among NIS players, who possess different types of skills and knowledge, all needed for innovation projects. Several policy measures promote collaboration in Hungary, too. Yet, available evidence on the intensity of innovation co-operations is somewhat mixed. The linkages between Hungarian innovative companies and other players of NIS were significantly less intense in 1999-2001 than those in the EU15 countries. Some improvements have been reported, though, in the 2002-2004 survey in two categories of collaboration, while academia-industry links became even weaker. For this period, only EU27 averages are available, and Hungarian figures indicate a better performance in this type comparison, except for co-operation with public research organisations.

Financial flow data, however, reveal that businesses fund research activities both in the HE and the government sectors to an extent exceeding the EU and OECD average. This high weight of business funding might be attributed to the low level of the Hungarian HERD and GOVERD in international comparison.

[26] Practices of the most successful automotive cluster is shown in *Grosz,* 2006.

[27] One example is the group of biotechnology-nanotechnology firms in the Graphisoft Park, which have a management/ holding firm that offers various services to its – partly – daughter companies.

5. GOVERNANCE – THE ROLE OF PUBLIC POLICY

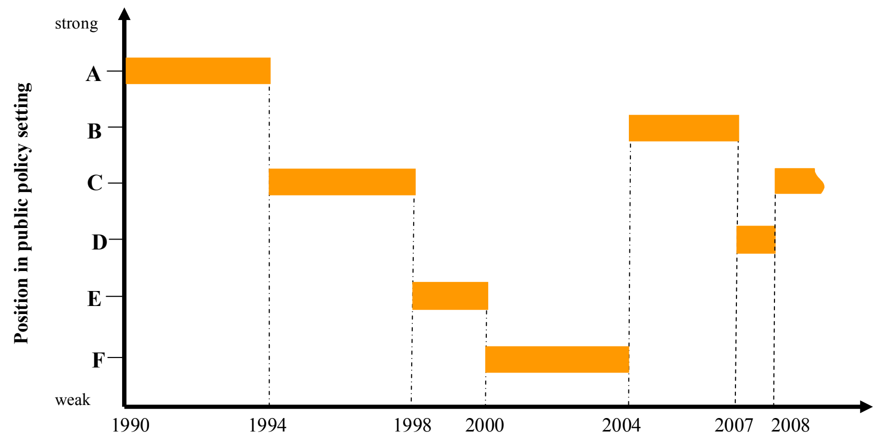
5.1. The structure of STI policy governance

5.1.1. National governance

Since 1990 the strategic planning, policy co-ordination and implementation at government level have been subject of constant reorganisation in Hungary. All governments restructured the system at least once during their 4-year terms.

The political status of the highest-level consulting and co-ordination body, the Science and Technology Policy Council (TTPK) has changed frequently. It was headed by a minister (1990-1994, 2000-2002) or by the prime minister (1994-1998 and 2002-). Its operational unit (secretariat) was in a politically strong position only at the early 90s. The body held meetings frequently until 1998 (at least four times a year), but since than it has rarely met: on average it meets once a year – its last meeting was held in January 2006 (before the last parliamentary election).

Figure 16 ***The changing political clout of the government agency responsible for STI policy implementation***



	A	B	C	D	E	F
Status	Government office	Government office	Government office	Government office	Office under Ministry	Division of Ministry
Level of autonomy	Full	Full	Full	Partial	Partial	No
Rank of the leader	Minister	State secretary	State secretary	State secretary	State secretary	Under secretary

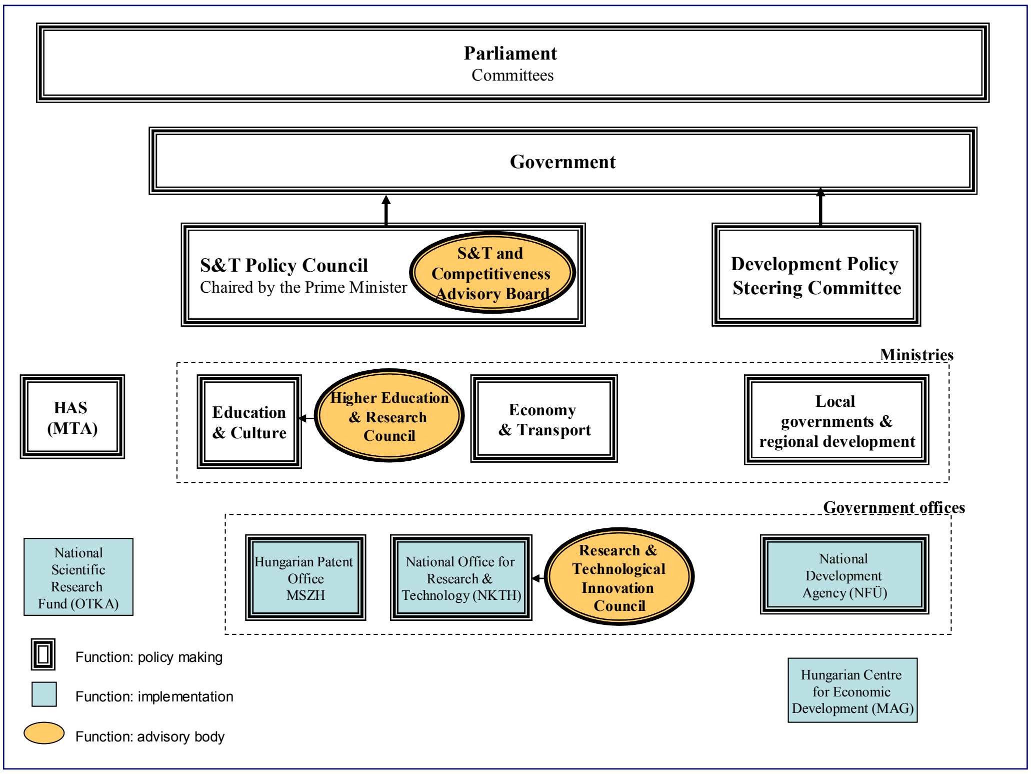
Source: authors' compilation

At the level of STI policy design and implementation the story is more colourful. Following the political changes in 1990 OMFB (National Committee for Technological Development) kept its previous position and was headed by a minister without portfolio. It played an important role in the first, very intensive period of restructuring the S&T system in the country. Since the role of government in STI has not been clarified, this organisation and its successor (NKTH) have been under constant restructuring and re-positioning by each government until today. It was a government office, sometimes under the supervision and control of a minister, but for some years it functioned as a division of the Ministry of Education.[28] (Figure 16) Since the frequently changing responsibility of ministers for supervising OMFB/NKTH, sometimes the Ministry of Education (and Culture), sometimes the Ministry of Economy (and Transport) had/has particular position in the STI governance system.

Other elements of the governance structure, including the tasks of ministries and other actors, more or less followed the re-positioning of TTPK and OMFB/NKTH.

The current STI governance system consists of two major levels: legislation and executive power. Two committees (the Education & Science and the Economic & Informatics) of the **Parliament** are the highest-level political consultative bodies in the field of STI policy. A new committee has recently been established for discussing and overseeing STI policy relevant issues (Innovation and Research Ad hoc Committee).

Figure 17 ***Major actors of the Hungarian national STI governance system and their linkages as of January 2008***[29]



Source: authors' compilation

The **Science and Technology Policy Council** (TTPK), established in its present form in 2003, is the highest-level consulting and co-ordination body on STI inside the government. The Council is responsible for discussing preparatory documents on policy decisions submitted to the Government, co-ordinating STI policy measures and facilitating their implementation. It is headed by the Prime Minister, and vice-chaired by two ministers (Education & Culture and Economy & Transport) and by

[28] But it has largely reserved its previous organisational structure and tasks still in this period (2000-2003)

[29] The figure contains only organisations which have direct function either in policy making, preparation and advising or in implementation. Important organisations, like Institute for Measurement, the Hungarian Space Agency are also constituting an integral part of the whole system.

the President of the Academy of Sciences. Other ministers[30] and chairpersons of advisory bodies[31] are members, while the presidents of NKTH and NFÜ have a permanent invitee status.

The **Science and Technology Policy Advisory Board** (called TTTT or 4T, established in 2003) is an expert committee of STI policy with advisory nature. Members of the Board are experts from industry and academia. It was renamed as Science, Technology Policy and Competitiveness Advisory Board in 2005 signalling the shift in its focus toward more application oriented policies in STI. Its mandate expired in July 2006, and has not been renewed since then.

Ministry of Education and Culture: The Ministry is in charge of the formation and implementation of science and education policies. It supervises the whole public education system from elementary schools to universities, thus it has a wide responsibility in facilitating appropriate education for the human resources for innovation. The **Higher Education and Research Council (FTT)** is an advisory body, which assists the minister in relation to higher education and academic research.

Ministry of Economy and Transport: The ministry operates a number of innovation policy measures and supervises the government offices responsible for quality management, intellectual property, standardisation, metrology, energy and consumer protection. On behalf of the government the Minister supervises the National Office for Research and Technology (NKTH).

The **sectoral ministries**, in particular, the Ministry of Agriculture and Rural Development, the Ministry of Environment and Water, and the Ministry of Health, are responsible for mission-oriented research relevant in their field of responsibility.

Research and Technological Innovation Council (KTIT): The Council's main responsibility is to make strategic decisions on the use of the Research and Technological Innovation Fund[32] (allocation strategy, funding schemes to be launched, etc.). It is a 15-member body, with six senior government officials (delegated by the relevant ministries) and nine members (including the chairperson) from business and academia. The members are appointed by the Prime Minister for 3 years. The mandate of the Council was renewed for the period of March 2007 and December 2009. From 2007 the non-governmental members are selected based on delegation of various business associations and academic organisations.[33]

The **National Office for Research and Technology** (**NKTH**) is responsible for the implementation of the government's STI policy, including the drafting of R&D and innovation programmes and managing international R&D co-operation on behalf of the government. Its president and vice-presidents are appointed by the Prime Minister. The President of NKTH is responsible for the operative tasks of the Office. NKTH submits its strategic proposals to KTIT, and until the end of 2007 implements the programmes through the Agency for Research Fund Management and Research Exploitation.[34] The division of decision-making competences between the Minister of Economy and Transport and the National Office for Research and Technology was re-allocated in January 2007, decreasing the decision making power of NKTH and giving strong rights to the minister in making operational decisions in relation to the use of the Fund. It was a major step backward as the principle of subsidiarity and autonomy of the agency has been compromised. The Parliament has modified this regulation in November 2007 and from January 1, 2008 the President of NKTH will have again a full responsibility for Fund allocation decisions.

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[30] Ministers of finance, agriculture, environment protection, European affairs and health

[31] TTTT and FTT (see more details later)

[32] The Fund is the largest public financial source for promoting innovation. (see more details in 5.2).

[33] Previously the selection was based on personal capacity of the invited individuals, following a long consultation with these and other stakeholders.

[34] From February 1, 2008 MAG will manage all the EU funded and most of the national sources financed grant systems and contracts (managed by KPI until the end of January 2008). MAG is not supervised by the President of NKTH.

The **Agency for Research Fund Management and Research Exploitation** (KPI) is responsible for managing calls for proposals financed by the Research and Technological Innovation Fund.[35] It operates under the supervision of the president of NKTH. It has two major functions: to manage fund allocation mechanisms and contracts and to provide advisory services for S&T stakeholders at national and regional level in dissemination. From January 1, 2008 KPI will be integrated into NKTH.

From 2007 the **Hungarian Economy Development Centre (MAG Zrt**.) has taken the management of all grant schemes and contracts financed by the EU Funds in relation to economic developments.[36] As a consequence, the management of nationally and EU funded STI grants are organisationally fully separated. Measures financed by purely national sources are managed by KPI (from January 2008 by NKTH), while the EU-funded ones by MAG.

Hungarian Patent Office (MSZH): The Hungarian Patent Office, established in 1896, is the principal government organisation in charge of intellectual property protection. On behalf of the government it is supervised by the Minister of Economy and Transport. MSZH's functions include, inter alia, (1) the official examinations and procedures in the field of industrial property, (2) preparation and implementation of the Government's strategy for the protection of intellectual property; (3) suggesting and implementing policy measures in relation to its mission, and (4) performing international and European co-operation in the field of intellectual property protection.

Hungarian Scientific Research Fund (OTKA): OTKA was established by law in 1991 with strong mission to provide support to scientific research and to develop the research infrastructure. It functions as an independent grant agency with a strong focus on basic research. Special consideration is given to develop a new generation of researchers. It enjoys a full independency in setting up its fund allocation strategy, launching funding schemes and making decisions on supports for research projects. Due to a restrictive fiscal policy, the annual budget of OTKA has steadily been decreasing even in nominal terms in recent years: HUF 5.85 bn (~ EUR 23.4 m); HUF 5.63 bn (~ EUR 22.5 m); and HUF 5.18 bn (~EUR 20.7 m) in 2005-2007, respectively. (www.otka.hu)

National Development Agency (NFÜ): This government agency is assigned to carry out mid- and long-term development and planning activities, to prepare and implement strategic plans and operational programmes in order to exploit EU Cohesion and Structural Fund support, including the STI policy priorities of the First National Development Plan 2004-2006 and the National Strategic Reference Framework for 2007-2013. It is the highest implementing body within the development policy framework. Furthermore, with the exception of the Agricultural and Rural Development Operational Programme (OP), NFÜ is in charge of all the Managing Authorities of the various OPs financed by the Cohesion Fund and the Structural Funds of the EU. On behalf of the government the Minister for Local Government and Regional Development supervises the NFÜ, and co-ordinates the development policy efforts of the government and the various interested governmental agencies. The most important decisions on strategic socio-economic issues are discussed by the **Development Policy Steering Committee (FIT**). It is headed by the Prime Minister, and its members are responsible for various policy objectives.

Hungarian Academy of Sciences (MTA): According to the Act XL of 1994, the Hungarian Academy of Sciences is a self-governing public body. It has a high degree of autonomy in scientific, political and financial respects. The president of MTA reports to the Government (every year) and to the Parliament (every other year) on the state of art in S&T in Hungary. Its budget is appropriated by the Parliament.

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[35] Between 2004 and 2006 this agency also administered the RTDI calls of the first National Development Plan, financed by the EU.

[36] MAG was established by the Hungarian Development Bank in October 2006 to administer the projects financed by the Economic Development Operational Programme (EDOP) of the New Hungary Development Plan (2007-2013).

5.1.2. Regional governance of innovation

As introduced in Chapter 3.7 the country consists of 7 NUTS-2 regions. These regions are recipients of development funds, but they have no any decision-making power on education or STI.

In STI policy formulation the role of **Regional Development Councils (RFT**) has recently been strengthened. They have two principle sources of funding for RTDI projects: a contribution from the central government budget, as well as 25% of the Research and Technological Innovation Fund to be spent on promoting RTDI activities at regional level. The **Regional Development Agencies (RFÜ**), founded in 2004, act as the operational arms of the RFTs.

According to a recent NKTH funding scheme all the regions have established **Regional Innovation Agencies (RIÜ)**.

Despite this step-by-step development, the governance of innovation policy at regional level is far from being well-developed, **dependence on the central government** is still high and regional strategic actions are difficult to co-ordinate with stakeholders.[37]

In regional innovation systems the enterprise promotion agencies obviously play important roles. In direct regional and local business support, the **Hungarian Foundation for Enterprise Promotion** (**MVA**) has the widest network. It implements the SME development programmes of the government through a network of 140 Local Enterprise Agencies, set up jointly by local authorities, business associations and local chambers of commerce. Within this network, general business incubators provide favourable conditions for micro and small enterprises. Innovation is not (yet) a core theme for the Foundation.

5.2. Regulatory framework

In the 1990s the regulatory framework in relation to innovation was aligned to the needs of the market economy and the EU guidelines, including the functioning of the capital and labour market, intellectual property rights and competition/fiscal/trade policies. The laws on the Hungarian Academy of Sciences (1994), on higher education (1993) and on venture capital (1998) directly aimed at reforming the innovation system and promoting innovation activities.

As a reaction to newly emerging challenges and opportunities three important new acts have recently been accepted by the Parliament:

- Law on Research and Technological Innovation (Act of CXXXIV of 2004)
- Law on Research and Technological Innovation Fund (Act of XC of 2003)
- Law on Higher Education (2005)

Law on Research and Technological Innovation

The main objectives of this law are to promote sustainable development of the Hungarian economy via the exploitation of R&D results and technological innovation, to enhance the competitiveness of enterprises and to create jobs with high value added activities.

The law highlights the role of governments in promoting innovation by saying that the state promotes business R&D and technological innovation activities without distorting market competition. The state should co-operate with businesses to improve the infrastructure and institutional system for R&D and technological innovation. Public resources should be spent through open and competitive schemes which must be regularly monitored and evaluated. Small and medium sized enterprises

[37] For an example see: Borsi et al. (2007)

(SMEs) should be given a preferential status in the government's innovation and R&D policies. It defines a wide range of innovation services to enterprises on both national and regional levels.

The law has a more declarative than a regulative character, but it played and plays an important role in highlighting the importance of innovation in social and economic development. One of the most important impacts of the law is the positive changes in relation to spin-off firms' creation. Since 2004 both the regulatory framework has become much more favourable and the attitudes of higher education and public research institutes on commercialising their intellectual assets have started to change. (see Box on page 39)

Law on Research and Technological Innovation Fund

The law aimed at creating a stable and predictable financial source for RTDI activities by setting up the Research and Technological Innovation Fund.

There are two important revenue sources of the Fund: (i) the central budget and (ii) the contribution paid by medium-sized and large enterprises. The "innovation contribution" is 0.3% of the adjusted net revenues of the previous year. The contribution to the Fund should be reduced with the amount of direct costs of in-house research and development activities, as well those of commissioned from a public research institution or from a non-profit research organisation, financed by own sources. Micro and small enterprises are exempted from paying this contribution.

According to the law the government's contribution to the Fund is strongly regulated. The public contribution should match to the amount of business contribution two years preceding the budgeted year (based on Taxation Office data).

The Fund helps re-orienting private sector resources towards innovative activities, assisted by matching public funds, and makes possible multi-year funding both legally and from a management point of view. According to the law the allocation of the Fund must be based on open competition and its use should be transparent and monitored.

Since the Law was approved the Parliament has amended it several times, usually without any discussion on its content and taking into consideration any professional analyses or assessments. The annual national budget laws are usually used for such changes.[38] Some examples only in relation to this law (GKM, 2007):

- The starting date for acting by the government according to the above rule on its financial contribution was postponed from 2006 to 2007 (Budget Law 2006)[39]
- The scope of Fund allocation has been widened with (a) social sciences, (b) covering the cost of the country's science & technology diplomatic network and (c) the cost of the government's advisory body, the TTTT. The cost of Fund management is also covered by the Fund (not exceeding 3.3% of the annual total contribution). (Budget Law 2006)
- According to the Budget Law of 2007 at least of 40% of all available resources should be granted to business in 2007, and this share should go up to 50% in 2008 and 60% in 2009. HUF 1 bn have been allocated to basic research.

These activities of the parliament are obviously motivated by the need of the government to manage day-to-day budgetary challenges and not by a higher or growing interest in STI-related issues. Neither the potential impacts nor the consequences have ever been assessed. The high-level STI policy bodies have never discussed such important steps.

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[38] The Act on budget is a fairly lengthy document (thousands of pages), and it is full of tables, data, figures – hence it is easy to hide amendments of a strategic importance.

[39] This made legally correct a lower contribution in 2006 (12.3 bn HUF against the originally obligatory 15.9bn HUF – the business contribution to the Fund in 2004). In 2007 the government has accomplish its commitments.

The new Law on Higher Education

The new law on higher education, passed in 2005, was a reaction to the challenges of the European Higher Education Area, earmarked by the Bologna-process.

The law aimed at preparing the Hungarian higher education system for satisfying successfully the demand coming from businesses and thus leading to a better alignment between higher education and the labour market. One of its objectives is to put more emphasis on efficiency requirements in the management of higher education institutes, by introducing new boards responsible for these objectives.

The law was amended on 2006 to introduce a tuition fee[40] at higher education institutes with the aim to strengthen competition among HE institutes by introducing strong (financial) incentives in order to raise the overall quality of education and to force the institutes to compete for students. It is expected that those representing lower quality and/or not offering relevant competence will be closed down or integrated into other faculties. This new model indirectly stimulates students to pursue a research career, since full-time PhD students are exempt from paying tuition fees, and are often granted scholarships, too. There are no publicly available estimates how this may affect the enrolment rate, and thus eventually the pool of educated workforce, from which the future generations of researchers can be recruited.

IPR and commercialisation of R&D results

The most important legal act on IPR is the Act No. XXXIII of 1995 on the Protection of Inventions by Patents, while later laws regulate other related areas, such as the protection of trademarks and geographical indication, etc.

The Law on Research and Technological Innovation (CXXXIV of 2004) stipulates that all publicly financed research units should devise own internal regulation regarding management of IPR issues as of 2006.

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. In many cases, technology transfer offices have been established at publicly financed research organisations to deal with these obligations.

In promoting and facilitating to set up spin-off companies, the Parliament modified 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 no. 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.

5.3. STI policy and priority setting

In the early 1990s the shift from centrally planned to market economy has significantly changed the role, the function, the objectives and the priorities of STI policy.

At the beginning (between 1990 and 1995) the governments' policies focused on a fast international reorientation, the prevention of scientific values, introducing Western methods for allocating public resources and using peer review systems for decision-making in funding.

In the second part of the 1990s more focus was given to systemic approaches. The innovation capacity and network building, the role of the financial market in innovation and the importance of business-academia link became top areas in priority lists. The preparation and approval of a new law on venture capital, the launching of the first (and so far the only) technology foresight programme, the

[40] Because of political reasons it is called differently as 'partial development contribution'

emergence of new funding schemes in promoting research-intensive FDIs and efforts to develop network building capacities, and the regular evaluation of publicly funded STI programmes could mark this process.

Since 2000 several important policy documents have been published:

- The very ambitious science policy document, entitled "*Science and Technology Policy – 2000*", marked a return to the linear model of innovation. The systemic and complex nature of innovation, even the basic concept of demand for innovation, was much less considered than in other periods.
- OMFB launched the first *Hungarian Technology Foresight Programme (TEP)* in 1998. Its final reports were published as a series of booklets in 2001. The Steering Group and the seven thematic panels[41] assessed the current situation, outlined different visions for the future, and devised policy proposals. Their main concern was to identify major tools to improve the quality of life and enhance international competitiveness, and thus they emphasised the significance of both knowledge generation and exploitation.
- In the period of 2002 and 2004 the most important policy document in STI was the *First National Development Plan* (or the Community Support Framework – CSF). This paper laid emphasis on three areas in STI: /a/ supporting application-oriented RTD activities; /b/ improving the conditions of research and technology transfer in the public and non-profit sector; and /c/ reinforcing corporate innovation capacities and capabilities.
- The government's advisory body on STI policy, the TTTT in its 2004 report titled "*Science and Technology Policy in Hungary*" has summarised its concrete recommendations for actions in line with the Lisbon targets and the mid-term modernisation of the society. The TTPK has discussed the document and approved it, but no actions have followed.

Two major policy documents have been recently approved: the New Hungary Development Plan, 2007-2013 and the mid-term "Science, Technology and Innovation (STI) Policy Strategy" of the Government.

The **New Hungary Development Plan**[42](2007-2013) is the framework document for allocating the financial resources provided by the EU Structural Funds and the national contributions. In total, EUR 23.9 bn on current price is available for Hungary.

Growing employment and better conditions for economic growth are in the core of the programme. Six priority areas have been identified: economy, transportation, social renewal, energy and environment, regional development and state reform. One of the key objectives in the Economic Development priority area is to create "an innovative, knowledge-based economy" by "supporting market oriented R&D activities; promoting the innovation activities and co-operations of businesses; motivating the establishment of technology intensive (spin-off) small businesses; promoting technology transfer; strengthening bridge building and incubation activities; development of the background infrastructure of R&D." Other priority areas, like "Social renewal", also contain measures in relation to innovation (the human resource development for STI).

[41] TEP panels on human resources; health and life sciences; information technology, telecommunications and the media; natural and built environments; manufacturing and business processes; agro-business and the food industry; transport

[42] The Hungarian National Strategic Reference Framework in line with EU regulation, approved by the European Commission on May 7, 2007

EDOP objectives & STI priority areas

Four specific objectives have been selected:

- increasing R&D and innovation capacity and co-operation;
- complex development of corporate capacities;
- development of the business environment;
- facilitating the access of SMEs to capital.

STI priority areas:

- 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 (sic!, 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 Economic Development Operational Programme (EDOP), approved by the European Commission on August 7, 2007, defines how the financial resources provided by the EU Structural Funds will be allocated in order to improve the competitiveness of the Hungarian economy. The funds allocated for the "R&D and innovation for competitiveness" priority amount to approx. EUR 822 m (to be supplemented by 15% national contribution), which is roughly one third of the total EUR 2.44 bn budget of EDOP. (See further details in the Box)

The Law on Research and Technological Innovation stipulated that the government should prepare an STI strategy by May 2005.[43] The government approved the strategy in March 2007 (i.e. with a 2-year delay) and its Action Plan in August 2007.

This **mid-term STI policy strategy** is aiming at enhancing the competitiveness of the economy. A major objective is "*that Hungary will become by 2013 a country where knowledge and innovation are the driving engines of the economy. Companies with domestic financial interest should appear on the global market with competitive products*."

The document identifies some strategic goals: (i) strengthening of companies' RTDI activities; (ii) building of internationally competitive RTDI capacities and centres; (iii) strengthening knowledge supporting the competitiveness of society; and (iv) strengthening the regions' RTDI capacity.

Key technology areas and targeted industrial sectors have also been identified. Key technological areas are: ICT; life sciences and biotechnology; materials science and nanotechnology; technologies of renewable energy resources; and environmental technologies. The most targeted sectors are: the IT and electronics industry; engineering and vehicle manufacturing; pharmaceutical industry; chemical industry; food processing industry; and innovative services.

The strategy sets out several target indicators to be reached by 2010 and 2013. (see box and Figure 18)

The Action Plan for 2007-2010 (accepted in August 2007) consists of a matrix listing 93 tasks to be fulfilled with deadlines, responsible and involved government organisations, and identifying budget lines for their implementation.

Indicators and quantitative targets of the mid-term STI strategy

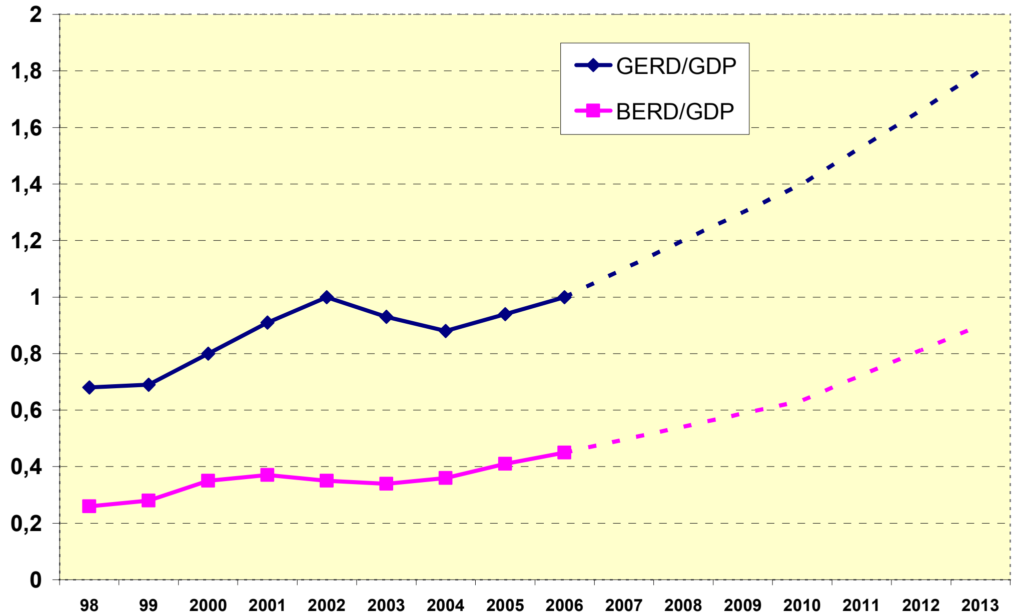
		2006	2010	2013
R&D spending	GERD/GDP	1.0%	1.4%	1.8%
	BERD/GDP	0.45%	0.63 %	0.9%
	BERD/GERD	44.8%	45%	50%
Summary Innovation Index (EIS)		66% of EU25		EU25
Share of S&E graduates		5.1%	5.5%	6%
Share of new to markets products:		4.2%	5%	6%
EPO patents per 1 million inhabitants		19	24	28
Early-stage Venture Capital/GDP (%)		0.002	0.005	0.006

[43] Government Decree of 1023/2007 (IV.5.)

Among others the government plans to revitalise the top-level policy decision system (deadline: December 2007), submitting a new law on the Academy to the parliament[44] (December 2007), further steps in liberalising the commercialisation activities of universities and public research organisations (December 2008), improving the statistical system of STI (December 2008) and the better co-ordination of the management and allocation of RTDI-related public funds.

One of the major challenges of the STI strategy and its Action Plan concerns the implementation capacity and capabilities of the relevant administration. Based on previous experiences rooted in the Hungarian administrative culture, radical changes would be needed in order to fulfil the tasks specified by these official documents.

Figure 18 ***Facts and targets of STI strategy***



Source: Facts from KSH, Research and Development (various years); future objectives from the STI strategy approved by the Hungarian government in March 2007

5.4. The role of policy tools in STI policy formulation

Policy formulation in Hungary faces similar challenges as other countries in the region: fast- changing environment, the internationalisation of the economy, higher social demand for improving the efficiency and effectiveness of the public services and **measuring the impacts of policy actions**. All these would require a systemic application of modern innovation and R&D policy tools. Some of them have already been used in Hungary, but not systematically, while others have never been applied. They do not form a coherent system serving the policy formulation process, evidence-based policy making is hampered by both the lack of inputs and the poor political understanding of the need to apply modern tools in policy making.

Policy analysis

It is hard to identify direct policy analyses behind policy decisions. But it does not mean that such papers are not prepared and those have no contribution at all to policy intelligence.

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[44] The main aim is to separate two functions of MTA: act as a public body and an important actor in research governance [Government Decree of 1066/2007(VIII.29.)]

R&D data have been collected in Hungary for decades (from 1994 following the OECD methodology). Innovation surveys, using the Community Innovation Survey questionnaire, have also been conducted in Hungary (CIS3 and CIS4).

The State Audit Office, based on its assessment how public R&D expenditures in 2004 were spent (ÁSz, 2004), suggested several policy-relevant recommendations. Some of them were taken into consideration when the government prepared the law on innovation. In 2006 the Science, Technology Policy and Competitiveness Advisory Board (TTTT) commissioned two reports: one for analysing the options to promote business RTDI efforts and one for discussing methodological issues of measuring STI activities. Some of the recommendations have been incorporated in the new RTDI policy strategy and its action plan. Both NKTH and the Ministry of Economy and Transport have also occasionally commissioned opinion polls and many studies on a number of innovation-related issues.

In spite of such analyses and other source of inputs, policy reviews have not been produced since 1990, either in the form of white papers or parliamentary debates.

It needs to be noted that there are other potential data sources for STI policy analysis. The most easy to use could be the tax return sheets of the Hungarian Tax Office (APEH), which contain data on the contribution to the Research and Technological Innovation Fund and on RTDI tax allowance. Public administrations also collect data suitable for STI policy analyses, but the mining in these databases is extremely difficult since their design has been focused strictly on their primary aims (usually funding scheme management, accounting and project/contract level monitoring).

Policy dialogue

Policy dialogues play limited role in STI policy formulation. Facilitating the effective dialogue between a wide range of stakeholders, building platforms for serving such exercises is not considered as precondition for successful policy setting and implementation. STI policy is not in the centre of public interest including the media.

Although, some of the main stakeholders are represented in key decision making bodies (TTPK or KTIT), a wider and more systematic communication runs only on an ad hoc basis. For example the Revised Lisbon National Action Programme was open for comments to the general public only prior to its final approval. The new mid-term STI policy strategy of 2007, and in particular its action plan have not been discussed with stakeholders at all.

In the past 2-3 years there has been a continuous policy debate with the involvement of the government, business, interest organisations and the MTA on the role of the Academy, its operation and the effectiveness of basic research. The debate, which – especially in its most fiery period – seemed to be rather un-professional, was closely followed by both the scientific community and innovative companies. Many share the opinion that this debate positively influenced the Academy’s decision on launching an internal self-evaluation exercise as well as a reform programme.

Monitoring

Monitoring has not been a widely used practice in Hungary, the recently approved STI strategy is the first such type of document which clearly set indicators in advance to measure the impacts of implementation.

In 2007 the KTIT accepted its monitoring strategy. According to this document NKTH will thoroughly monitor the programmes and projects with a considerable amount of budget allocated or pursuing essential policy goals, while those with lower funding would be checked only by financial and administrative criteria. The strategy was supported by a report prepared by international experts on monitoring of STI measures.

Evaluation

Evaluation is also used on an ad hoc basis in Hungarian STI policy. In spite of the fact that in the mid-1990s there had been conscious efforts to introduce systematic evaluations (2-3 programmes were evaluated annually), nowadays external evaluations are carried out only occasionally. Internal evaluations of different funding schemes are done by public officials, but the results are unpublished.

In the past years the following evaluations have been carried out:

- The first Hungarian Technology Foresight Programme (called TEP) was evaluated by an international panel of experts
- Cooperative Research Centre programme
- Ex-ante and mid-term evaluation of the Economic Competitiveness Operational Programme (2004-2006)
- Two ex-ante evaluations have been carried out in relation to the Community Support Framework for 2007-2013 in relation to innovation promotion: one for assessing horizontally the New Hungary Development Plan across its OPs (stating that there is a trade-off between its measures and STI) and one for explicitly evaluating the EDOP as such.

Significant improvements can be forecasted in this area, pushed by two factors. Firstly, the law on innovation of 2004 clearly highlighted that all STI policy measures should regularly be evaluated by independent experts. Secondly, according to EU rules, all the policy measures financed by the Community Support Framework must be subject to ex-ante, mid-term and ex-post evaluation. The government has approved a decree in 2005 on the evaluation of RTDI projects and programmes.[45]

It is a promising sign that KTIT, following the recommendation of NKTH, decided to run three evaluations in the near future, as a first step of the agency's new policy on monitoring and evaluation: the Hungarian participation in FP6, the applications of the "Jedlik Ányos" Programme, and the funding scheme for promoting R&D infrastructure.[46]

Co-ordination and policy integration

The high-level bodies of TTPK and TTTT could provide an appropriate organisational framework for the necessary co-ordination and integration of STI and related policies. However in practice they are not functioning well, since the number of meetings is very low, relevant analyses are not available and many STI-relevant decisions have never been discussed at their level (a telling example is the recently accepted STI strategy).

In practical terms none of these high-level bodies are appropriately embedded into the government's decision making organisational structure (their position in the system of information flows is weak and their consultancy role has more an ad hoc than a systematic nature).[47] The outcome is that the co-ordination is weak and important policy areas, closely linked to innovation are not integrated (like education, employment, competition, public procurement, investment, environment etc.).

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[45] Government decree of 198/2005 (IX. 22.) on the evaluation system and the requirements of evaluation on RTDI programmes financed by public sources (In Hung: Kormányrendelet a közfinanszírozású támogatásban részesülő kutatás-fejlesztési és technológiai innovációs programok értékelése rendszeréről és tartalmi követelményeiről)

[46] The call for tender on the evaluation of the "Jedlik Ányos" Programme was published in mid-November, 2007

[47] For example: in spite of the legal regulations neither TTPK nor TTTT have never been involved into the preparation of research budget, the reorganisation of the STI governance structure or its main organisations

5.5. Instruments

The Hungarian STI policy instruments are dominated by supply side and direct measures. There are a large number of STI policy measures existing, which seem to target all the main objectives of STI policies. But usually neither evaluation nor impact assessment reports are available on the impacts and benefits of these measures.

We strongly rely on the EU's Trend Chart/ERAWATCH database, which provides an easy access and a full coverage of all the member states' actual innovation policy measures.[48]

In the past 2-3 years a number of changes took place in the Hungarian STI policy mix:

[A] Funding has increased for two reasons:

- ✓ Co-funding from the European Regional Development Fund (ERDF) has become available since May 1, 2004. The First National Development Plan (2004-2006) allocated EUR 144.1m for RTDI activities, the New Hungary Development Plan for 2007-2013 allocates EUR 967 m (annual average: EUR 138.1 m) under the "*R&D and innovation for competitiveness*" priority of the Economic Development Operational Programme (EDOP).
- ✓ The newly established Research and Technological Innovation Fund became effective from January 2004. Companies' contribution amounted to HUF 16 bn (~ EUR 64 m) in 2004, HUF 20.5 bn (~ EUR 82 m) in 2005, and HUF 23 bn (~ EUR 92 m) in 2006 (preliminary figure).

[B] Grants have become the dominant tool in direct support since 2004 irrespective of the subject and the objective of the support, and the type of beneficiaries. (Previously loans were favoured in the case of close-to-market activities. This shift was not a result of an overall evaluation of the previous practice, but more a copy of Western European approaches.)

[C] The tax incentives for businesses have remained in place, but the Law on Research and Technological Innovation Fund has introduced a new incentive. (See more in Table 12).

[D] Since December 2004 new specific technology areas have been selected as targeted for support (e.g. mobile telecommunications, nanotechnology and biotechnology).[49]

[E] Based on the Law on Research and Technological Innovation a much stronger emphasis has been put on regional RTDI issues.

The measures, applied by the Hungarian STI policy target all the RDTI objectives identified by different policy documents in the past 10 years (Table 10). Most schemes focus on promoting business R&D and firms' innovation activities (20 different schemes). Networking and co-operation is also targeted by a large number of supporting mechanisms (17 schemes). As part of this policy objective, international co-operation is considered as high priority area (6 schemes). The focus on regional innovation system is relatively new, but the four measures on this challenging area indicate a shift from national toward more regional focus.[50]

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[48] The data on Hungary is available at: http://www.proinno-europe.eu/index.cfm?fuseaction=wiw.measures&page=list&CO=20 or at http://cordis.europa.eu/erawatch/

[49] The weight of technology-specific schemes has changed in the past 17 years in the Hungarian STI policy. In the early 1990s no technology priorities were identified as a reaction to the fast privatisation and transition of the economy. In the middle of the 1990s, when this process started to normalise, two programs were launched (IKTA – Application of ICT; and Biotech). When these programs finished, new technology-specific actions were not initiated until late 2004. But in the whole period since 1990 the horizontal policy measures (supporting academia-industry co-operation, applied R&D with no technology priorities, international RTDI co-operation, etc.) have plaid dominant role in the STI policy.

[50] In the second part of the 1990s the government agency, OMFB, launched special funding schemes for promoting regional innovation. These schemes were operated by the local Chambers of Commerce. Later these schemes disappeared.

Table 10 ***STI funding schemes (2007 October)***

Measure (HU_Trend Chart Id. #)	Objectives of STI policy					
	1. Increase the share of innovative firms	2. Networking and collaboration capacity building	2.2. Promoting international co-op.	3. Human resource development	4. Facilitating regional innovation system	5. Developing R&D infrastructure
Application-oriented co-operative RTDI (HU_1)	■	■				
Social conditions of RTDI - MEC (HU_13)		■	■			
"Jedlik Ányos" Programme (HU_24)	■	■		■		
RTDI infrastructure of public organisations (HU_51)						■
RTDI co-operation (HU_55)		■				
Support to new firms - start-ups, spin-offs (HU_58)	■					
Development of corporate research centres (HU_69)	■					■
SME RTDI activities (HU_73)	■					
Agri-food RTDI projects - GAK (HU_74)	■					
200% of R&D expenditures deductible (HU_84)	■					
Employment of PhD, MSc or MBA students (HU_85)				■		
"Pázmány Péter" Programme (HU_87)		■		■	■	
"Déri Miksa" Programme (HU_88)	■	■	■			
Innovative Education Support System (HU_89)				■		
Information infrastructure for R&D - KFIIF (HU_90)					■	
Co-operative Research Centres - KKK II. (HU_91)	■	■		■		■
Mobile Communications RTDI Centre (HU_92)	■					
Regional Innovation Agencies - RIÜ (HU_93)					■	
Large international R&D projects - NAP2005 (HU_94)		■	■			
INNOCSEKK - innovation voucher (HU_96)	■				■	
"Asbóth Oszkár" Programme (HU_97)		■	■			
Large R&D centres - NAP Nano (HU_98)		■	■			
"Irinyi János" Programme (HU_99)	■					
Establishing model incubator for biotech (HU_100)	■	■				
IPR protection for SMEs abroad (HU_103)	■					
"Baross Gábor" Programme (HU_104)						
"Baross Gábor" Programme II. (HU_105)	■	■				
"Kozma László" Programme (HU_106)	■	■		■		
RTDI in supplier networks - INTEG2006 (HU_107)		■				
"Teller Ede" Programme - NAP BIO 2006 (HU_108)						
RTDI management - INNOTETT_06 (HU_110)	■	■				

Source: Trend Chart/ERAWATCH 2007 October (http://www.proinno-europe.eu/index.cfm?fuseaction=wiw.measures&page=list&CO=20)

Note: Programmes in yellow have been (are) financed by the EU Structural Funds

The Science, Technology Policy and Competitiveness Advisory Board (TTTT), in its 2004 report, strongly suggested a thorough review of the large number of STI-related funding schemes in order to rationalise them (leading to a smaller number of measures and less administrative burdens both to the applicants and to public agencies administering them). Other stakeholders, like the Chamber of Commerce and Industry or the Association of Innovation also shared this view and supported such recommendations, but no major steps have been taken so far.

In addition to the measures summarised in Table 10 there are several other schemes in effect (but not available by or not targeted directly at enterprises).

OTKA, the Hungarian Scientific Research Fund provides financial support for basic research projects, international co-operation, research infrastructure development and fellowships to young scientists.

In October 2007 the NFÜ announced 8 funding schemes to promote STI (as part of the EDOP and the Central-Hungary Operational Programme of the New Hungary Development Plan). These measures can be considered as successors of previous programmes financed by EU Funds in the period of 2004-2006.[51] NFÜ has allocated ~ EUR 150 m for national and ~ EUR 44 m for Central-Hungarian regional projects.

General overview of OTKA's supporting activities

OTKA grants to research projects support Hungarian researchers in three main branches of scientific fields: in life, natural & engineering and social sciences. The share the first two areas are more or less equal (40-40% of the available sources), the rest is for social sciences. Universities are the main beneficiaries (this sector's share in total OTKA funding is usually between 60-65%). MTA institutes receive 25-30%. The rest is allocated to other public institutes (ministries' research institutes, archives, libraries). (Table SA37and Figure SA22) Companies also financed by OTKA, but both the size of support and the number of projects is marginal (it is natural, since OTKA focuses on basic scientific activities).

5.5.1. Promotion of business R&D and technological innovation

The promotion of business R&D and innovation activities is standing in the focal point of the present Hungarian STI policy. Most of the measures address this issue. Some indirect fiscal measures and several direct funding schemes are in operation.

Almost all innovation policy objectives are addressed, but due to the lack of evaluation their impacts can not be assessed. It is hard to identify policy-relevant documents (analysis, impact assessments or others) behind launching new schemes, so the evolution of this support system probably follows more ad hoc than strategic approaches.

The Hungarian taxation system provides incentives for promoting different responses to the actual challenges of the NIS in the country. The impacts of these taxation measures can hardly be assessed, given the lack of the access to data necessary for such analysis.

Local governments can also influence economic development in their region. They operate industrial parks or co-operate with such organisations, offer various advantages (local tax exemptions, favourable infrastructural conditions etc.) to investments with a higher knowledge content or value added.

Table 11 and Table 12 summarise the major measures providing direct and indirect support to RTDI activities in Hungary.

[51] Support of market-oriented R&D and promotion of technological co-operation; support of research centres; support of innovation and science parks; and promotion of firms' innovation

Table 11 ***Direct measures in supporting business RTDI activities in Hungary by STI policy objectives***

Policy objective	Funding Scheme (short description)	Allocated budget in m EUR	Note
Supporting the development of new products, processes or services	Application-oriented R&D projects Trend Chart: HU_1	**28.0**	2004-2006
	Innovation & research activities of SMEs – HU_73: R&D, absorptive capacity and academy-industry link building	**18.44**	2004-2006
Strengthening the adaptation and utilisation of R&D results and the establishment of new technology-based firms	Support to new, technology and knowledge-intensive micro-enterprises and spin-off companies – HU_58	**6.6**	2004-2006
	"Baross Gábor" Programme, Supporting technological innovation in the South-Plain region – HU_104 : Spin-off orientation	**2.0**	2006-2007
	5LET 2005 (subprogramme of the Irinyi János Programme) - HU_99: Individual inventors promotion in commercialisation of their R&D results and technology ideas	**5.6**	2006-2008
Innovation services to firms & service capacity building	INNOCSEKK – HU_96: Voucher to micro- and small enterprises for ordering innovation services	**20.0**	2005
	IPR protection for SMEs abroad – HU_103	**0.24**	2006-2009
	"Baross Gábor" Programme, Supporting regional innovation networks – HU_105	**19.2**	2006
	Establishing a model incubator centre for biotechnology (BIOINKUB) – HU_100	**4.0**	2005-2007
Improving the quality of corporate research infrastructure	Development of corporate research infrastructure related to the creation of new RTD jobs – HU_69	**8.4**	2004-2006
Strengthening the technology base of industry	Agri-food RTDI projects	**10.0** **12.0**	2004 2005
	Mobile Communications R&D and Innovation Centre – HU_92	**8.0**	2005-2008
	Setting up a Nanotechnology Research Laboratory – HU_98	**7.2**	2006-2009
Human resources development in business	"Kozma László" Programme – HU_106: Support for the employment of researchers	**3.2**	

Source: Trend Chart, 2007 October

Note: Programmes in yellow have been (are) financed by the EU Structural Funds

Table 12 ***Main tax incentives for promoting R&D and innovation in Hungary***[52]

Policy objective	Name	Measure
Promote R&D activities of companies by increasing BERD	200% of R&D expenditures deductible	Companies can deduct 200% of their R&D expenditures from their taxable income. A 300% RTD tax allowance is applicable from 2004 if a company lab is located at a university or public research institute.
	Research and Technological Innovation Fund	Firms pay 0.3% of the adjusted net revenues of the previous year as a contribution to the Fund. Micro and small enterprises are exempted. The contribution to the Fund should be reduced with the amount of direct costs of in-house research and development activities, as well of those commissioned from a public research institute or from a non-profit research organisation, financed by own sources.
Training of scientists	Employment of PhD, MSc or MBA students	The employment of PhD, MSc or MBA students is tax-free in the field of educational and research activities and other services closely related to these activities, up to the level of the official minimum wage.
Promote research staff at companies	Decreasing the costs of researchers in scientific projects	Companies may enjoy tax allowance based on the wages of researchers working in basic or applied R&D projects (max. 10% of total wages).

5.5.2. Promotion of public-private partnerships for innovation

One of the major bottlenecks of the NIS in Hungary is the weak linkages among actors, in particular among enterprises and higher education and public research organisations. Policies from the middle of the 1990s have recognised this weakness, so it is not a coincidence that many direct measures aimed and aims at promoting the networking of both large firms and SMEs. The current measures are summed up in Table 13.

In recent years one of these measures has been evaluated: "Cooperative Research Centres (KKK)*"* (HU_91). According to the evaluation report the KKK had a positive impact on the innovation activities of the member or associated companies, the number of PhD students and the quality of education and training by the member universities and the creation of new, technology-based (spin-off) companies. The results suggest that the budget of the programme has been used in an efficient way. Under this label 19 centres are in operation in the country, but in addition to that 19 so-called "*regional knowledge centres*" at universities have also been established with similar objectives (setting up new organisational units for strengthening academy-industry links and co-operation) and with strong public financial support (under the aegis of the so-called "Pázmány Péter" Programme). These two sets of organisations exist parallel with no clear distinction either by functions or targeted technology/scientific focus.

As part of Knuth's monitoring strategy setting exercise, two other schemes – the Asbóth and Pázmány Programmes (HU_97, HU_87) – have been subject of pilot assessment. (Arnold *et al*., 2007) According to the report industrial exploitation of university capabilities are weak and universities lack experience to address industrial needs.

[52] See more at http://www.nkth.gov.hu/main.php?folderID=891&articleID=3943&ctag=articlelist&iid=1

NKTH has recently launched a new support scheme, called Technology Platform. The initiative has similar aims as the European Commission had in the FP6. Companies are invited to combine their efforts in identifying strategic sector-specific RTDI objectives and action plans. Public support is provided to form the platform and starting their strategy formulation process. According to NKTH 10 platforms are planned to be supported in early 2008.

Table 13 ***Direct measures in promoting the networking capabilities of firms in Hungary***

Policy objective	Funding Scheme (short description)	Allocated budget in m EUR	Note
Network-Building and co-operation promotion	Co-operative Research Centres II – Trend Chart HU_91	**8.0**	
	"Pázmány Péter" Programme: Regional Knowledge Centres at Universities – HU_87	**36.0** **24.0** **10.0**	2004 2005 2006
	Technological innovation in supplier networks – HU_107: to enhance the innovation capabilities of SMEs in order to prepare them to establish long-term supplier relationships with medium-sized or large enterprises, called integrators	**6.9**	2006-2008
	"Asbóth Oszkár" Innovation Programme for Cutting-edge Industries – HU_97: to accelerate the evolution of the cutting-edge industries in health, biotech and agriculture-based renewable energy-resources by promoting the establishment of technology platforms and innovation clusters.	**26.0**	2005-2009
	"Jedlik Ányos" Programme – HU_24	**44.0**	
	S&T co-operation of businesses and publicly financed research units HU_55	**12.0**	2004-2006
	Several other schemes, listed in Table 10 among others, aim to strengthen industry-academy links as well (HU_1, HU_105 and HU_106)		
Promotion of International co-operation	Participation of SMEs in EU 6th Framework Programme – HU_22		
	"Déri Miksa" Programme – HU_88: to strengthen firm's participation in EUREKA projects; to improve academia-industry co-operation and the options of Hungarian exploitation of research results achieved by participating in EU R&D projects	**4.0**	2004-2006
	Large international R&D projects – HU_94: to support large, interdisciplinary R&D projects, conducted by bi- or multilateral co-operation, including NoEs or IPs financed by the EU RTD FP	**9.6**	2005-2007

Source: EU, Trend Chart, 2007 October

Note: Programmes in yellow have been (are) financed by the EU Structural Funds

In summary

Since the start of political transformation Hungarian governments have not found an appropriate position of STI in their policies and they could not integrate STI policies effectively into their strategies. This snag might be attributed to the narrow understanding of innovation both at the wider social and political levels. This is reflected by the fact that the main STI policy government bodies and agencies have been subject to constant restructuring since 1990.

The Hungarian STI governance system formally consists of all the organisational elements of NIS in developed nations' innovation systems. The highest level coordination body, the TTPK is chaired by the Prime Minister and its advisory body (TTTT) consists of independent experts. The legal basis for STI policies is strong (laws on innovation, innovation fund, higher education, etc. while funding schemes are managed by either independent agency (OTKA) or government office (NKTH).

Major new pieces of legislation have been approved recently. The Law on Research and Technological Innovation, approved in 2004, has stipulated the basic principles of public support for R&D and technological innovation. The newly established Research and Technological Innovation Fund helps re-orienting private sector resources towards innovative activities, assisted by matching public funds, and makes multi-year funding possible both. The new Law on Higher Education and its modifications, in line with the Bologna process, have made significant changes in the management and functioning of higher education institutes.

The frequent changes in the status, mandates and operation of critical elements of the governance system have obviously hindered organisational learning, and thus the establishment of good practices in policy planning, co-ordination and implementation.

Evidence-based policy making suffers from both the lack of inputs and the poor political understanding of the need to apply modern tools in policy making.

The mid-term STI strategy (approved in 2007) as reflected by its objectives and quantitative targets of its defined indicators, and the Action Plan seem to be extremely ambitious.

The present STI policy applies close to 40 measures, in several cases with significant overlaps. Public support to RTDI cannot be efficient and effective given the irregular, ad hoc nature of co-ordination of various STI policy tools and measures, operated by different organisations. Since only a limited number of individual measures have been evaluated so far, it is impossible to assess the policy mix as a whole. The newly introduced monitoring and evaluation strategy of NKTH and the strong requirement of the EU on monitoring the use of EU Funds, however, may change this situation in relatively short term.

Policy-making processes are not sufficiently transparent, and there is worrisome lack of systematic dialogue with stakeholders and experts. Modern decision-preparatory methods – technology foresight, technology assessment, benchmarking, monitoring, and evaluation, etc. – are rarely used. Policies might be influenced by pressure groups and short-term political considerations rather than by a sound understanding of the impacts of foregoing decisions and current (as well as foreseeable future) socio-economic needs.

6. HIGHLIGHTS ON SPECIFIC ISSUES

The previous chapters have provided insights into the Hungarian national system of innovation by discussing the main framework conditions, the performance of the NIS, the activities of its major actors, and describing the internal linkages of the system. STI policy making and implementing experience have also been analysed (governance system, policy approaches, actual measures). The picture, however, is far from complete, important elements and their relationships could not be touched upon.

Firms' attitudes towards capitalising on knowledge are changing significantly, and the globalisation process has resulted in a fast growing internationalisation of R&D and innovation. Firms should change their strategies with regard to the ways they adjust their activities to this new global environment. Small and open economies, like Hungary, must pay particular attention to issues such as the business enterprises' innovation capabilities in innovation, the potential in the human resources for RTDI and the internationalisation of knowledge creation and application. These facts may explain the OECD's special request to discuss three specific issues in this report.

6.1. Innovation capabilities of businesses

The innovation capabilities of enterprises include a wide range of organisational skills, competences, resources, cultural issues, their interdependence, linkages and the cross-fertilisation of many factors. We may also take into consideration learning, management, R&D and co-operation capabilities. Multiple internal and external factors shape the innovative capabilities and activities of companies.

The macroeconomic environment, the functioning of the capital market (its risk-taking capability and openness for innovative projects), the stability and quality of the regulatory framework, the level of law enforcement, the quality of public governance or public procurement practices can be mentioned as examples of important external factors. But other actors in the NIS and the internal and external linkages, networking capabilities of the system can also hinder or facilitate business innovation activities. It is hard to prioritise these and other elements, but it must be noted that in order to have a full coverage of the title each should be carefully taken into consideration.

The size of this report and the limited volume of available information and analyses on the present situation in Hungary suggest focusing our attention to only two important aspects of this subject: the innovation capabilities of small and medium-size enterprises (SMEs) and the cooperation capabilities of businesses, in particular academia-business links.

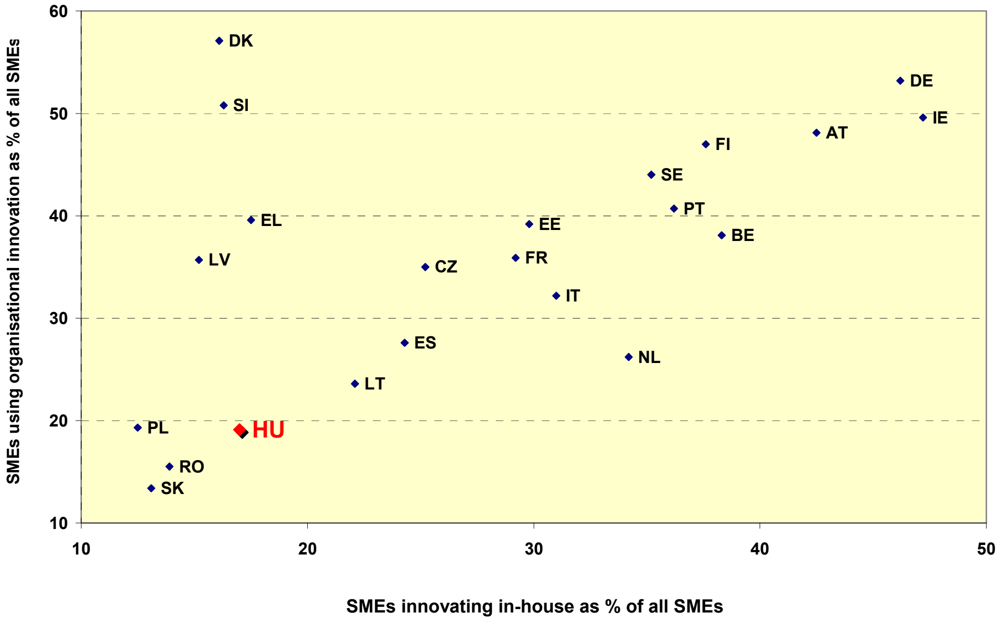
6.1.1. SME's innovation capabilities

As discussed in detail in Chapters 3.6 and 4.2, both statistical data and international surveys (CIS 3 and CIS4) clearly highlight that

- the share of innovative enterprises is small in Hungary, and innovation plays only a minor role in business success for the large majority of firms, and
- the share of innovative firms is much higher among the large firms than among SMEs.

The low overall level of innovation activities of firms is a serious challenge, especially in the indigenous SME category. Several EIS indicators, such as SMEs innovating in-house, innovation expenditures, sales of new-to-market and new-to-firm products, the share of early stage venture capital in GDP and SMEs using organisational innovation reflect the difficulties. Hungarian SMEs are close to the lower end of the EU27 by both in-house and organisational innovation activities. (Figure 19)

Figure 19 ***In-house and organisational innovation at SMEs in the EU***



Source: EIS 2006

Firms' innovation capabilities in Hungary are strongly determined by the fact that 59% of them considered the lack of demand for new products as the reason for a passive innovation attitude. Creating new markets via innovation is usually not part of SMEs' strategies. The low or missing market pressure may contribute to a negative feedback on the innovation capabilities of companies. In some cases excessive competition might hinder assuming risks involved in investing in innovation. The lack of resources (both internal and external) and the high cost of innovation were the two reasons most frequently mentioned as bottlenecks (similarly to their counterparts in other European countries).

As already mentioned the number of business R&D units has grown dynamically from 258 in 1998 to 1,027 in 2006. In the same period the R&D personnel has almost doubled. (Figure 6 and Table SA13) The main source of growth in the number of research units was the micro and small enterprise sector. They had 256 units in 2000 (53.6% in total), and 667 units in 2006 (64.9% in total). In the same period the medium-sized companies have kept their share (by an increase from 101 in 2000 to 181 in 2006), but in R&D employment their weight decreased from 28% in 2000 to 18.6% in 2006.

In 1998-2006 when the BERD in Hungary was continuously rising, the share of micro- and small enterprises in BERD has increased (from 8.4% in 2000 to 14.8% in 2006) at the expense of medium-sized enterprises (a decrease from 21.3% in 2000 to 12.3% in 2006). (Table SA10)

It should, however, be noted that in the reviewed period several policy measures have been introduced, which might have lured companies to apply 'creative accounting techniques'. (see tax benefits in Table 12) It can only be stated that the micro and small firms have expanded their R&D activities in the recent years (while its genuine volume is uncertain).

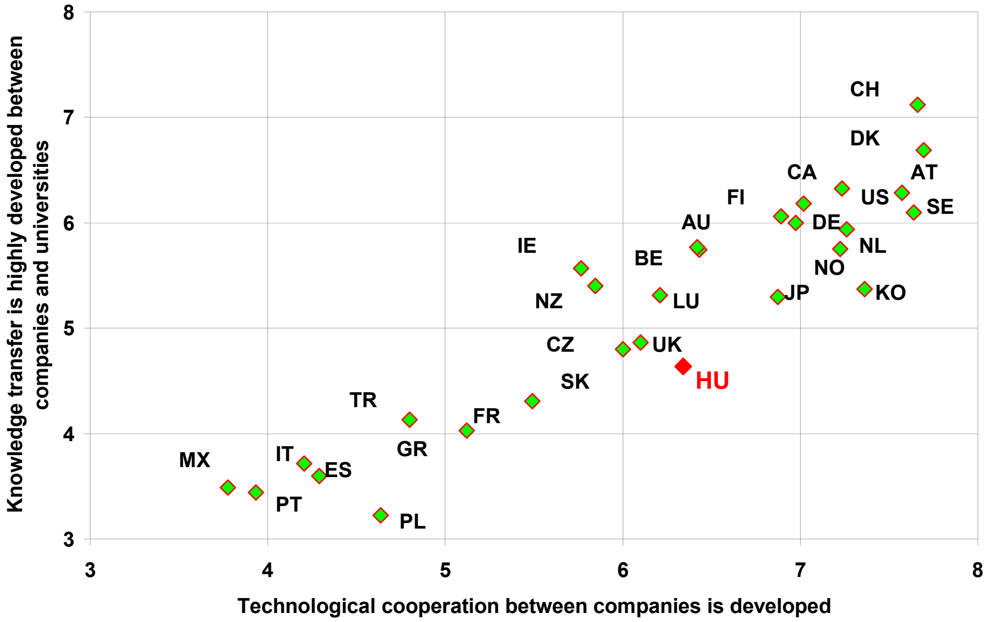
Based on the number of employees the Hungarian medium-size firms are comparable with those in the EU. Concerning their output (net revenues) Hungarian medium-sized firms on average are lagging behind the range of net revenues set by the Eurostat and applied to the classification of the size groups of businesses. Accordingly, Hungarian medium-sized firms (with some exceptions, of course) belong to the small firm categories rather than to the former size category in the EU.

6.1.2. Co-operation capabilities

Innovation processes draw on different types of knowledge and skills, often possessed by various actors. The co-operation of these players is, therefore, indispensable for successful exploitation of knowledge.

According to the IMD data, there is a strong correlation between technological co-operation of companies and knowledge transfer between universities and enterprises. (Figure 20) Hungary is in the mid-range of the OECD countries on both indicators.

Figure 20 ***Technological co-operation of firms and knowledge transfer between firms and universities in the OECD member states***



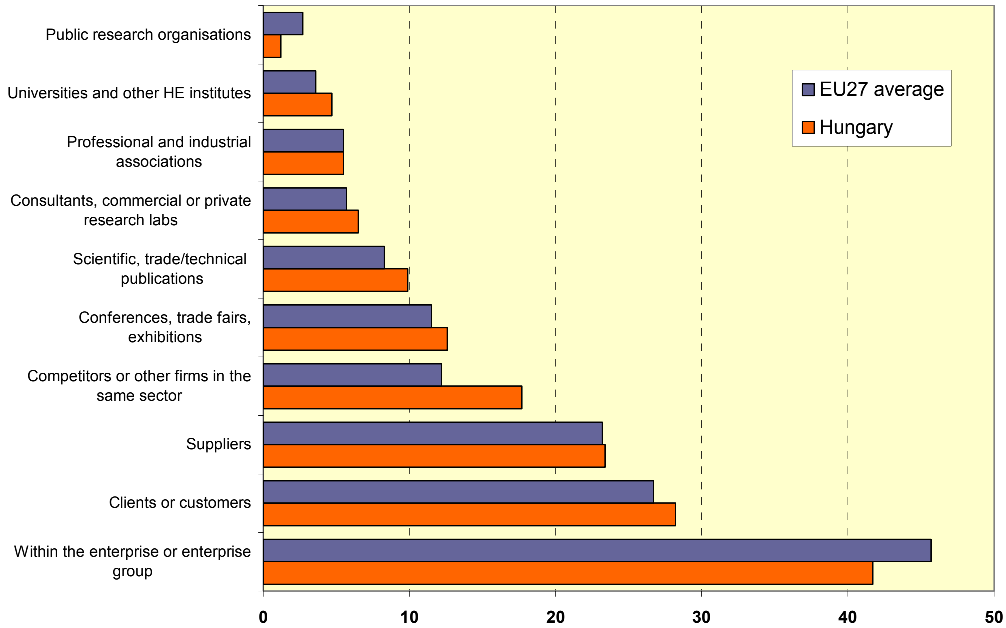
Source: IMD World Competitiveness Online, based on IMD executives' survey 2007
Note: the index from 1 to 10 is depicted

Innovative Hungarian firms conduct at least as intense co-operation activities as the EU27 average (CIS4). (Figure 21) They, just as their peers in the EU favour to use internal sources for innovation activities but on a lower level than most of their European counterparts (41.7% of innovative firms declared it as highly important source). Clients and customers are declared by 28.2% of Hungarian innovative companies as highly important source, followed by suppliers (23.4%), and competitors or other firms in the same sector (17.7%).

In identifying the co-operative partners of innovative firms the Hungarian pattern indicates higher level of co-operation activities than the EU27 average. Suppliers are at the top (26.2%), followed by clients and customers (19.6%). Universities are surprisingly in third place (13.7%). By almost all partner categories Hungarian firms over-perform EU27 (except in the case of public research organisations). (Eurostat, 2007)

These two sets of data suggest that while universities and other HE institutes are favoured partners of innovative firms, this relationship only partly serves as a serious source of information. The very poor position of public research organisations, either as a source of information or partners for collaboration, cries for urgent action.

Figure 21 ***Highly important sources of information for innovation, as a percentage of innovative enterprises, Hungary and EU27 average, 2004 (%)***



Source: Eurostat, Community Innovation Statistics, Statistics in Focus, 81/2007

Academia-industry collaborations

The linkages of traditional knowledge-producing organisations (higher education and public research institutes) have a special importance in all NISs. In the following we aim at identifying some channels and ways of such co-operation.

The number of co-publications, co-patents, university-business contracts, number of spin-off companies and so on, may measure academy-industry collaborative research performance.

A recent study on 12 Hungarian universities stated that 73% of total publications were co-publications with other actors outside their university.[53] (Table 14) 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.* forthcoming)

Seven percent of the total R&D spending of the reviewed 12 universities was funded by businesses in 2000-2004. Enterprises covered 17% of the R&D budget of engineering and technology faculties. In spite of the high R&D intensity of the Hungarian pharmaceutical industry the business financed R&D activity at universities in medical sciences is surprisingly low (4,3%), while the share of co-published scientific articles in this field is high. (Table SA39)

In the past the university was theoretically the owner of intellectual property developed by its employees, although in practice this rule was often exempted. Licence revenues of universities were minuscule, while patent regulations of Hungarian universities supported neither in-house patenting nor licensing. Over the last 2 years, based on new pieces of legislation and regulation universities have

[53] The reviewed 12 Hungarian universities performs 90% of all national higher education publications registered in the Web of Science data base

introduced their own internal IPR and some of them have begun to modify their internal procedures accordingly.

Table 14 ***Distribution of partners who co-published with selected 12 Hungarian universities by partners (2001-2005, %)***

Affiliation of Co-authors	Hungarian	Foreign	Total
Business firms	2.1	2.0	4.1
Health care organisations	4.3	3.9	8.2
Universities	11.2	45.7	57.0
Research organisations	14.8	14.1	28.9
Others	1.2	0.6	1.8
Total	33.6	66.4	100.0

Source: Annamária Inzelt, A., Schubert, A., Schubert, M and Szőke, Sz: Collaboration of Universities in the mirror of co-publications (work in progress)

Notes: The 12 selected universities are: Corvinus University of Budapest; Budapest University of Technology and Economics; University of Debrecen; Eötvös Loránd University; University of Kaposvár; University of Miskolc; University of West Hungary; University of Pécs; Semmelweis University; Szent István University; University of Szeged, Pannonia University

A publication may be double-counted if the co-authors are belonging to two or more investigated Hungarian universities.

Several success stories in the last few years have been related to co-operative research projects financed from national and/or European sources.

Spin-offs are rather new phenomena in the Hungarian NIS. In the 1990s venture capital activities have driven the establishment of some high-tech and/or knowledge intensive start-ups, as spin-offs from higher education or academic research institutes. Due to the financial incentives and the favourable regulation (see the law on innovation), the number of spin-off companies has started to grow. Universities and natural science institutes of the Academy play an important role in this process.

6.1.3. Public policies to foster innovation capabilities of businesses

The government launched several initiatives to develop firms' innovation capabilities. (Tax relief fostering business spending on R&D, the promotion of mobility of highly-skilled labour force, in particular those involved in research activities at or for firms, and the training of PhD students at companies.)

The innovation levy on businesses (introduced in 2004 by the law on Research and Technological Innovation Fund) aims at promoting business R&D by the option of deducting the cost of companies' own research, redistributing firms' contribution to the benefit of innovative ones, and providing a favourable treatment to micro- and small enterprises (they need not contribute to the Fund). (See Chapter 5.5.1 in more detail)

The promotion of innovative capabilities of businesses is targeted by many public direct measures via both domestic and international (mostly EU) financial sources.

National public support schemes

A large number of funding schemes are in operation with similar or same objectives, partly or fully aimed at improving innovation capabilities of businesses. All of these schemes are discussed in Chapters 5.5.1 and 5.5.2.

The use of EU Funds

The GVOP (Economic Development and Competitiveness Operational Programme) of the National Development Plan for 2004-2006 had a strong focus on RTDI. Funding schemes aimed at improving RTD, commercialising and co-operation capabilities of enterprises. One of its action lines directly aimed at improving the innovation capabilities of firms (GVOP 3.3)

Monitoring reports on GVOP's activities clearly show that companies were very active in submitting proposals. The mid-term evaluation of the Economic Competitiveness Operational Programme (2004-2006) carried out in early 2006 gave an overall positive assessment on the absorptive capacities. The budget allocated for the RTDI priority was committed by the end of 2005, and the demand exceeded the available resources by 80%.

The success rate was around 50% in terms of both the number of applications and by financial means, but in some schemes it was over 70%. A large number of applications (over 1,500) were submitted by enterprises and about 1,000 projects led by firms have been granted. Thirty-three applications were submitted by companies to improve their RTD infrastructure and 24 were granted. The 14 Co-operative Research Centres granted also had many companies among their consortia members from the targeted technology area and/or sector, but their number is not published. (Table SA38)

Other Operational Programmes, in particular those related to education and training (the Human Resource Development Operational Programme) also contributed to the development of the HRST for innovation.

GVOP funding schemes (2004-2006)

"Application-oriented co-operative RTD activity" (GVOP 3.1.1) scheme aimed at supporting research projects, and academia-industry collaboration was given a priority.

"S&T co-operation of businesses and publicly financed research units" (GVOP 3.2.2), as a continuation of the Co-operative Research Centre programme, provided support to research facilities established and operated jointly by HE institutes and companies.

The sub-programme of *"Promotion of business R&D capacities and innovation capabilities"* (GVOP 3.3) consisted of into three funding schemes:

* *"Support to new, technology and knowledge-intensive micro-enterprises and spin-off companies"* (GVOP 3.3.1) aimed at promoting the establishment of new technology and/or knowledge intensive firms (special attention was given to university-based spin-offs) and to commercialization of RTD results.

* *"Development of corporate research infrastructure related to the creation of new RTD jobs"* (GVOP 3.3.2) aimed at enhancing firms' RTD capabilities by developing skills for commercialisation of research results and upgrading their RTD infrastructure.

* *"Innovation and research activities of SMEs"* (GVOP 3.3.3) provided support to promote the introduction of new, technologies and services and support the development of absorptive and innovation capabilities of SMEs (focusing on RTDI activities and collaboration with academia)

The New Hungary Development Plan for 2007-2013 is continuing several successful funding programmes in line with the previous planning period (2004-2006).

In summary

Most firms are not under market pressure for innovation, and thus their innovative capabilities are hidden, downgrading or not developing. Their internal resources are limited and they complain of, as everywhere, the lack of access to external sources (loans, venture capital, public support etc.).

Innovative firms more or less follow the European pattern in terms of the highly important sources of information for innovation, and the intensity of their co-operation activities is above the EU27 average. While the partnerships with universities and other higher education institutes are important, public research organisations do not play a significant role in innovation co-operation of businesses. The reasons should be identified, since this segment of the Hungarian R&D is internationally strong and recognised, and the loss of knowledge created by them decrease significantly the efficiency of the NIS and diminish business innovation capabilities.

Several policy schemes promote capability building, particularly in areas like RTD capacities, human resources, networking and co-operating capabilities. Recent legislation has created more favourable conditions for setting up spin-off firms at higher education institutes and public research organisations. Some schemes have promoted mobility of highly skilled labour force between businesses and academia.

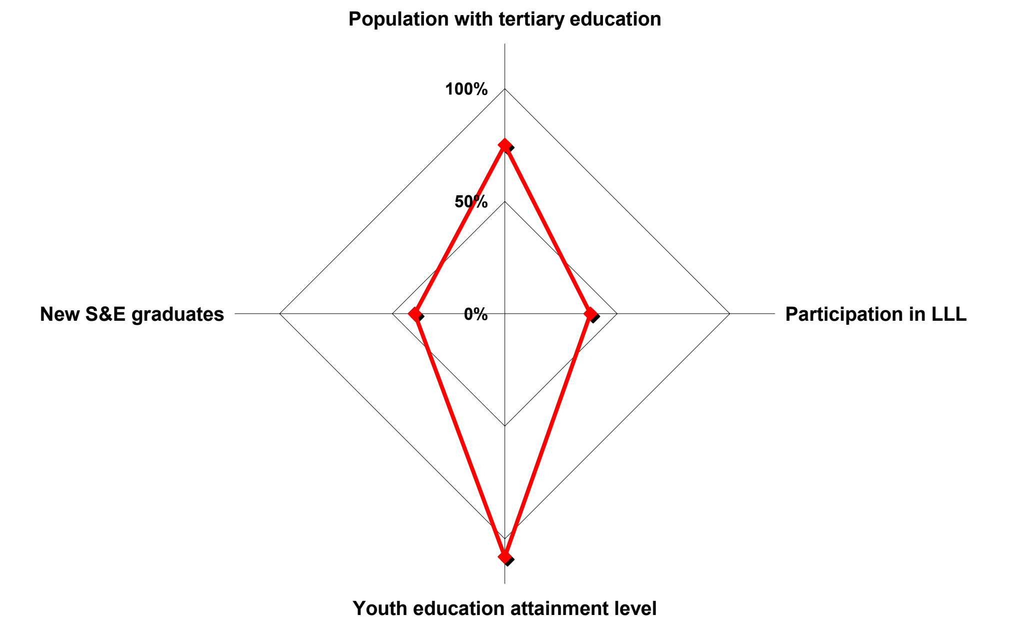
The expansion of business R&D both in terms of total expenditures and the number of actors involved indicates the emergence of a stronger base, on which innovation capabilities can be improved, albeit from a low level. But the low number of innovative firms, as well as the unsatisfactory position of medium-sized enterprises highlights major snags in NIS.

6.2. Human resources for STI

Highly skilled human resources are becoming key factors of competitiveness, being essential for producing, diffusing and disseminating knowledge. In order to improve the NIS (not only in Hungary) it is crucial to better balance the supply and demand of highly-skilled workers as well as entrepreneurs, managers, engineers and scientists.

All indicators concerning human resources in the European Innovation Scoreboard highlight that Hungary lags behind the EU25 average. With respect to 3 out of 4 indicators concerning human resources, Hungary performs well below most of the member states. The situation is particularly serious in the cases of life-long learning[54] and science & engineering graduates.[55] (Figure 22)

Figure 22 ***Hungary's position vis-à-vis the EU25 average by EIS human resources (EU25=100)***



Source: EIS 2006

Note: LLL means Life-Long Learning

The low share of S&E graduates might be regarded as a rational reaction if it is seen in its wider historical perspective. Job prospects were not promising for engineers for most of the 1990s, although improved in recent years. Further, the severe lack of financial and marketing managers, as well as the booming opportunities for lawyers made these specialisations more attractive. Since 2001, there has been a marked increase in the absolute number of students at S&T faculties, albeit with significant fluctuations.

According to the available EIS data for the period of 1999 and 2005 Hungary is not in a catching up phase as measured by these indicators, and hence the competitive position of the country in relation to the EU has not changed in these important areas. (EIS, 2006)

As we have seen in Chapters 3.2 and 4, the transformation of the economic and scientific system caused a dramatic decrease in R&D jobs. Slight turning in this declining trend may be observed since

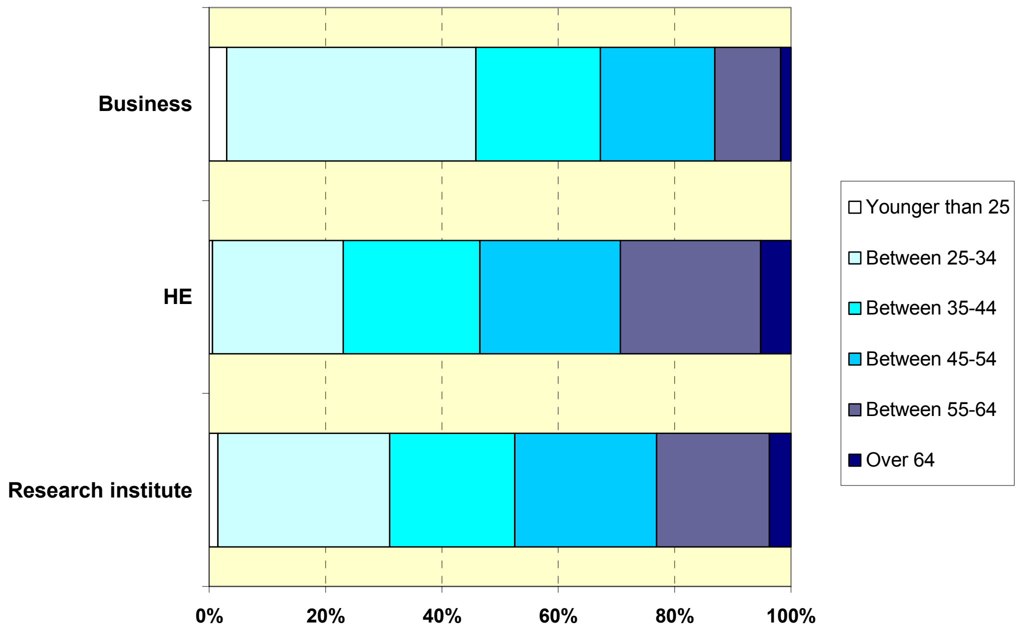
[54] The participation in life-long learning per 100 population aged 25-64 is 4.2 in Hungary, while it is 11.0 in the EU25

[55] S&E graduates per 1000 population aged 20-29 in Hungary: 5.1, as opposed to EU25: 12.7

1998. (Table SA15 and Figure 6) It took a decade to reach the 1990 level: 17,547 (FTE) researchers in 2006. In spite of the fact that the country is on an ascending curve, Hungary lags considerably behind the EU average concerning the share of R&D personnel in thousand inhabitants. (Table SA14, Figure SA15, Figure SA17 and Figure SA18)

One quarter of scientists is aged above 55 years of age and less than 30% are below 34. Since 2000 slight rejuvenation could be detected. The average age of researchers at universities and research institutes is increasing, while at enterprises it is decreasing. Nearly half of researchers at companies are younger than 34. (Figure 23 and Table SA20) Several new incentives are encouraging the employment of young, PhD graduated researchers at firms. (see Chapter 5.5)

Figure 23 ***Researcher personnel - age cohort by sectors in Hungary, 2006***



Source: KSH, Research and Development 2006

The proportion of female scientists was 34 % in 2006: the highest in medical sciences (46%) and humanities (48%), and the lowest in engineering (20%). (Table SA19) At the same time the average proportion of female students is 56%.

6.2.1. Current or prospective mismatches between supply and demand of HRST and innovation

In the last few years the business community put several times the issue of the lack of *educated people* on the government's agenda. From time to time, firm representatives have stated that the shortage of skilled workers is an obstacle to investment and innovation. The quantity of skilled workers was insufficient for innovative businesses, while the unsatisfactory level of vocational training has hampered the improvement of emerging industries and the introduction of new technologies in traditional industries. Business representatives emphasised that Hungary has to invest more in problem-solving capabilities, engineering and IT skills. The activities of businesses could highlight the importance of education at each level and resulted in a growing attention to this subject by both governments and political parties. (Inzelt, Csonka, and Andrási, 2007)

According to a survey in 2005 by the AmCham in Hungary, the majority of 114 executives of fully or partially US-owned companies shared the view that since 2000 the labour market was one of the areas where they could recognise significant improvements. They assessed highest the availability of workforce, well-educated managers and the productivity of labour. The highly-educated labour force was considered as more creative, skilled and motivated than the average in Europe. In spite of the improvements the prevailing shortages of skilled workforce, in particular with good entrepreneurial attitude and language skills still hinder investments. (AmCham, 2005)

A recent study, commissioned by the Public Employment Service, investigated the present and future mismatches between demand and supply on labour market for workers with tertiary education level in 2005-2015. The Survey covered 6,000 premises in various economic sectors. (Dávid *et al*., 2007) The main lessons of the study are the following:

- Generally the demand for engineering is 1.7 times higher than the supply. A surplus is forecast for agricultural, environment protection, mechanical and metallurgical engineers, while shortage for electrical engineers. In some regions economic development and attracting foreign investment are hampered by the lack of not only electrical but mechanical engineers too.
- Hungary was successful to educate more people in ICT in the past decade when demand was increasing fast. Based on forecast demands the education system should provide higher ICT skills to non-ICT professionals and improve specialisation in ICT-related professions.
- The demand and supply is more or less balanced in medicine. But there are some specialisations where Hungary faces shortages (such as vascular surgery, nervous surgery, isotope diagnostic, anaesthesiology, and epidemiology). The surplus is high among the pharmacists.
- In legal professions fresh graduates represent 3.7 times higher supply than demand.

The Hungarian higher education system was quite reluctant to investigate the career prospects of their fresh graduates. In an environment of fast-growing enrolment rate, the higher education institutes were much more interested in increasing the number of registered students than in labour market success of their graduated students. The Ministry of Education has commissioned spot surveys to learn more about mismatches between the supply and demand, and recently introduced a systematic survey on careers of fresh graduates.

Up-to-date information is available from the sporadic surveys that investigated the population graduated in 1998 and 1999 in higher education. A recent survey, based on these data, mapped the early career phase – taking two samples, one in the first year after graduation and another one in 2004. (Galasi *et al*., 2004) According to this source a relatively high proportion, roughly one-third of the fresh graduates were over-qualified for their jobs. This over-qualification may be considered as a natural phenomenon as many labour-market careers usually start at lower qualified jobs. In 5 years the share of over-qualification slightly decreased (from 34.5% to 31%) The proportion of over-qualified employees is higher among college graduates than university degree holders. In the reviewed period there were better chances to enter and perform jobs that are relevant to the qualification with university degree than with college degree. (0)

Table 15 ***Harmony between qualification and jobs by level of HE in %***

Relation between job and qualification in 1998/99 and 2004	**College**	**University**	**Total**
Not overqualified any years	45.2	57.5	49.6
Overqualified in both years	17.8	9.8	15.0
Not overqualified in 1998/99 but in 2004	17.2	14.2	16.1
Overqualified in 1998/99 but not in 2004	19.9	18.5	19.4
Total	**100**	**100**	**100**

Source: Galasi *et al.* 2004

By fields of science the most over-qualified fresh graduates are in agriculture and social sciences. The qualification and jobs were more balanced in medicine. (Table SA40)

A recent study (Tamás *et al*., 2005) investigated the potential demand for HRST for the coming 10 years. Based on different assumptions, four models have been identified. One of the main findings was that even according to the most optimistic scenario the labour force with PhD degree will become the bottleneck of the Hungarian science system. According to their calculation there will be a shortage of researchers with PhD degree in 5 to 10 years, if the present training trends will not change. The effect of this shortage will endanger the functioning of the research system, but the innovation activities will also be strongly influenced. The country will lose its present attractiveness for FDI toward higher value-added and knowledge-intensive activities. As the study concludes, the government should react immediately to this challenge by initiating the necessary changes in the PhD training (both in quantity and quality) and easing the inflow of researchers with PhD from abroad. Both options need significant changes in STI policy approaches and objectives.

Some adjustment to the needs of the labour market may be observed. Reorganisation of vocational training has started and the Bologna process will probably result in successful reactions to market demands. An important adjustment to the labour market demand is signalled by changes in the number of state financed enrolment by fields of education. From 2006 to 2007 the number of state supported enrolled students decreased by 16%. One exception is engineering studies, where the quota has increased.

6.2.2. International mobility of HRST

Mobility is one of the most efficient tools for knowledge flow that may upgrade or downgrade the knowledge dissemination and diffusion capabilities of the system. *International mobility* has impacts on both demand and supply. There have been several attempts to map the influence of international mobility of highly skilled workers (financed by the EU), but there are only limited reliable data available on this issue.

An important factor of mobility is that international economic relationships have been broadening. Foreign direct investment has increased two-way mobility of qualified people (including R&D personnel) inside and across the MNCs.

Table 16 ***The proportion of Hungarian scientists and engineers staying more than 6 months abroad as % of total RSE in headcount, 1995-2006***

	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006
All	4.7	2.3	2.1	1.9	2.0	1.9	1.8	1.4	1.3	1.2
Employee	1.6	1.3	1.3	1.3	1.2	1.3	1.1	0.9	0.9	0.7
Fellow	2.3	1.0	0.8	0.7	0.8	0.6	0.7	0.5	0.4	0.5

Source: KSH, Research and Development (various years)

Hungarian researchers usually go abroad – similarly to their European colleagues – to find better opportunities either in the US or in more advanced European countries. The share of Hungarian scientists and engineers staying abroad longer than 6 months was 4.6% in 1991 and it has gradually decreased to 1.2% in 2006 (Table 16) Their number decreased from 570 in 2000 to 388 in 2006 (KSH, 2007a) An unrecorded group of migrant researchers are PhD students who are studying abroad and do not return to Hungary or leave the country after graduation without entering a research position at home.

Only short time series are available on the inflow of foreign researchers. In the period of 2004 and 2006 their proportion in total Hungarian scientists and engineers was between 2.6% and 3.1%. (Table 17)

Table 17 ***The share of foreign researchers and fellows as % of total RSE in Hungary in headcount (2004-2006)***

Scientists & Engineers (SE)	2004	2005	2006
From EU	1.1	1.2	1.3
From Europe outside EU	1.1	1.1	1.2
Non European	0.4	0.4	0.6
Total foreign SEs	**2.6**	**2.7**	**3.1**

Source: KSH, Research and Development 2006

Higher education is the largest employer of foreign researchers (more than 60%), but its proportion is decreasing, while the share of business has increased from 17% to 22%. (KSH)

According to a small survey, conducted by the Hungarian Academy of Sciences as an input to this report, 6 out of 26 MTA institutes have reported returnees from abroad in the past 5 years and only a few of them enjoyed repatriation grant. 56 foreign researchers worked in 11 institutes in late 2007. About 40% of all foreign guest researchers arrived from the former centrally planned economies (mostly from Romania, Ukraine and Russia), another 40% from Western Europe. The US has relatively small proportion, about 5%. (Source: MTA, 2007)

6.2.3. Policy measures

The promotion of human resources for research and technological development was given high priority in public funding since 1990.

The mid-term STI policy strategy of 2007 puts emphasis on the human resources challenges and consider this issue as one of the areas the government should focus on in the period of 2007 to 2013. Its Priority line #3 calls for “A respected, knowledge-based, creative and innovative workforce suited to the demands of society and the economy”.

The EDOP for 2007-2013, co-financed by the EU Structural Funds also underlines the importance of human skill development in RTDI. Primary focus is given to IT and communications, in particular language skills. The lack of entrepreneurial and management skills is also considered as a bottleneck in developing economic and innovation activities mostly in micro- and small firms.

A large number of funding schemes are in operation at the end of 2007. (See further details in the box above.)

Two funding agencies, OTKA and NKTH have recently jointly launched a funding scheme (OTKA-H07) for promoting the development of human resources for basic research. The programme has three funding lines: (1) supporting the inflow of researchers working abroad (indirectly promoting the return of Hungarian researchers staying long abroad); (2) funding research activities of young scientists with PhD either at prominent Hungarian or foreign laboratories; and (3) supporting the access of large research facilities abroad (like ESA, CERN, ESRF, EMBL etc.) for PhD students or young scientists with PhD. The allocated amount of funding is EUR 4 m.

Current public support schemes for HRST promotion

The "**Kozma László" Programme** provides support to employ researchers with technical, business and scientific qualification.

The "**Pázmány Péter",** the **"Jedlik Ányos"** and the **Co-operative Research Centers Programmes** aim at promoting business-university links, among others, via the exchange of staff and PhD education.

A **tax incentive** inspires employers to hire PhD, MSc and MBA students by making their labour cost lower.

The "**Polányi Mihály" Programme** provides grants for young researchers who have benefited from OTKA funds to conduct high-level basic research. Young researchers might continue their research by establishing their own research group and bring their work closer to commercialisation phase. The programme also supports those well-known young researchers who work abroad but would like to return to Hungary.

The "**Bolyai János" Scholarship** programme provides grant for conducting research for 1-3 years. Outstanding young researchers (aged under 45) are targeted, the main objective is to enhance the post-doc employment. This scheme exists since 1997 and is governed by MTA.

There is also a short-term mobility grant, "**Eötvös Scholarship**" for outstanding persons (aged under 40) with PhD/DLA degree to conduct their activities in a foreign country for 3-8 months.

"**Öveges József" Programme** provides grants for post-docs, and talented young researchers.

In summary

The rapid and profound changes in the socio-economic environment during the past 15-20 years have resulted in a fundamental restructuring of the educational system, and led to major changes in the number of research personnel, and the demand for HRST by business enterprises.

The major challenges in relation to the existing or potential mismatch of demand and supply in the labour market are the following:

- *Slow and inappropriate reaction of the education system to the fast changing market requirements*
- *Low share of natural science and engineering graduates in international comparison*
- *Serious shortage of highly qualified researchers (with a PhD degree) is projected in the medium to long-run, which may hinder economic growth and the evolution of higher knowledge-intensive activities in the country*
- *Limited mobility between academia and industry*
- *Low level of life-long learning*

Skills, values and knowledge that are being increasingly recognised by the global labour market are becoming important requirements in the Hungarian domestic labour market as well. Any efforts aimed at improving the supply of HRST need to have a long-term approach and much wider perspectives than narrow focus on HE; science & technology education can only be rely on a strong elementary and secondary education system, and, in turn, appropriate training and remuneration of the teachers at those levels.

The opening up of the science system is a necessary condition for tackling successfully the projected HRST shortages.

6.3. Internationalisation of STI in Hungary

The access to foreign knowledge and its application is of high importance in emerging (catching up) economies, like Hungary. This process runs through different channels, including business-to-business contacts (FDI, strategic collaborations etc.), international mobility of highly skilled labour force, as well as internationalisation of S&T activities.

6.3.1. Flow of technological knowledge

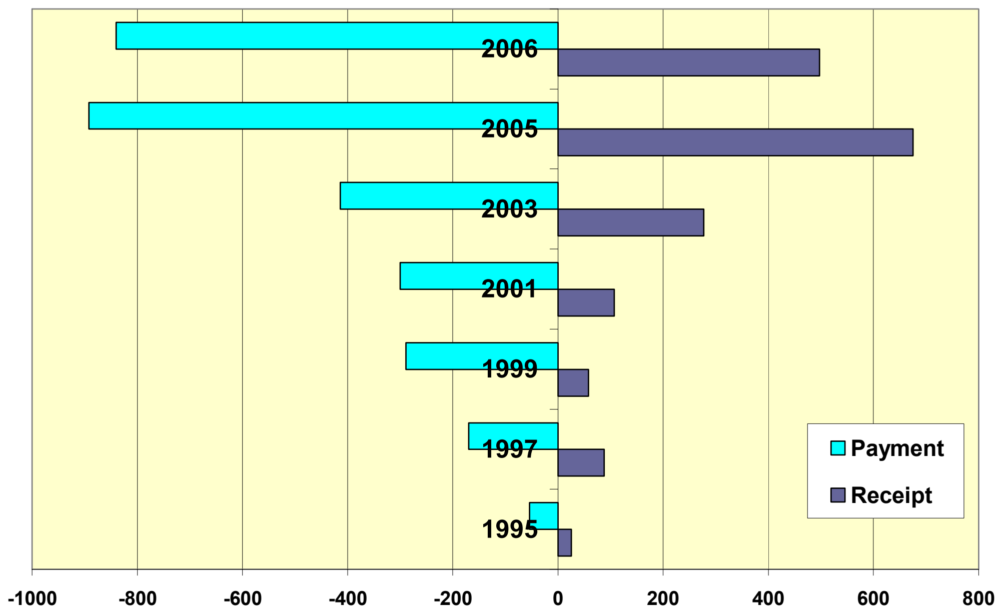
The flow of technological knowledge can be measured by several indicators. In the following the technology balance of payments and other patent related statistics will be used to identify drivers and strengths.

The **technology balance of payments (TBP)** measures international transfer of technologies in the form of licenses, patents, know-how, research and technical assistance.

In the OECD database there are only a few data are available on Hungary's TBP. In 1999 the payment was USD 502.7 m and the receipt USD 216.1 m, which resulted in a USD 287.6 m deficit. According to the OECD TBP database (OECD, 2007a) the Hungarian TBP accounted for -0.78% of the GDP in 2005.

The annual balance of payments of licenses and patents data is available from the National Bank of Hungary (MNB, Balance of current account). According to these data the balance of payment of these categories was continuously negative in the period of 1995-2006. (Figure 24)

Figure 24 ***Balance of payments of licences and patents between 1995 and 2006, Hungary (m EUR)***



Source: MNB (Hungarian National Bank) database, November 2007
http://www.mnb.hu/Engine.aspx?page=mnbhu_statisztikai_idosorok&ContentID=9822

Both TBP and other related data reflect the ability of a country to sell technologies abroad (receipt side) and its capabilities to use technologies of foreign origin (payment side). The fact that the balance is positive or negative does not say much about the competitive position of a nation.

In the case of Hungary the negative figure clearly indicates two facts. First the strong position of foreign owned multinational companies in the national economy (they import extensively technologies from other affiliates of the parent company). Second, the fast modernisation of the economy and catching up is fuelled by imported technologies and technological knowledge.

The intellectual property right activities of Hungary, as in all other emerging economies in CEE, are far behind the EU25 averages. This is true not only for patenting, but in the cases of trademarks and industrial design as well. Hungary's position is between 5.8% and 18.7% of EU25 averages in these categories. (EIS, 2006)

The **international patent statistics** show a relative strength of Hungary in ICT. In the period of 1995-2003 the country produced 17.8% annual growth rate in patent applications to EPO in this area. In the early 2000s about one third of all Hungarian EPO applications belonged to ICT.

Biotechnology applications show a dynamic growth, and although they are more visible than in peer new member states, they are still on a low level (9 applications to EPO in 2001). (OECD, 2003)

More than 50% of domestic inventions (patented in EPO) were owned by foreign, mostly European residents in 2001-2003.[56] (OECD, 2007b)

The number of patents, owned by Hungarian organisations or citizens invented abroad is small, but growing.

The patents with at least one foreign partner show also a growing trend in the same period. (Table 18) Between 2001 and 2003 we may identify foreign investors as partners in close to 40% of all Hungarian patent applications to EPO. The international comparison, however, shows that small and less developed economies are more engaged in such types of international collaborations. (OECD, 2007b)

Table 18 ***Number of patents based on applications to EPO, 1998-2003***

	1998	1999	2000	2001	2002	2003
Domestic ownership of invention made abroad	41	89	67	67	86	78
Patents at least with one foreign inventor	70	131	156	123	141	164

Source: OECD, Patent Statistics; http://stats.oecd.org/wbos/default.aspx?DatasetCode=RFOREIGN

The non-patent literature (NPL) in the patent applications may indicate the scientific linkages of inventions. Emerging knowledge-based technology fields, like ICT or biotechnology, have stronger relationship with the relevant scientific communities, which are reflected by the NPL-related patent statistics as well. Higher shares of NPL in patent citation may indicate a kind of specialisation of a country in fields with more scientific knowledge-intensive activities. In the period of 1990-2004 the share of NPL in citation of all patents was about 18% in case of Hungary (only India and Canada performed better), in the case of ICT it was about 26% (following India, Belgium and Canada). While patenting activities in Hungary are generally at a low level in international (European) comparison, relatively large proportion of such efforts is scientific knowledge-driven. (OECD, 2007b)

6.3.2. Collaboration in international R&D programmes and initiatives

Since 1990 governments have devoted particular attention to reintroducing Hungary into the international RTDI community.

[56] The share of European partners in total was close to 80%

Regarding participation in RTDI collaborations, membership in various international organisations such as COST, EMBO, EUREKA, NATO and CERN have been significant for the Hungarian research community. EUREKA offered opportunities for science-industry collaborations, including co-operation with international industrial partners. The large number of bilateral intergovernmental S&T agreements has also accelerated successfully the internationalisation of Hungarian RTDI. In terms of STI policy, memberships in the OECD (1996) and in the EU (2004) have opened significant new avenues.

In the 1990s the PHARE assistance programme of the EU considered S&T as a priority and launched several funding schemes which contributed to the improvements of the international collaboration capabilities of the Hungarian S&T community. Several national public programmes have also been launched with the aim of facilitating this process. The box summarises the current public funding schemes. (Fir further details, see Figure 13)

Current public initiatives to promote international RTDI collaborations

The **Albert Apponyi Programme** encourages building and upgrading international RTDI collaboration, such as exchanging international experiences, organising workshops and conferences.

The **Miksa DÉRI Programme** is specifically concerned with EUREKA projects.

The **NAP 2005** targets large, interdisciplinary R&D projects, conducted in the framework of bi- or multilateral co-operation, including EU Network of Excellence and EU Integrated Projects.

The bilateral and multilateral R&D programmes and, to a lesser extent, international innovation programmes are crucial for Hungarian project participants. They are important vehicles for the Hungarian RTDI community to gain access to international networks of knowledge creation (and to additional sources of funding). Active Hungarian participation is reported in EU RTD Framework Programmes, EUREKA, COST and bilateral intergovernmental ones.

Hungarian research groups joined gradually the EU's R&D Framework Programme. First, in the middle of the 1990s some specific programmes were opened for candidate countries allowing project level participation. From 2004 as a member state Hungary can fully enjoy the benefits of the FPs.

Hungarian teams participated in international collaborations via 2,215 R&D projects in 2006. Companies had a 28% share but in engineering and technical sciences their weight was over 70%. (KSH, 2007a)

The strengths of the research community are indicated by the Framework Programme (FP) statistics of the European Union. Hungary has always been among the top three candidate countries/new member states with respect to the number of project participation and the size of funds awarded. FP4 provided EUR 15.6 m to Hungarian project participants. This amount grew to EUR 64.2 m in FP5, and EUR 141.5 m in FP6. This EUR 141.5 m represents 0.89% of FP6 total budget and Hungary has the 16th position out of the 25 member states (only Poland has better position than Hungary in the group of all new members states). (Table SA41)

The number of projects with Hungarian participants has also grown significantly. Not only quantitative, but qualitative improvement can also be detected. In FP6 there were 755 projects with at least one participant from Hungary[57] and 96 projects were coordinated by Hungarian project leaders. Hungarians participated in 1 out of 10 FP6 projects. This share was the highest in the "Citizens", "Food" and "Euratom" specific programmes. (Figure 25)

In spite of the results in FPs it should be noted that in comparison to old member states of similar size, Hungary's position is lagging behind in terms of project participation and grants awarded as share of population or researchers. There is room for further catching up.

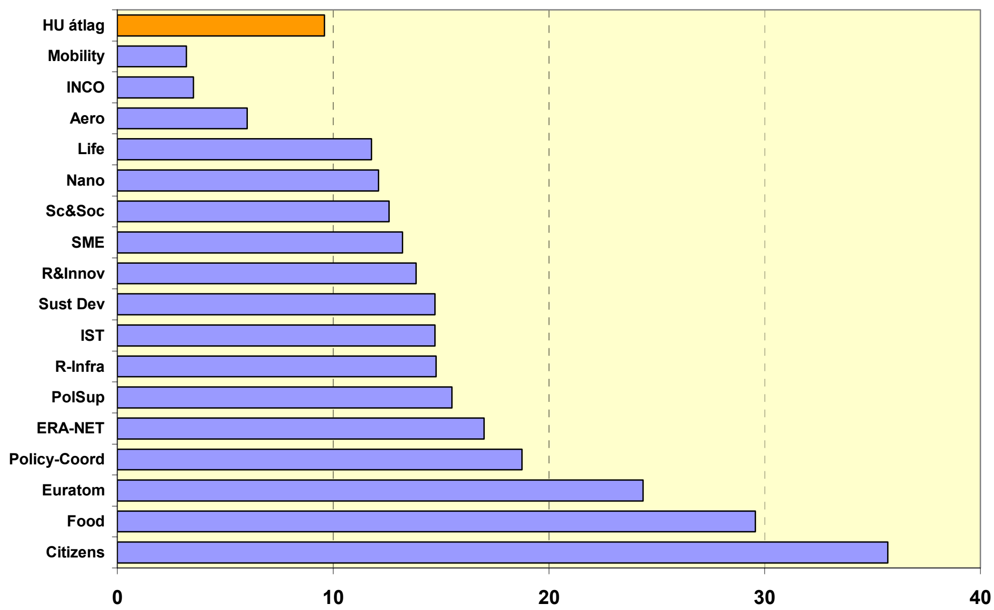
[57] Altogether 1,102 teams participated from the country, but the same research group could join more than one projects, so the number of organisations with experiences of participation in EU-funded research projects must be somewhere between 755 and 1,102

Hungarian researchers were most successful in terms of financial support obtained and the number of participants in the specific programme on IST. A large number of Hungarian teams participated in the specific programmes of mobility, sustainable development, food, nanotechnologies and life sciences as well.

FP6 was a real success story of higher education institutes in Hungary. In terms of financial support from the EU the most successful individual applicant in the group of all new member states was the Budapest University of Technology and Economics. There are 7 universities in the top ten Hungarian beneficiaries. The first company is ranked 8th and there are three more companies among the top 30.

The Framework Programmes are much more popular for the academic community in Hungary. Firms' participation is limited: they represent 17.6% of all project participations. In FP6 relatively high business interests could be seen in the support of INCO (43% of all HU participants), in aeronautics & space (36%), in nanotechnologies (30%), in food (21%) and in life sciences (20%). In IST the share of business participation is at the level of the Hungarian average (18%).

Figure 25 ***The share of projects with at least one Hungarian participant as percent of all projects in a given specific programmes of FP6 (%)***



Source: NKTH, 2007 based on data available from the Commission

In financial terms enterprises have proved to be the most successful in the IST programme (companies received 37% of all EU financing to Hungarian participants in this programme), but aeronautics & space (with 28%), nanotechnologies and SME programmes (with 24-24%) were also successfully targeted by enterprises.

EUREKA and COST have also provided good opportunities for Hungarian researchers to participate in international RTDI collaborations. In 2007 there were 141 COST projects with Hungarian participation (environmental-related areas, materials & nano-sciences and food are the fields with largest representation). In EUREKA there are 40 participants in 24 projects from Hungary with a dominance of biotech (10 projects).

6.3.3. The role of MNCs

The applied privatisation policy and special incentives resulted in a boom of FDI in the early 1990s. The weight of foreign owned firms in both GDP and export reached 70% by 2000.

Much of FDI's development role in Hungary can be traced back to the dominance of export-oriented, efficiency-seeking investments.[58] The contribution of this type of FDI to Hungary's macroeconomic indicators (GDP, employment, export) as well as to local technology upgrading exceeded that of market-seeking FDI. The main entry mode of investors with this latter motivation was through privatisation. Privatisation offered a unique opportunity for these companies, competing in the saturated market of developed countries, to gain huge new markets with a non-negligible growth potential. In contrast, the dominant part of efficiency-seeking investors established greenfield facilities. Efficiency-seekers' global orientation explains that the technology level of efficiency seekers' local production facilities corresponds to or is not much below the world technology frontier. Nevertheless, the main contribution to enhancing Hungary's innovation potential was given by strategic asset-seeking investors (or by investors that turned into strategic asset seekers once they recognised the existence and the value of local knowledge and skills).

The new owners of these Hungarian companies recognised the special values in their new companies and decided not only to sustain the research activities in Hungary, but improve it. These business research labs have quickly become integral part of the parent company's worldwide innovation network. Examples are GE Lighting Tungsram (in lighting industry) or Chinoin (in pharmaceutical industry).

Other global companies, like NOKIA, ERICSSON and Knorr Bremse have assessed carefully the potential benefit of investing into the highly skilled labour force available in a country with good education traditions, but relatively cheap labour cost, and decided to set up their own research centres in Hungary as green-field investment between 1997 and 2002.

As we could see in previous chapters, majority foreign-owned firms play a significant role in the Hungarian NIS. Both CIS results and R&D statistics underline that majority or fully foreign-owned companies have reached a dominant position, they are much more innovative than indigenous firms. They account for around 70% of BERD in Hungary, while running about 10-15% of research units. The number of their research units grew from 90 in 2003 to 136 in 2006. (Table SA9) Their activities are concentrated in a couple of sectors: pharmaceutical, ICT and automobile industries.

In October-November 2007, as part of the preparation of this report, a sample of the largest RTDI performers was interviewed in order to (1) identify the main features of their R&D activities, (2) describe the evolution of corporate R&D activities, and (3) position them in a broad network of co-operation partners. Special

The composition of companies interviewed

The sample consisted of nine firms, all in foreign ownership. Six of them are in manufacturing, while three in the services sector. Six existed before 1990, most of them were privatised in the early 1990s. Three companies were established as green-field facilities.

Three belonged to the pharmaceuticals industry, which industry accounts for a significant share of BERD in Hungary. Five ICT-firms have been interviewed.

It must be noted that these firms do not represent the foreign-owned segment of the economy.

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58 Dunning [1993] argues that FDI-decisions can be driven by four types of motivations. Market-seeking investments are driven by the intention to acquire new markets, with a possibly high growth potential. Resource-seeking location decisions are typically motivated by the aim of acquiring specific resources such as raw material or labour, at the lowest real costs. Efficiency-seeking investments are carried out with the motivation to configure assets globally in order to maximise efficiency within the firm and exploit economies of scale. As a result, value chain within firms becomes globally distributed, with higher specialisation in specific locations. Strategic assets seeking investments intend to acquire dynamic, mainly intangible resources and created factors such as knowledge, innovation capabilities, management or organisational skills.

attention was given to identifying the role of these actors as facilitators of internationalisation of RTDI activities. (The composition of the sample is detailed in the box.)

The size of the sample is too small to provide any quantitative analysis. But since the interviewed companies account for a significant chunk of the Hungarian BERD, tendencies, common features and differences may give a rough insight as to how these actors contribute to the functioning of the NIS.

Major findings of the interviews:

(i) The interviewed companies vary in terms of the distribution of research activities among categories ranging from adaptive to strategic research. A few companies have reported a clear trend towards increasing importance of mid- to long-term research objectives. The more the activity of the local research lab (or of local researchers) is strategic and long term, the less it is related to local (manufacturing and service) activities. In this case local researchers are becoming integral part of the MNCs global research undertakings.

(ii) R&D activity (as reflected both by the level of expenditures and the number of researchers) keeps expanding at ICT firms. Pharmaceutical firms have recently become more cautious with their expansion moves, explained by new, unfavorable fiscal regulations. Nevertheless, since their R&D expenditures are usually linked to their net sales and net sales keep growing, so does the yearly amount allocated for R&D purposes as well.

(iii) The interviewed firms have been broadening their strategic networks with higher education institutes, and increasingly engaging in strategic joint research activities, which has resulted in a slow increase in the share of extra-mural activities. A relatively small share of extra-mural activities can be traced to outsourcing of the R&D activities *per se*, extra-mural activities are rather joint research projects.

(iv) The highly diversified character as well as the intensity of horizontal relations was a common feature of all the interviewed companies. Both the number and the intensity of university co-operations were increasing in the case of these companies and some of them co-operated with public research institutes as well. Interviews revealed that although university co-operation were of exceptional importance for all the companies, its reasons differed according to industry characteristics. Firms with ICT-related R&D activities engaged in networking with various universities in order to "influence" the curricula, and get access to the most talented students. Pharmaceuticals firms were more interested in joint research projects, testing etc. Both types of firms have been sponsoring universities with laboratory equipment, software and computers.

(v) The horizontal co-operations range from local universities (joint research undertakings, grants and research competitions to students, participation in the formation of the academic curricula) to consultants, and strategic partners (including clients, suppliers and even competitors).

(vi) The evolution of other types of co-operation (within the MNC-network or with clients, suppliers, competitors) is determined mostly by industry-specific factors. Software R&D labs closely co-operate with clients. Local research labs or at least researchers incorporated into the parent companies' global research projects were in close co-operation with the parent companies' research labs in different countries.

In summary

The fast modernisation of the Hungarian economy is fuelled by imported technologies and technological knowledge. FDI has been a significant driver in the internationalisation of R&D and innovation activities in the past 17 years. Their R&D and innovation activities (training, organisational innovation, technology transfer and innovation management) have oriented significantly the evolution of the national innovation system. The worldwide MNC networks provide opportunities to further open up the Hungarian NIS. Their affiliates are active in *integrating their Hungarian partners into international production and innovation networks by diffusing technological and organisational innovations, as well as by setting high performance and quality standards. The R&D centres of MNCs have become part of the NIS, built up linkages with public research organisations (first of all with universities.*

The other driver of internationalisation of Hungarian R&D is the expanding collaboration of the R&D community with foreign partners. The Hungarian research community have widened its international co-operation network fast and successfully since the early 1990a. The collaboration culture of both academic and business research organisations have improved in the past 17 years.

7. SWOT ANALYSIS OF THE HUNGARIAN NIS

The SWOT focuses on three major aspects: (1) the socio-economic climate, (2) the NIS as such, and (3) the STI policy governance.

7.1. Socio-economic climate

STRENGTHS	WEAKNESSES
(a) Open economy, with liberal regulation concerning trade and FDI (b) Significant inflow of FDI, bringing new products, services, processes and managerial methods (c) In general skilled labour force	(a) Low level of willingness for meaningful strategic dialogues among major political actors on issues with long-term nature, including STI policies (b) High level of budget deficit and government debts, and slow economic growth; and hence the overriding importance of fiscal policy (c) Dual economy: a small group of highly productive and technologically intensive foreign-owned companies; fragile indigenous SMEs (d) Weak demand for innovation (e) Frequently changing rules and regulations (tax rules etc.) (f) Uneven regional development (g) Low level of labour mobility (h) Shortage of skilled labour in certain sectors and regions (i) Insufficient networking capacity

OPPORTUNITIES	THREATS
(a) New markets opening up due to globalisation, internal EU markets and economic development in Eastern and South-Eastern European emerging economies (b) Success of public reform policies and convergence programme (c) Joining the euro-zone (d) Effective use of the EU Structural Funds	(a) Volatility of global capital markets (b) Slipping back towards a low-cost production site (c) Further delays in joining the euro-zone, and hence focus on fiscal targets sidelines appropriate innovation policy agenda (d) A politically and economically weakening EU, and its ensuing strategic disorientation (e.g. the failure to achieve the Lisbon objectives)

7.2. National innovation system

STRENGTHS	WEAKNESSES
(a) All major organisational elements in a developed NIS are formally in place (b) An increasing number of indigenous firms, integrated into international production and – to a lesser extent – innovation networks (c) Fairly developed human R&D capacities in public research institutes and higher education, intense participation in international collaborations	(a) Low share of innovative firms in general, and innovative SMEs in particular (b) Low level of co-operation in innovation activities, in particular among firms and public research organisations (c) Low level of GERD, and especially BERD (d) Uneven geographical distribution of RTDI activities (e) Share of working age population with tertiary education below the EU average (f) Low ratio of science and engineering graduates among people aged between 20 and 29 (g) Insufficient RTDI management capabilities in higher education and public research organisations (h) Substandard physical infrastructure in the publicly financed research units

OPPORTUNITIES	THREATS
(a) Deeper and more profitable integration into the international production and innovation systems, due to the increasing share of knowledge-intensive activities of the Hungarian partners (firms, R&D units, others) (b) Closer integration into RTDI networks of MNCs (stronger horizontal integration of Hungarian subsidiaries of MNCs into the NIS; more intense participation of major European MNC-driven RTDI initiatives) (c) Effective use of the EU funds and instruments provided by the Structural Funds in 2007-13, the 7th RTD Framework Programme, and the Competitiveness and Innovation Programme	(a) Weakening publicly financed R&D units, due to shrinking public funds for promoting RTDI activities, given a failed macroeconomic stabilisation programme, and hence a 'cyclical' need for further, even more severe restrictions (b) Decreasing level of RTDI activities by MNCs in Hungary (c) Increasing migration of young researchers

7.3. STI governance

STRENGTHS	WEAKNESSES
(a) Recent legislation provides a favourable overall legal and financial framework for RTDI activities (creating a more stable RTDI Fund, tax incentives for RTDI, etc.) (b) A new STI policy strategy and Action Plan approved in 2007	(a) Poor policy planning, co-ordination and lack of integration of major government policies in relation to STI (b) Lack of evaluation of publicly financed R&D units and funding schemes (c) Major elements of recent STI legislation are not or very slowly implemented (d) Low level of co-ordination among the different RTDI public funding sources (e) Weak innovation policy community, lack of demand for STI policy analysis

OPPORTUNITIES	THREATS
(a) Devising and implementing a sound catching-up strategy with a strong focus on innovation (b) Systematic use of modern decision preparatory tools (evaluation, independent reviews, foresight, technology assessment etc.) to assist policy learning (c) Using the existing, but ineffectively operated mechanisms for policy co-ordination (d) Regular involvement of stakeholders in STI policy processes (e) More efficient, better co-ordinated, and hence more influential strategic thinking, as well as policy implementation due to the revised Lisbon Strategy (f) Exploiting the various EU schemes to develop the STI policy setting capabilities and systems	(a) Bitter rivalry among the key actors in STI policy-making as a consequence of non-cooperative political culture and/or severe macroeconomic tensions

8. CONCLUDING REMARKS

Hungary has made considerable progress since 1995, when the follow-up on the last OECD review on her national innovation system was conducted. The fundamental social and economic transformation process has been completed, and a number of political and economic institutions required for long-term development have also been (re-) introduced. The economy is gradually closing the gap with the EU both in terms of GDP per capita and labour productivity, to a very large extent driven by FDI and foreign trade. There is a long way to go, however, even to reach the current level of the EU average GDP per capita. Framework conditions for innovation have also been improved by major new laws.

Decision-makers, however, cannot be complacent given the current and likely future impacts of several internal and external factors. Five major internal issues can be highlighted from the foregoing analyses, which ask for further substantial efforts to change the current situation:

- the dual economy syndrome;
- macroeconomic tensions;
- linkages among the major players of the NIS;
- human resources for innovation;
- co-ordination of major economic and STI policies on the one hand, and STI policy design and implementation on the other.

In the meantime major changes are occurring in the international settings (ever increasing impacts of rapid S&T developments and growing ethical, social concerns about some of them, global activities of MNCs, expanding international production networks, anti-globalisation movements, EU enlargement, opening up of China and thus re-direction of global capital flows, ever stronger environmental concerns, deep conflicts among socio-economic systems based on different set of values, etc.). Thus, Hungary is at cross-roads again. It has to consider what role to play in the globalising learning economy, i.e. what future she envisions for herself. To be more specific, does the country passively accept the fate of a mere surviving economy, drifting along without having its own strategy? Or, by implementing a clear strategy, does Hungary intend to be a prosperous country in which most citizens enjoy high living standards, good health and a clean environment within 15-20 years?

Further factors also necessitate that decision-makers devote more time and attention to strategic thinking and actions. International competitiveness should be enhanced significantly and then maintained for long-term to speed up the cohesion process and thus improve quality of life. It is far from being a trivial task, however. Hungary is squeezed in a 'nutcracker' formed by advanced countries, on the one hand, and dynamic industrialising countries, on the other. The former ones are capable of controlling international production networks and markets via new technologies, financial muscles and superior business models, while the latter ones are characterised by extremely low wages and highly disciplined workforce. It is crucial for Hungary to escape from this trap. That requires more intense, and more widespread, innovation activities – technological, as well as organisational, managerial and financial innovations – to raise productivity and find new markets.

Macro-economic pressures, notably budget, trade, and balance of payment deficits, also call for a successful, competitive economy. Brain drain, which is harmful both from an economic and a social point of view, can only be reversed, or at least slowed down, by offering attractive conditions for researchers and engineers; i.e. challenging projects, appropriate funds, much better equipment and higher income. Further, there is already a very high share of foreign-owned companies in Hungary, but they should be better embedded in the domestic economy by improving the performance of the local supplier base, creating attractive conditions for more intense academia-industry relationships, and thus convincing foreign firms to invest in knowledge-intensive activities in Hungary and offer well-paid jobs by doing so.

In sum, only a significantly strengthened national innovation system (NIS) can tackle the challenges outlined above. That would require better performing players in the NIS, and even more importantly, intensified relationships between them. Effective science, technology and innovation (STI) policies are, therefore, needed to promote innovation activities. Indeed, there are over 40 STI policy measures in place in Hungary.

In spite of the impressive number and range of STI policy measures, for a large number of innovation performance indicators Hungary is lagging considerably behind most other EU countries. Moreover, there is no obvious link between economic and innovation performance. A number of hypotheses can be put forward concerning the root cause of this major challenge. The most plausible of those seems to be the one that stresses the chief role of the so-called framework conditions. The macroeconomic situation, the structure of the economy, the level and type of competition, the overall entrepreneurship culture and human resources have so unfavourable impacts on innovation activities of firms that the incentives provided by STI policy schemes cannot counterbalance those effects. Thus, there seems to be no 'panacea' to improve innovation performance, e.g. by introducing some new STI policy measures. In other words, a 'simple, quick fix' option cannot replace substantial policy efforts, based on a comprehensive approach.

It would go beyond the scope of this report to offer policy recommendations, but the results of the previous chapters point to several conclusions. At a *strategic level*, conscious co-ordination of major economic and STI policies, guided by an overarching socio-economic development strategy, is likely to yield major achievements. It can also align the EU goals and funding opportunities with the national ones. To this end, a careful monitoring of the implementation of the recently approved STI policy strategy can provide useful feedbacks, and indicate if there is a need to refine the strategy. Foresight processes would be useful to underpin these strategies, as well as orchestrate the main objectives at these different levels; in other words, to establish how RTDI processes – advanced by appropriate STI policies – can contribute to overall socio-economic development, and thus a faster cohesion with the more advanced EU members.

At the level of *policy design and implementation*, the systematic use up-to-date decision-preparatory methods – thorough analyses of innovation performance, combining census, taxation, R&D and innovation data; evaluation of individual policy measures, as well as that of the policy mix as a whole; and technology assessment – would contribute to devising and implementing sound and effective STI policy measures. Recurring consultations with the major actors of the national innovation system can also assist the policy processes to a significant extent.

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STATISTICAL ANNEXES

Tables

Table SA1 ***Capital inflow and outflow 2005-2007 (m EUR)***

	H1 2005	H1 2006	H1 2007
Non-debt generating financing	-1,277	-1,128	-2,529
Hungarian FDI to foreign countries	-1,698	-555	-1,307
FDI to Hungary	894	30	-116
Shares /equity	1,193	1,137	9
Reinvested profits	-300	-16	-27

Source: MNB

Note: 2007 figures are corrected for a 1.9 bn EUR rise in outflow due to a technical issue related to change in ownership of Budapest Airport privatised in early 2006.

Table SA2 ***Share of gross value-added by the size of enterprises and by industries in Hungary and in the EEA, 2003***

Industry	SMEs				Large
	Micro	Small	Medium	SME all	
Mining and energy	7.8	23.2	35.9	**66.8**	33.2
Manufacturing	4.9	9.8	19.3	**34.0**	66.0
Electricity, gas & water supply	1.4	4.5	7.6	**13.5**	86.5
Construction	29.3	32.1	23.6	**85.0**	15.0
Trade, repair, consumer goods	27.5	30.5	25.6	**83.6**	16.4
Trade, hotels and restaurants	27.9	27.2	18.3	**73.5**	26.5
Transport, communication, post	9.4	8.7	7.6	**25.7**	74.4
Education	63.7	23.2	12.4	**99.2**	
Health & social work	77.2	10.6	5.5	**93.3**	6.7
Total	**18.3**	**16.0**	**18.3**	**52.6**	**47.4**
EU-19	**21.2**	**14.1**	**15.7**	**51.0**	**49.0**

Source: KSH, Research and Development 2005

Table SA3 ***Main comparable RTDI indicators of Hungary and the OECD, 1990-2005***

		1995	2000	2002	2004	2005
Total						
GERD as a percentage of GDP	*Hungary*	0.71	0.8	1.00	0.88	0.94
	OECD	2.07	2.23	2.23	2.21	2.25
GERD per capita population (current PPP $)	*Hungary*	67.3	96.2	147.1	144.8	164.9
	OECD	404.1	534.5	573.6	617.6	659.3
Total researchers per thousand labour force	*Hungary*	2.6	3.5	3.6	3.6	3.8
	OECD	5.5	6.3	6.6	6.9	6.9
Business						
BERD as a percentage of GDP	*Hungary*	0.31	0.35	0.35	0.36	0.41
	OECD	1.38	1.56	1.51	1.49	1.53
Percentage of GERD financed by industry	*Hungary*	38.4	37.8	29.7	37.1	39.4
	OECD	59.5	64.4	62.4	62.1	62.5
Percentage of GERD performed by businesses	*Hungary*	43.4	44.3	35.5	41.1	43.2
	OECD	66.7	69.7	67.7	67.5	67.9
Percentage of BERD financed by industry	*Hungary*	78.3	75.8	69.3	77.4	77.8
	OECD	85.8	89.2	89.6	89.4	89.4
Researchers in business as a percentage of national total	*Hungary*	27.9	27.1	29.0	28.9	31.5
	OECD	61.9	63.7	64.3	64.5	64.4
Higher Education						
HERD as a percentage of GDP	*Hungary*	0.18	0.19	0.25	0.22	0.24
	OECD	0.34	0.38	0.39	0.39	0.4
Percentage of GERD performed by HEIs	*Hungary*	24.8	24.0	25.2	24.6	25.1
	OECD	16.3	17.0	17.4	17.8	17.7
Percentage of HERD financed by industry	*Hungary*	2.1	5.5	11.8	12.9	11.8
	OECD	6.2	6.2	6.2	6.1	n.a.
Government						
GOVERD as a percentage of GDP	*Hungary*	0.18	0.21	0.33	0.26	0.26
	OECD	0.3	0.23	0.27	0.27	0.27
Percentage of GERD performed by the Government sector	*Hungary*	25.6	26.1	32.9	29.6	28.0
	OECD	14.5	10.3	12.2	12.1	11.8
Government researchers as a percentage of national total	*Hungary*	33.6	32.3	30.9	31.5	31.2
	OECD	9.7	8.1	7.6	7.4	n.a.

Source: OECD, Main Science and Technology Indicators, 2007 online database

Table SA4 ***R&D expenditures per research personnel (FTE) by sectors, 2000-2006***

	2000	2001	2002	2003	2004	2005	2006
Research institutes							
Research personnel (RSE) - FTE	4,653	4,657	4,622	4,741	4,693	4,959	5,226
Research expenditures (m HUF)	27,494	36,391	56,328	55,091	53,640	58,171	60,373
Expenditures per researchers (m HUF)	**5.9**	**7.8**	**12.2**	**11.6**	**11.4**	**11.7**	**11.6**
Higher Education							
Research personnel (RSE) - FTE	5,852	5,938	5,999	5,957	5,902	5,911	6,073
Research expenditures (m HUF)	25,310	36,193	43,135	46,972	44,615	52,246	57,943
Expenditures per researchers (m HUF)	**4.3**	**6.1**	**7.2**	**7.9**	**7.6**	**8.8**	**9.5**
Business							
Research personnel (RSE) - FTE	3,901	4,071	4,344	4,482	4,309	5,008	6,248
Research expenditures (m HUF)	46,704	56,372	60,828	64,566	74,641	89,703	114,872
Expenditures per researchers (m HUF)	**12.0**	**13.8**	**14.0**	**14.4**	**17.3**	**17.9**	**18.4**

Source: KSH, Research and Development 2006

Table SA5 ***The number of R&D units by sector, 1995-2006***

	1995	2000	2002	2004	2005	2006
Government	107	121	143	175	201	208
Higher Education	1,109	1,421	1,613	1,697	1,566	1,552
Business enterprises	226	478	670	669	749	1,027
Total	**1,442**	**2,020**	**2,426**	**2,541**	**2,516**	**2,787**

Source: KSH, Research and Development 2006

Table SA6 ***Capital investment on R&D by sectors, 2006***

	Total spending (m HUF)	Capital investment (m HUF)	Number of research units	Number of RSE staff (FTE)	Capital investment per		
					Total spending (%)	Research unit (m HUF)	RSE staff (m HUF)
R&D institutes	60,373	5,071	208	5,226	8.4%	24.4	1.0
HE	57,943	6,543	1,552	6,073	11.3%	4.2	1.1
Business	114,872	30,129	1,027	6,248	26.2%	29.3	4.8

Source: KSH, Research and Development 2006

Table SA7 ***Business R&D expenditures (BERD) in Hungary, 1998-2005***

	1998	1999	2000	2001	2002	2003	2004	2005
BERD (m USD*)	292.8	322	435	484.2	484	486	538.7	634.6
Growth rate (%)	-8.6	10.0	35.1	11.3	0.0	0.4	10.8	17.8
BERD as percentage of GDP (%)	0.25	0.28	0.35	0.37	0.35	0.34	0.36	0.41
BERD as percentage of GERD (%)	38.4	40.2	44.3	40.1	35.5	36.7	41.1	43.2

Source: OECD, Main Science and Technology Indicators, 2007 online database
* constant prices (USD 2000), PPP

Table SA8 ***Compound annual growth rate of BERD* in Hungary, the EU25 and the OECD, 1999-2005***

	1999	2000	2001	2002	2003	2004	2005
Hungary	10.0	35.1	11.3	0.0	0.4	10.8	17.8
EU25	8.1	5.8	3.6	0.6	0.4	0.8	2.2
OECD	5.7	6.9	2.6	-1.9	1.7	1.9	5.1

Source: OECD, Main Science and Technology Indicators, 2007 online database
* constant prices (USD 2000), PPP

Table SA9 ***The number of business R&D units and BERD by ownership, 2003-2006***

	2003		2004		2005		2006	
	units	bn HUF	units	bn HUF	Units	bn HUF	units	bn HUF
Majority domestic	496	12.4	452	15.1	496	19.1	679	28.1
Majority foreign	45	15.9	47	27.1	44	32.7	59	44.7
Foreign (100%)	45	27.0	56	28.0	62	32.9	77	35.3
Majority state-owned	31	2.6	29	3.7	34	3.7	38	4.1
Majority local government-owned	10	0.3	9	0.2	8	0.3	12	0.3
Unknown	47	6.4	76	0.5	105	1.0	108	1.6
Total	**674**	**64.6**	**669**	**74.6**	**749**	**89.7**	**1,027**	**114.9**
Share of foreign-affiliated business R&D units	13.4%	66.4%	15.4%	73.9%	14.2%	73.1%	13.2%	69.7%

Source: KSH, Research and Development, 2006

Table SA10 ***Composition of BERD by size of firms (%)***

	2000	2001	2002	2003	2004	2005	2006
Micro-enterprises (0-9)	3.0	3.1	5.3	5.2	3.3	3.7	5.1
Small enterprises (10-49)	5.4	4.9	6.9	6.7	6.9	7.1	9.7
Medium-size enterprises (50-249)	21.3	22.4	12.2	9.6	7.9	8.6	12.3
Large enterprises (250-)	70.3	69.6	75.6	78.5	81.9	80.4	72.4
Unknown	-	-	-	-	-	0.2	0.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: KSH, Research and Development 2006

Table SA11 ***The number of firms with R&D activities by size-categories, 2000-2006***

	2000	2001	2002	2003	2004	2005	2006
Micro-enterprises (0-9)	161	281	301	280	274	308	443
Small enterprises (10-49)	95	101	120	138	138	155	224
Medium-size enterprises (50-249)	101	115	121	124	130	137	181
Large enterprises (250-)	121	133	128	132	127	131	143
Unknown	-	-	-	-	-	18	36
Total	**478**	**630**	**670**	**674**	**669**	**749**	**1,027**

Source: KSH, Research and Development (various years)

Table SA12 ***Distribution of business R&D activities by size of firms, 2000 and 2006 (%)***

	2000				2006			
	Number of research units	**R&D personnel (FTE)**	***Of which:* researchers**	**R&D expend.**	**Number of research units**	**R&D personnel FTE**	***Of which:* researchers**	**R&D expend.**
Micro enterprises (0-9)	33.7	7.1	8.1	3.1	43.1	12.0	12.3	5.1
Small enterprises (10-49)	19.9	10.0	9.5	5.4	21.8	16.6	15.3	9.7
Medium-size enterprises (50-249)	21.1	27.7	28.0	21.2	17.6	19.3	18.6	12.3
Large enterprises (250-)	25.3	55.2	54.4	70.3	14.0	51.5	53.2	72.4
Unknown	-	-	-	-	3.5	0.6	0.6	0.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: KSH, Research and Development 2001 and 2007

Table SA13 ***R&D units and personnel at business enterprises in Hungary, 1998-2006***

	1998	2000	2002	2004	2005	2006
Number of R&D units	258	478	670	669	749	1,027
Number of R&D personnel (FTE)	5,593	6,471	7,196	6,704	7,393	9,279
of which. scientists and engineers (FTE)	3,044	3,901	4,344	4,309	5,008	6,248
Number of R&D personnel (FTE) per unit	**11.8**	**8.2**	**6.5**	**6.5**	**6.7**	**6.1**

Source: KSH, Research and Development 2006

Table SA14 ***Total R&D personnel per thousand inhabitants***

Countries	1998	1999	2000	2001	2002	2003	2004	2005
EU27	4.0	4.0	4.2	4.2	4.3	4.3	4.4	..
Austria	3.9	..	..	..	4.8	..	5.3	5.7
Czech Republic	2.2	2.3	2.4	2.6	2.6	2.7	2.8	4.2
Denmark	6.6	6.9	7.0	7.5	7.9	7.7	7.9	8.0
Finland	9.0	9.8	10.1	10.3	10.6	11.0	11.1	11.0
Hungary	*2.0*	*2.0*	*2.3*	*2.3*	*2.3*	*2.3*	*2.3*	*2.3*
Ireland	3.1	3.2	3.4	3.5	3.5	3.6	3.9	4.0
Korea	2.8	3.0	2.9	3.5	3.6	3.9	4.0	4.5
Netherlands	5.4	5.5	5.5	5.6	5.4	5.3	5.6	..
Norway	..	5.7	..	6.0	6.0	6.4	6.5	6.6
Poland	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0
Portugal	1.9	2.0	2.1	2.2	2.3	2.5	2.4	2.4
Slovakia	3.05	2.75	2.82	2.68	2.5	2.5	2.7	2.7

Source: Science and Technology Indicators, OECD, 2007a

Table SA15 ***Number of researchers (FTE) and their share in total labour force in Hungary, 1998-2006***

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total number of researchers (FTE)	11,731	12,579	14,406	14,666	14,965	15,180	14,904	15,878	17,547
Researchers per 1000 labour force	2.9	3.1	3.5	3.6	3.6	3.6	3.6	3.8	…

Source: KSH, Research and Development (various years); OECD, Main Science and Technology Indicators (various years)

Table SA16 ***Employment of (FTE) researchers by sector, Hungary***

	1998	1999	2000	2001	2002	2003	2004	2005	2006
R&D institutes	4,608	4,550	4,653	4,657	4,622	4,741	4,693	4,959	5,226
Higher education	4,398	4,768	5,852	5,938	5,999	5,957	5,902	5,911	6,073
Business	2,725	3,261	3,901	4,071	4,344	4,482	4,309	5,008	6,248
Total	**11,731**	**12,579**	**14,406**	**14,666**	**14,965**	**15,180**	**14,904**	**15,878**	**17,547**

Source: KSH, Research and Development (various years)

Table SA17 ***Share of research employment (FTE) by sector, Hungary (%)***

	1995	2000	2001	2002	2003	2004	2005	2006
Business	27.9	27.1	27.7	29.0	29.5	28.9	31.6	35.6
Governmental	33.6	32.3	31.8	30.9	31.2	31.5	31.2	29.8
Higher education	38.5	40.6	40.5	40.1	39.2	39.3	37.2	34.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: OECD Main Science and Technology Indicators, 2007 online database, and authors' calculations based on KSH data (for 2006)

Table SA18 ***Total staff number of R&D units by sectors and by occupations, 2006 (heads, [FTE])***

Occupation	R&D institutes	HE	Business	Total
Scientists and engineers	6,217 [5,226]	18,928 [6,073]	7,641 [6,248]	32,786 [17,547]
Technicians	2,317 [1,597]	3,387 [1,195]	2,737 [2,151]	8,441 [4,943]
Other manual and non-manual workers	2,964 [1,346]	4,850 [1,255]	1,370 [880]	9,184 [3,481]
Total	**11,498** **[8,169]**	**27,165** **[8,523]**	**11,748** **[9,279]**	**50,411** **[25,971]**

Source: KSH, Research and Development, 2006

Table SA19 ***Women in researcher jobs by fields of science***

Fields of science	Number of researchers		Proportion of female researchers to total (%)
	Total	Female	
Natural science	4,714	1,335	28.3
Engineering and technology	10,475	2,082	19.9
Medical science	4,319	1,988	46.0
Agricultural science	1,916	648	33.8
Social science	4,899	1,803	36.8
Humanities	6,463	3,117	48.2
Total	**32,786**	**10,973**	**33.5**

Source: KSH, Research and Development 2006

Table SA20 ***Age cohort of research personnel in Hungary, 2003-2006 (headcount)***

	2003	2004	2005	2006
Younger than 25	431	390	394	442
Between 25 and 34	7,666	7,883	8,480	9,349
Between 35 and 44	6,400	6,636	6,872	7,425
Between 45 and 54	7,929	7,576	7,606	7,582
Between 55 and 64	6,396	6,436	6,653	6,642
65 years and older	1,470	1,499	1,402	1,364
Total	**30,292**	**30,420**	**31,407**	**32,786**

Source: KSH, Research and Development (various years)

Table SA21 ***Age composition of research personnel, total and selected scientific areas, 2006 (headcount)***

	Number	- 25	25-34	35-44	45-54	55-64	65 -
Total		**1.3%**	**28.5%**	**22.7%**	**23.1%**	**20.2%**	**4.2%**
of which:							
Natural science	4,714	1.2%	26.0%	22.8%	22.6%	23.5%	3.9%
Engineering and technology	10,475	2.6%	37.4%	19.4%	19.4%	17.8%	3.4%

Source: KSH, Research and Development 2006

Table SA22 ***Number of researchers with PhD degree, 1998-2006***

Years	1998	1999	2000	2001	2002	2003	2004	2005	2006
	6,275	6,361	7,075	7,369	8,655	8,836	9,185	9,639	10,488

Source: KSH, Research and Development (various years)

Table SA23 ***Researchers with scientific degrees and titles by type of research unit****

	Ordinary and corresponding members of the Academy of Sciences		PhD	
	2003	**2006**	**2003**	**2006**
R&D institutes and other research units	102	114	1,841	2,121
	(33.7%)	(34.5%)	(20.8%)	(20.2%)
Higher education	195	205	6,448	7,554
	(64.3%)	(61.9%)	(73.0%)	(72.0%)
Business	6	12	547	813
	(2.0%)	(3.6%)	(6.2%)	(7.8%)
Total	**303**	**331**	**8,836**	**10,488**
	(100%)	**(100%)**	**(100%)**	**(100%)**

Source: KSH, Research and Development 2003 and 2006

* Some scientists holding scientific degree and title could have been taken into account for more than one research unit.

Table SA24 ***Current IPR performance in selected countries, per million population, 2003***

	Patenting			Community Trademarks	Community Industrial Designs
	EPO	USPTO	Triad[a]		
EU-25	136.7	50.9	32.7	100.7	110.9
Germany	311.7	123.0	85.2	140.5	186.5
Finland	305.6	104.6	101.7	106.8	95.5
Netherlands	244.3	78.3	59.6	141.0	132.8
Austria	195.1	74.7	33.7	187.0	195.8
France	153.7	56.8	36.5	76.0	88.1
Belgium	144.5	52.4	32.0	92.2	124.6
United Kingdom	121.4	44.6	33.0	125.2	76.1
Ireland	77.3	37.4	14.8	143.0	49.0
Slovenia	50.4	15.4	2.8	21.7	33.9
Hungary	*18.9*	*5.3*	*1.9*	*18.8*	*15.2*
Czech Republic	15.9	4.3	1.5	25.7	40.9
Estonia	15.5	1.2	0.0*	31.7	9.2
Greece	11.2	1.8	0.8	27.7	2.8
Slovakia	8.1	3.3	0.3	10.8	17.3
Portugal	7.5	1.9	0.6	73.8	49.8
Lithuania	5.9	2.2*	0.3	12.2	20.3
Latvia	5.8	1.0*	0.6	14.7	5.4
Poland	4.2	1.2	0.3	22.2	25.0

Source: European Innovation Scoreboard, 2006

[a] "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)." (EIS, 2006)

* 2002

Table SA25 ***The share of innovative enterprises in selected EU countries, 1999-2001 and 2002-2004 (% of firms with more than 10 employees)***

	All enterprises		**Manufacturing**		**Services**	
	1999-2001	**2002-2004**	**1999-2001**	**2002-2004**	**1999-2001**	**2002-2004**
Germany	60.9	65.1	66.5	74.0	57.1	n.a.
Austria	48.8	52.5	53.3	57.5	44.9	n.a.
Ireland	65.2	52.2	75.4	61.4	51.7	n.a.
Denmark	44.3	52.0	52.7	57.8	36.5	46.0
Belgium	50.1	51.3	59.1	58.2	42.4	34.6
Sweden	46.8	50.0	47.7	54.9	46.4	44.8
Estonia	35.7	48.7	38.9	48.2	33.0	n.a.
Finland	44.8	43.3	49.4	50.5	39.8	n.a.
United Kingdom	35.8	43.0	39.1	44.6	32.6	n.a.
Portugal	46.4	40.9	44.8	38.8	50.1	44.1
Czech Republic	30.3	38.3	32.3	41.7	27.4	25.8
Italy	36.3	36.3	40.2	37.6	25.3	27.6
Greece	28.1	35.8	27.3	34.9	32.7	n.a.
Spain	32.6	34.7	37.6	36.9	24.6	29.3
Netherlands	45.3	34.3	54.6	41.5	38.4	29.2
France	40.8	32.5	46.0	36.4	33.8	22.4
Lithuania	28.0	28.5	35.4	31.2	22.1	19.9
Slovenia	21.1	26.9	28.2	35.0	12.8	12.9
Poland	17.3	24.8	17.8	26.2	16.2	22.9
Slovak Republic	19.5	22.9	22.5	27.3	15.9	17.9
*Hungary**	*23.3*	*20.9*	*28.0*	*21.2*	*15.7*	*20.9*
Latvia	19.3	17.5	23.0	17.4	15.2	n.a.

Source: CIS3 and CIS4, Eurostat

* Data published by the Hungarian KSH and Eurostat, respectively, do not fully correspond due to the slightly different categorisations.

Table SA26 ***The share of innovative enterprises in Hungary broken down by economic sector and size-categories, 1999-2001 and 2002-2004 (%)***

	1999-2001				2002-2004			
	10-49	**50-249**	**250 -**	**Total**	**10-49**	**50-249**	**250 -**	**Total**
Manufacturing	25.1	32.6	47.0	28.0	15.9	32.3	53.0	21.2
Services	15.0	16.8	36.7	15.7	18.8	29.3	55.6	20.9
Total	**20.9**	**28.0**	**44.4**	**23.3**	**16.9**	**30.5**	**52.4**	**20.9**

Source: CIS3 and CIS4, Eurostat

Table SA27 ***Incidence of innovation co-operation in Hungary and in the EU15 countries, by partner and by location: proportion of enterprises with innovation activity indicating co-operation with specified partners in specified locations, % (Hungary: 1999-2001, EU15: 1998-2000)***

		Location						
		National	**EU15 or EFTA**	**CEE***	**US**	**Japan**	**Other**	**Total**
Other enterprises within the enterprise group	Hungary	1.6	3.3	0.6	0.6	0.3	0.2	**5.1**
	EU average	*23.0*	*13.0*	*2.0*	*6.0*	*1.0*	*2.0*	..
Suppliers	Hungary	17.3	14.6	0.8	2.6	1.1	1.5	**26.8**
	EU average	*36.0*	*16.0*	*2.0*	*5.0*	*1.0*	*3.0*	..
Clients or customers	Hungary	21.1	8.7	3.4	1.7	1.6	0.4	**24.8**
	EU average	*35.0*	*15.0*	*3.0*	*6.0*	*2.0*	*4.0*	..
Competitors within the same industry	Hungary	10.0	4.2	2.2	0.8	0.02	0.1	**10.9**
	EU average	*25.0*	*8.0*	*1.0*	*2.0*	*1.0*	*2.0*	..
Consultants	Hungary	12.5	2.8	0	0.2	0	0.02	**14.6**
	EU average	*24.0*	*4.0*	*0*	*1.0*	*0*	*1.0*	..
Commercial laboratories, R&D enterprises	Hungary	11.8	3.3	0.4	0.1	0	0.02	**13.7**
	EU average	*16.0*	*5.0*	*1.0*	*1.0*	*0*	*1.0*	..
Universities or higher education institutes	Hungary	21.5	2.8	0.8	0	0	0	**21.6**
	EU average	*35.0*	*7.0*	*1.0*	*2.0*	*0*	*1.0*	..
Government or non-profit research institutes	Hungary	7.9	2.2	0.8	0.02	0	0	**8.6**
	EU average	*21.0*	*4.0*	*0*	*1.0*	*0*	*1.0*	..

Source: Compiled by Balázs Borsi for Havas [2004c], based on the unpublished results of KSH [2003] and Eurostat [2004c]. Contribution by Zsuzsanna Szunyogh, KSH is gratefully acknowledged.

*Central and Eastern Europe in the Hungarian survey, candidate countries in the Eurostat report

Table SA28 ***Different types of co-operation partners of enterprises by selected EU member states, as percentage of innovative enterprises***

	EU27	HU	AT	CZ	EE	FI	PL	PT	SI	SK	UK
All types of co-operation	25.5	**36.8**	17.4	38.4	34.8	44.4	42.2	19.4	47.3	37.7	30.6
Other enterprises within your enterprise group	9.5	**10.1**	8.2	13.5	15.6	23.5	12.7	5.7	15.0	14.0	14.8
Suppliers of equipment, materials, components or software	16.5	**26.2**	7.5	30.7	23.3	40.8	28.2	13.9	37.5	31.7	22.6
Clients or customers	13.9	**19.6**	7.8	26.1	22.9	41.4	16.4	11.5	33.0	30.2	22.3
Competitors or other enterprises of the same sector	8.3	**13.6**	3.9	15.3	18.5	34.2	8.5	6.8	20.4	21.2	11.1
Consultants, commercial labs or private R&D institutes	8.9	**12.6**	7.3	15.0	10.0	32.7	7.9	8.7	19.7	18.6	12.6
Universities or other HE institutes	8.8	**13.7**	10.0	13.1	8.6	33.2	6.2	7.5	19.5	14.8	10.0
Government or public research institutes	5.7	**5.0**	5.2	7.4	6.1	26.4	8.7	4.8	13.2	11.4	7.6

Source: EUSOSTAT, CIS 2004

Table SA29 ***Innovation expenditures by innovative enterprises in selected EU countries, 2000 and 2004 (%)***

	Czech Republic		Estonia		Ireland		Hungary		Portugal	
	2000	**2004**	**2000**	**2004**	**2000**	**2004**	**2001**	**2004**	**2000**	**2004**
In-house R&D	22.0	21.5	13.9	19.9	31.8	24.1	13.3	17.3	10.6	15.5
External R&D contract	8.1	13.4	7.0	4.3	6.5	3.3	7.0	7.4	19.0	6.6
Acquisition of machinery and equipment	44.8	46.1	60.0	73.2	39.4	59.9	30.3	72.4	42.0	71.4
Acquisition of other external knowledge	9.3	19.1	2.1	2.6	6.3	12.7	46.7	2.9	3.9	6.5
Training, market introduction of innovations	15.9	-	17.0	-	16.0	-	2.6	-	24.5	-
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Authors' calculations based on Eurostat data

Table SA30 ***Relative position of Hungarian NUTS-2 regions vis-à-vis Hungary's average by selected indicators (Hungary = 100), 2004***

	GDP/ capita	GDP	GERD/ GDP	GERD	BERD	GERD/Highly educated workforce*
Hungary	**100**	**100**	**100**	**100**	**100**	**100**
Central Hungary	158.8	44.5	144.3	64.3	71.5	164.0
Central Transdanubia	95.6	10.5	56.7	6.0	6.8	84.0
Western Transdanubia	104.4	10.3	43.8	4.5	5.7	72.7
Southern Transdanubia	71.3	6.9	45.9	3.2	1.3	18.4
Northern Hungary	66.4	8.4	31.1	2.6	2.4	25.1
Northern Great Plain	65.5	10.0	81.4	8.1	8.5	71.5
Southern Great Plain	69.0	9.3	70.7	6.6	3.6	33.8

Source: Authors' calculation based on data from Eurostat

* Highly educated = workforce with university or college graduation

Table SA31 ***GERD in Hungarian NUTS-2 region between 1998 and 2006 (m HUF)***

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Central Hungary	44,435	50,230	69,166	88,263	111,346	115,131	116,692	138,790	163,076
Central Transdanubia	3,540	3,379	5,224	7,914	10,398	9,775	10,820	9,673	11,337
Western Transdanubia	2,590	3,143	2,916	7,007	5,677	6,261	8,225	6,737	9,431
Southern Transdanubia	1,941	2,464	3,893	4,629	5,849	5,220	5,773	6,458	6,926
Northern Hungary	2,352	1,582	2,429	2,837	3,897	4,121	4,729	5,890	7,363
Northern Great Plain	7,237	6,428	8,036	9,110	11,182	13,073	14,761	17,914	18,114
Southern Great Plain	5,525	6,951	7,844	9,195	11,942	13,048	11,896	14,659	16,941
Total	**67,620**	**74,177**	**99508**	**128,955**	**160,291**	**166,629**	**172,896**	**200,121**	**233,188**

Source: KSH, 2007 (prepared for this report)

Table SA32 ***Number of scientists & engineers as research workforce in Hungarian NUTS-2 region between 1998 and 2006 (FTE)***

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Central Hungary	7,869	8,466	9,532	9,686	9,884	10,064	9,791	10,341	11,451
Central Transdanubia	399	494	738	764	745	719	786	807	972
Western Transdanubia	492	527	624	685	670	664	600	673	842
Southern Transdanubia	472	531	624	644	548	695	728	842	822
Northern Hungary	413	439	505	538	581	582	639	645	736
Northern Great Plain	1,042	998	1,147	1,118	1,263	1,251	1,166	1,272	1,351
Southern Great Plain	1,044	1,124	1,236	1,231	1,274	1,205	1,194	1,298	1,373
Total	**11,731**	**12,579**	**14,406**	**14,,666**	**14,965**	**15,180**	**14,904**	**15,878**	**17,547**

Source: KSH, 2007 (prepared for this report)

Table SA33 ***The performance and relative share in total Hungary of the NUTS-2 regions by selected indicators***

	GDP (2004)		GERD (2006)		RSE personnel (HRST) (2006)	
	m EUR	%	m HUF	%	FTE	%
Hungary	**8,2302.7**	**100.0%**	**233,188**	**100.0%**	**17,547**	**100.0%**
Central Hungary	36,663.7	44.5%	163,076	69.9%	11,451	65.3%
Central Transdanubia	8,657.1	10.5%	11,337	4.9%	972	5.5%
Western Transdanubia	8,517.9	10.3%	9,431	4.0%	842	4.8%
Southern Transdanubia	5,696.5	6.9%	6,926	3.0%	822	4.7%
Northern Hungary	6,902.1	8.4%	7,363	3.2%	736	4.2%
Northern Great Plain	8,233.3	10.0%	18,114	7.8%	1,351	7.7%
Southern Great Plain	7,632.0	9.3%	16,941	7.3%	1,373	7.8%
Source:	Eurostat		KSH (2007)		KSH (2007)	

Table SA34 *Position of NUTS-2 regions in Hungary by selected indicators*

	GDP/head - Index, EU27=100 (2004)		BERD/GDP (2004)		Regional Summary Innovation Index (2006)	
	in PPP	Relative to Central Hungary	%	Relative to Central Hungary	RSII	Relative to Central Hungary
Central Hungary	101.6	100.0%	0.6	100.0%	0.6	100.0%
Central Transdanubia	61.1	60.2%	0.2	40.3%	0.33	55.0%
Western Transdanubia	66.8	65.8%	0.2	34.5%	0.25	41.7%
Southern Transdanubia	45.6	44.9%	0.1	12.1%	0.26	43.3%
Northern Hungary	42.5	41.8%	0.1	17.8%	0.25	41.7%
Northern Great Plain	41.9	41.2%	0.3	52.9%	0.26	43.3%
Southern Great Plain	44.2	43.5%	0.1	24.4%	0.24	40.0%
Source:	Eurostat		Eurostat		EIS 2006	

Table SA35 *Financial support of OTKA to organisations in the NUTS-2 regions in Hungary by scientific areas, accumulated data for the period of 2003-2007*

	Social sciences		Natural & engineering sciences		Life sciences		Total	
	m HUF	Share in total (%)	m HUF	Share in total (%)	m HUF	Share in total (%)	m HUF	Share in total (%)
Central Hungary	3,792.3	75.5	7,348.3	67.4	5,993.9	56.2	17,134.5	64.4
Central Transdanubia	54.5	1.1	382.2	3.5	161.2	1.5	598.0	2.2
Western Transdanubia	40.0	0.8	195.1	1.8	324.5	3.0	559.6	2.1
Southern Transdanubia	411.1	8.2	245.4	2.3	922.1	8.6	1,578.6	5.9
Northern Hungary	111.1	2.2	399.7	3.7	47.0	0.4	557.8	2.1
Northern Great Plain	293.1	5.8	1,014.3	9.3	1,600.5	15.0	2,908.0	10.9
Southern Great Plain	321.0	6.4	1,322.1	12.1	1,622.6	15.2	3,265.8	12.3
Total	**5,023.1**	**100**	**10,581.2**	**100**	**10,671.9**	**100**	**26,602.2**	**100**

Source: OTKA 2007 November (prepared for the request of this report)

Table SA36 ***Financial support of NKTH to organisations in the NUTS-2 regions in Hungary, 2004-2006***

	2004		2005		2006	
	Bn HUF	**Share of total (%)**	**Bn HUF**	**Share of total (%)**	**Bn HUF**	**Share of total (%)**
Central Hungary	13.4	59.6	17.8	63.9	17.4	65.7
Central Transdanubia	1.4	6.2	1.1	4.2	1.3	5.1
Western Transdanubia	1.0	4.5	1.2	4.3	1.3	5.0
Southern Transdanubia	1.3	5.8	1.1	4.1	1.0	3.7
Northern Hungary	1.4	6.2	1.6	5.7	1.4	5.2
Northern Great Plain	2.1	9.3	1.9	6.7	2.2	8.3
Southern Great Plain	1.9	8.4	3.1	11.1	1.9	7.0
Total	**22.5**	**100**	**27.8**	**100**	**26.5**	**100**

Source: NKTH Annual Report 2006

Table SA37 ***Financial support of OTKA by scientific areas and sectors between 2003 and 2007 (m HUF)***

	MTA research institutes	**HE**	**Enterprises**	**Others**
Natural & engineering sciences	3,084.3	7,500.5	16.5	306.0
Life sciences	3,041.5	6,484.4	17.2	1,128.8
Social sciences	1,409.7	2,868.0	6.6	738.7
Total	7,535.5	16,852.9	40.4	2,173.5
Share in total	28.3%	63.4%	0.2%	8.2%

Source: OTKA, 2007 November

Table SA38 ***GVOP 2004-2006 funding schemes in business innovation capability promotion, (Number of applications and approved projects, total financial support approved, level of competition)***

Funding scheme	Number of applications submitted	Number of application awarded	Number of enterprises awarded	Awarded financial support (m HUF)	Success rate in terms of	
					No. of applications	Financial request
3.2.1. Application-oriented co-operative RTD activity	556	274	93	15,309	49.2%	50.2%
3.2.2. S&T co-operation of businesses and publicly financed research units	22	14	n.a.	4,500	63.7%	69.9%
3.3. Promotion of business R&D capacities and innovation capabilities	1,044	454	454	13,103	43.5%	43.6%
3.3.1. Support to new, technology and knowledge-intensive micro-enterprises and spin-off companies	326	155	155	3,329	47.5%	48.2%
3.3.2. Development of corporate research infrastructure related to the creation of new RTD jobs	33	24	24	1,356	72.7%	85.6%
3.3.3. Innovation and research activities of SMEs	685	275	275	8,419	40.1%	39.1%

Source: NFÜ (National Development Agency), 2007; http://emir.nfu.hu/nd/kozvel/?link=kozv_1_1.inc&ht=1.1%20Operat

Table SA39 ***Funding Sources by Fields of Science at 12 selected Hungarian universities (2000-2004) in %***

Fields of Science	Total	State budget			Industry	Funds from abroad	Other funds
		Total	Block grants	Competitive grants			
Natural sciences	**100.0**	89.3	64.7	24.6	5.3	5.0	0.3
Engineering and technology	**100.0**	73.2	53.8	19.8	16.7	8.1	1.7
Medical sciences	**100.0**	90.8	73.0	17.8	4.3	4.7	0.2
Agricultural sciences	**100.0**	80.6	70.1	10.5	1.5	0.5	17.4
Social sciences	**100.0**	94.8	82.6	12.1	1.6	2.9	0.7
Humanities	**100.0**	97.8	83.3	14.5	0.4	1.6	0.2
Total	**100.0**	**87.5**	**69.3**	**18.3**	**6.6**	**4.8**	**1.1**

Source: Calculation based on KSH databank 2006, KSH; 2007, Budapest

Notes: 12 selected universities are: Corvinus University of Budapest; Budapest University of Technology and Economics; University of Debrecen; Eötvös Loránd University, Budapest; University of Kaposvár; University of Miskolc; University of West Hungary, Győr; University of Pécs; Semmelweis University, Budapest; Szent István University, Gödöllő; University of Szeged, Pannonia University

Table SA40 ***Harmony between qualification and jobs by fields of science in %***

Relation between job and qualification in 1998/99 and 2004	Agriculture	Human	Engineering	Medical	Social	Natural	Total
Not overqualified any years	33.0	57.0	50.2	75.3	40.2	54.8	49.6
Overqualified in both years	30.5	10.8	11.1	4.4	20.6	8.2	15.0
Not overqualified in 1998/99 but in 2004	17.7	16.2	17.0	5.5	18.7	12.5	16.1
Overqualified in 1998/99 but not in 2004	18.9	16.0	21.7	14.8	20.6	24.5	19.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Galasi *et al.* 2004

Table SA41 ***Hungarian project participants and their EU funding in EU FP6 specific programmes***

Specific Programmes	Number of participants in projects					EU funding m EUR		
	Total	**HAS**	**HE**	**Large Firms**	**SMEs**	**for HU partners**	**Total**	**HU/ total (%)**
Life sciences…	76	34	27	2	13	16,705	**2,072,764**	0.8
IST	216	39	81	38	1	38,788	**3,799,622**	1.0
Nanotechnologies…	74	21	28	16	6	9,465	**1,539,279**	0.6
Aeronautics and space	14	1	6	2	1	1,357	**982,497**	0.1
Food quality and safety	77	24	20	6	10	9,802	**740,058**	1.3
Sustainable development…	118	25	44	10	8	11,984	**2,117,772**	0.6
Citizens… in a knowledge-based society	61	19	39	0	1	7,094	**235,278**	3.0
Support of international co-operation	14	5	5	3	3	741	**341,943**	0.2
Support for the co-ordination activities	22	1	3	1	0	2,289	**195,167**	1.2
Support for the coherent development of research & innovation policies	6	2	1	0	0	434	**10,812**	4.0
Research and innovation	40	4	4	4	2	2,552	**205,540**	1.2
Human resources and mobility	129	47	72	1	3	19,818	**1,611,587**	1.2
Research infrastructures	30	24	4	1	0	3,410	**747,949**	0.5
Science and society	23	3	9	1	0	1,501	**94,162**	1.6
Euratom	27	19	5	1	0	1,462	**185,680**	0.8
Total	**1,102**	**319**	**400**	**113**	**81**	**141,538**	**15,810,681**	**0.9**

Source: NKTH, 2007

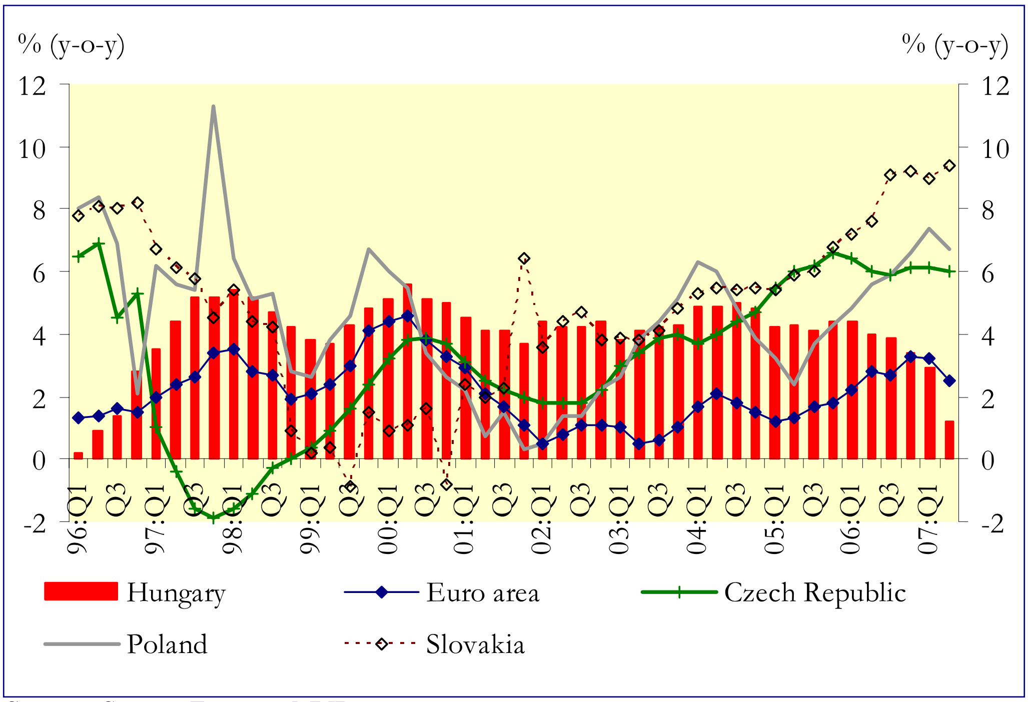
Table SA42 ***List of main actors in the Hungarian STI governance***

Type of organisation / Name of organisation	Website
Parliament	
Education and Science Committee	www.mkogy.hu/parl_en.htm
Economic and Informatics Committee	
Innovation & Science ad hoc Committee	
Government	
Science and Technology Policy Council	http://4t.gov.hu/main.php?folderID=1277
Science, Technology Policy and Competitiveness Advisory Board	
Ministries	
Ministry of Education and Culture	www.okm.hu
Ministry of Economy and Transport	www.gkm.gov.hu
Research and Technological Innovation Council	www.nkth.gov.hu/main.php?folderID=2644
Other public services	
National Office for Research and Technology	www.nkth.gov.hu
National Development Agency	www.nfh.hu
Hungarian Patent Office	www.hpo.hu
National Scientific Research Fund (OTKA)	www.otka.hu
Business associations & chambers	
Hungarian Chamber of Commerce and Industry (MKIK)	www.mkik.hu
Confederation of Hungarian Employers and Industrialists (MGYOSZ)	www.mgyosz.hu
National Association of Entrepreneurs and Employers (VOSZ)	www.vosz.hu
Hungarian Venture Capital and Private Equity Association	www.hvca.hu
Joint Venture Association	www.jointventure.hu
Hungarian Association of IT Companies	http://english.ivsz.hu/engine.aspx?page=ivsz_en
Hungarian Association of Biotechnology Companies	http://www.hungarianbiotech.org/html_hun/index.htm
Hungarian Association of Spin-off Companies	http://www.europeanspinoff.com/
Education associations	
Hungarian Rectors' Conference	www.crue.org/eurec/associate/h.htm
Conference of College Directors	www.fksz.huninet.hu/ffk.htm

Professional associations	
Federation of Technical and Scientific Societies (MTESZ)	www.mtesz.hu
Hungarian Innovation Association (MISZ)	www.innovacio.hu
Hungarian Academy of Engineering (MMA)	www.mernokakademia.hu

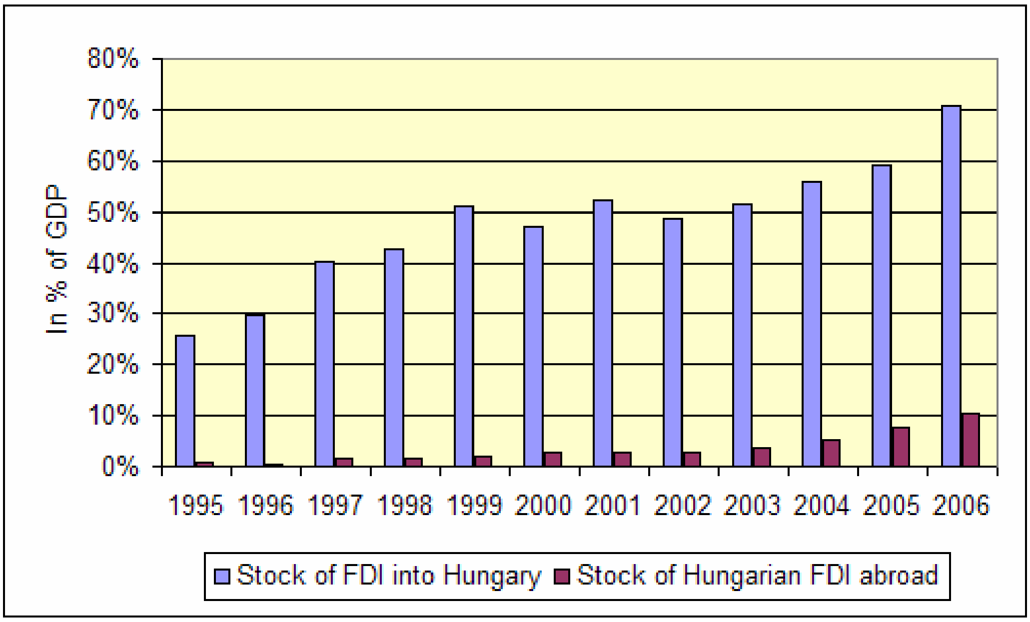
Figures

Figure SA1 ***Annual GDP growth in four Central European countries and the Euro area***



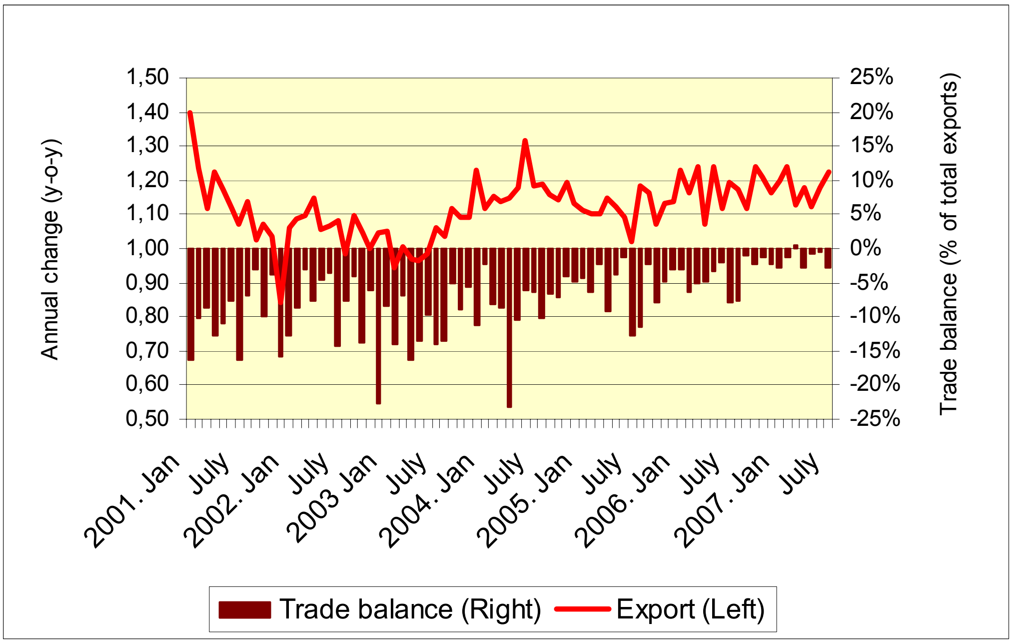
Source: Source: Eurostat, MNB

Figure SA2 ***FDI inflow and outflow in Hungary, % of GDP***



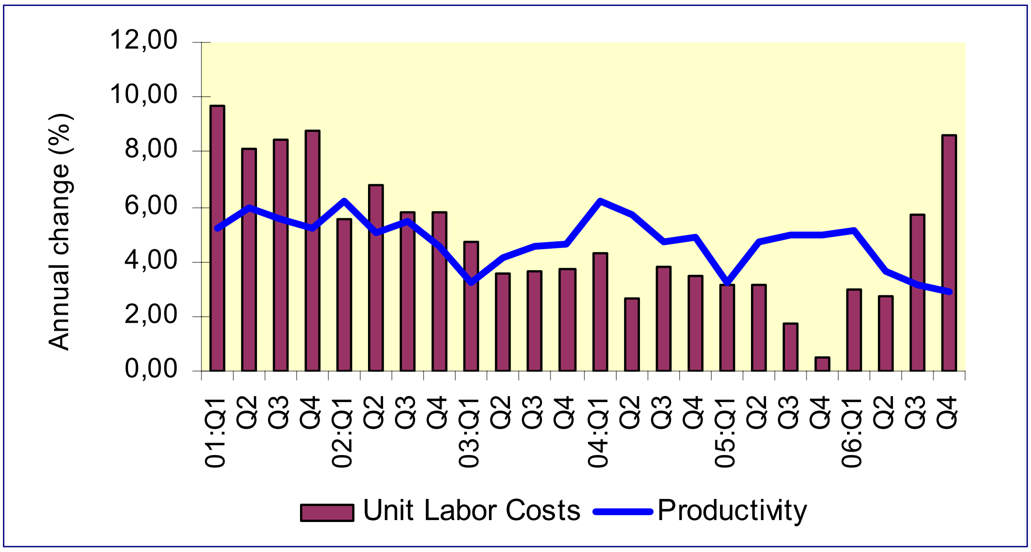
Source: MNB

Figure SA3 ***External trade (annual change)***



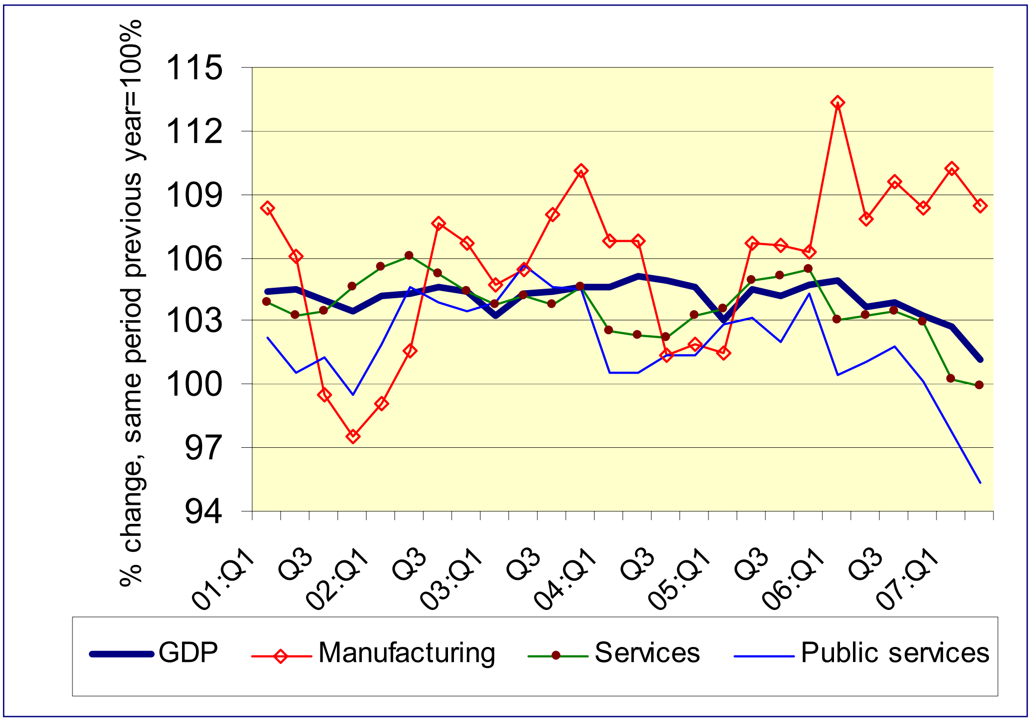
Source: KSH, MNB

Figure SA4 ***Productivity and unit labour costs (annual change, % y-o-y)***



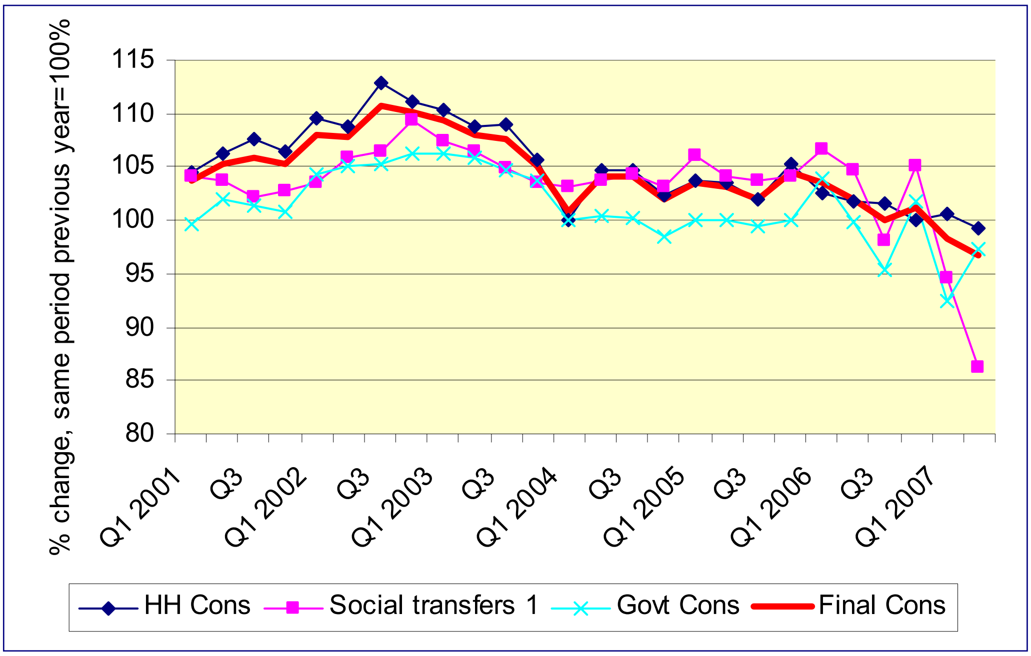
Source: MNB

Figure SA5 ***GDP growth***



Source: KSH National accounts

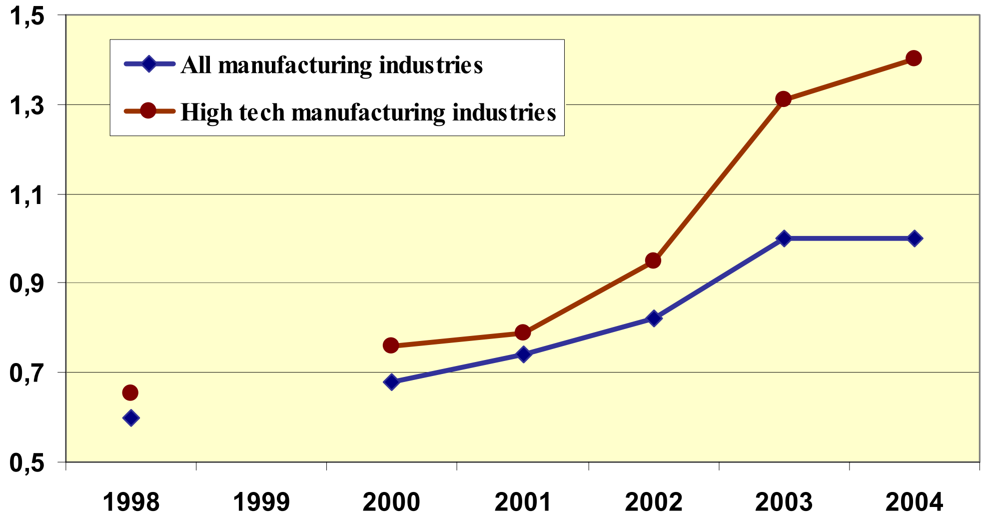
Figure SA6 ***GDP and the demand side***



Source: KSH

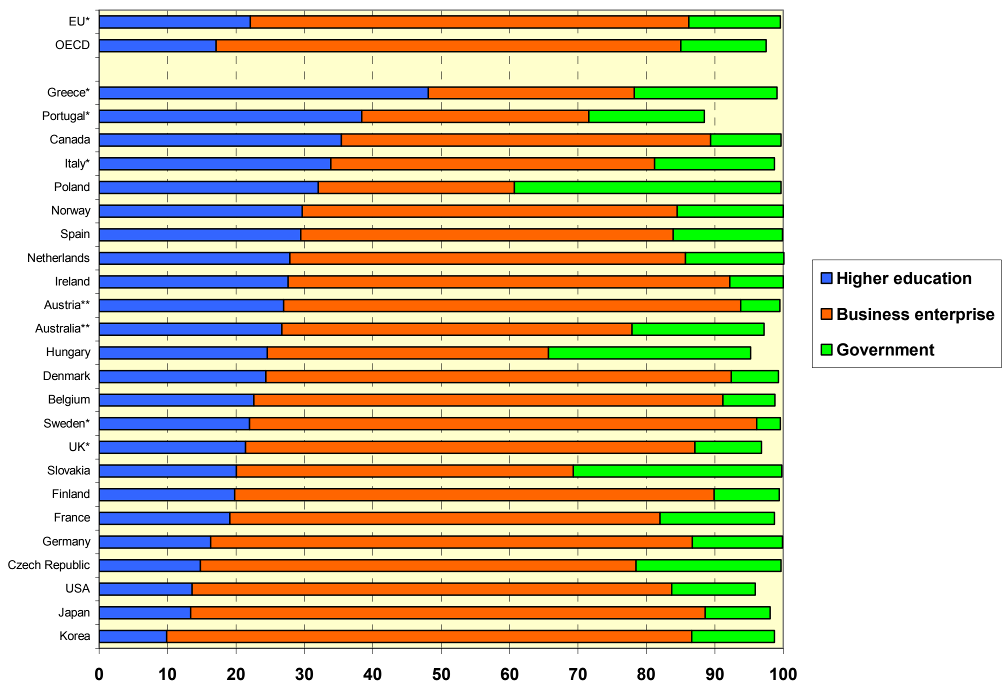
Notes: HH Cons = Households Consumption; Govt Cons = Government's consumption; Final Cons = Final Consumption

Figure SA7 ***Export market shares as % of OECD total, All manufacturing and high-tech manufacturing, 1998-2004***



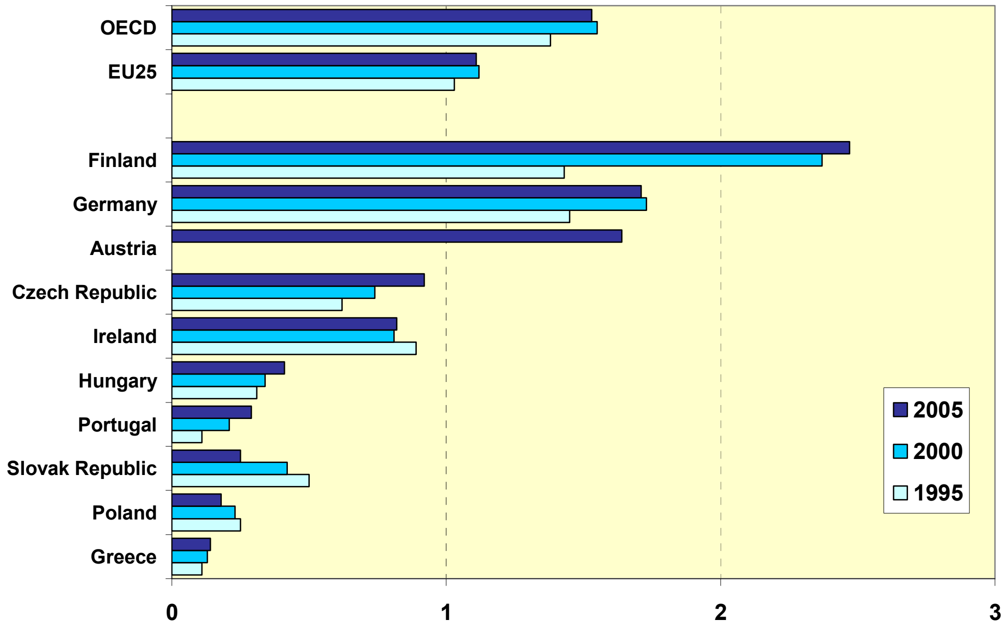
Source: OECD in Figures (various years)

Figure SA8 ***The distribution of GERD by performing sectors***



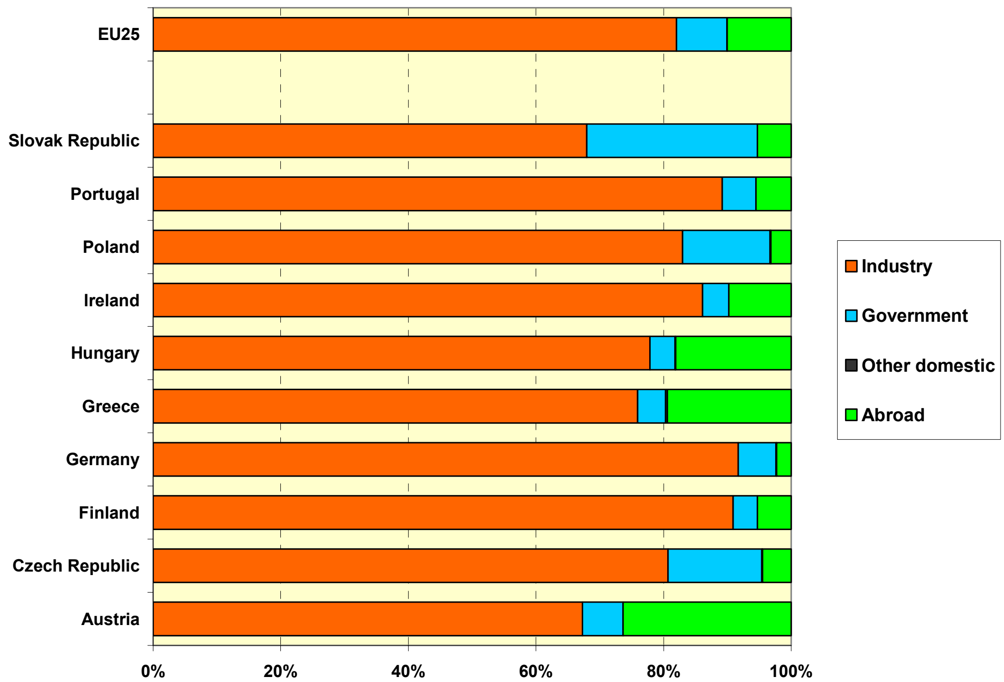
Source: OECD

Figure SA9 ***Business R&D Expenditures (BERD) as percentage of GDP in selected OECD countries, 1995, 2000 and 2005 (%)***



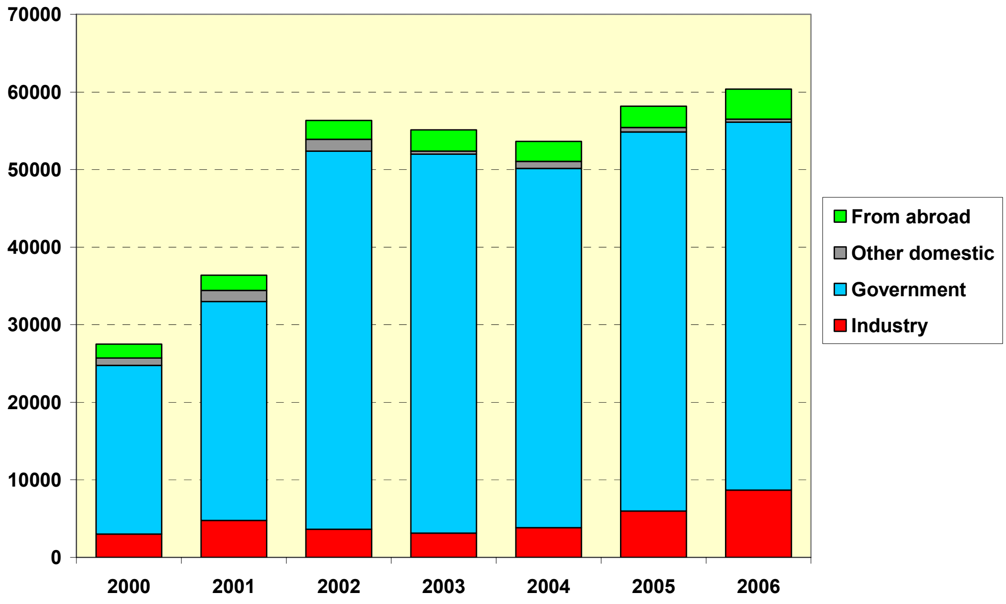
Source: OECD, Main Science and Technology Indicators, 2007 online database

Figure SA10 ***BERD by source of funding in selected EU countries (2005 or latest available year)***



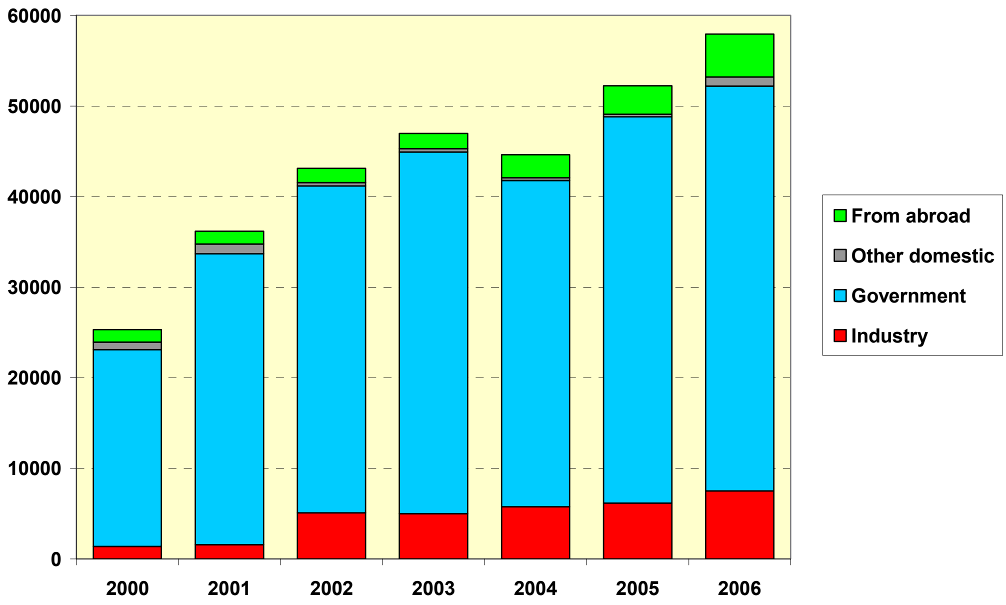
Source: Authors' calculations based on the OECD, Main Science and Technology Indicators 2007 online database

Figure SA11 ***Sources of GOVERD, 2000-2006 (m HUF)***



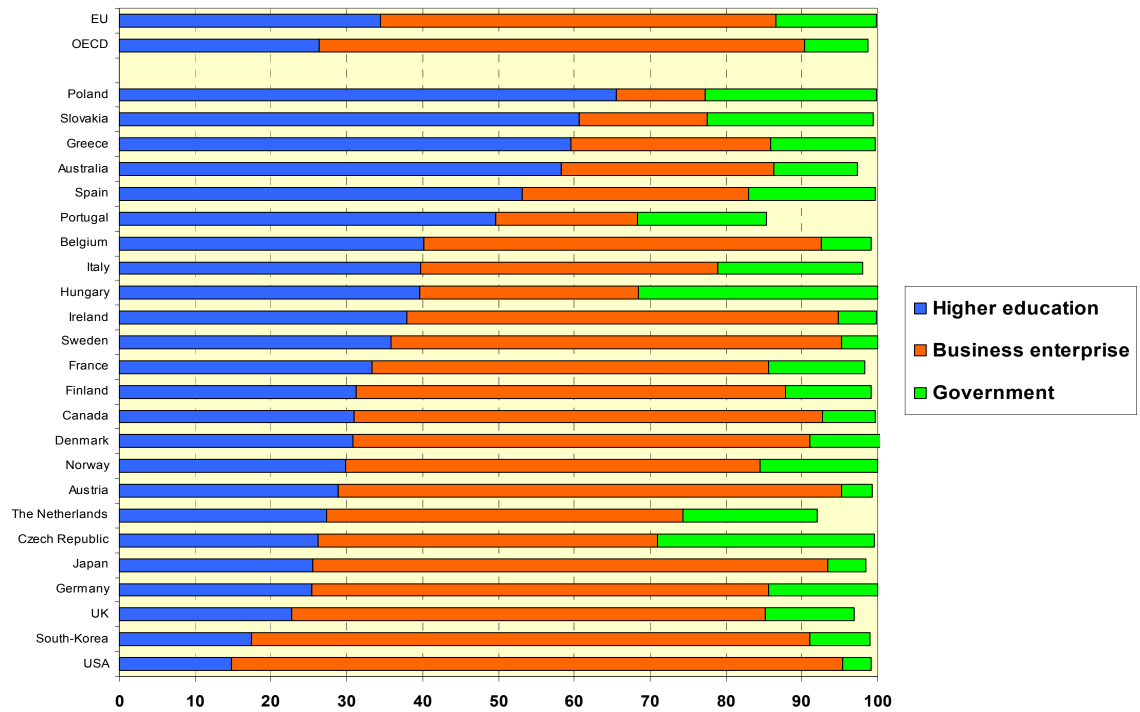
Source: Authors' calculation based on KSH data

Figure SA12 ***Sources of HERD, 2000-2006 (m HUF)***



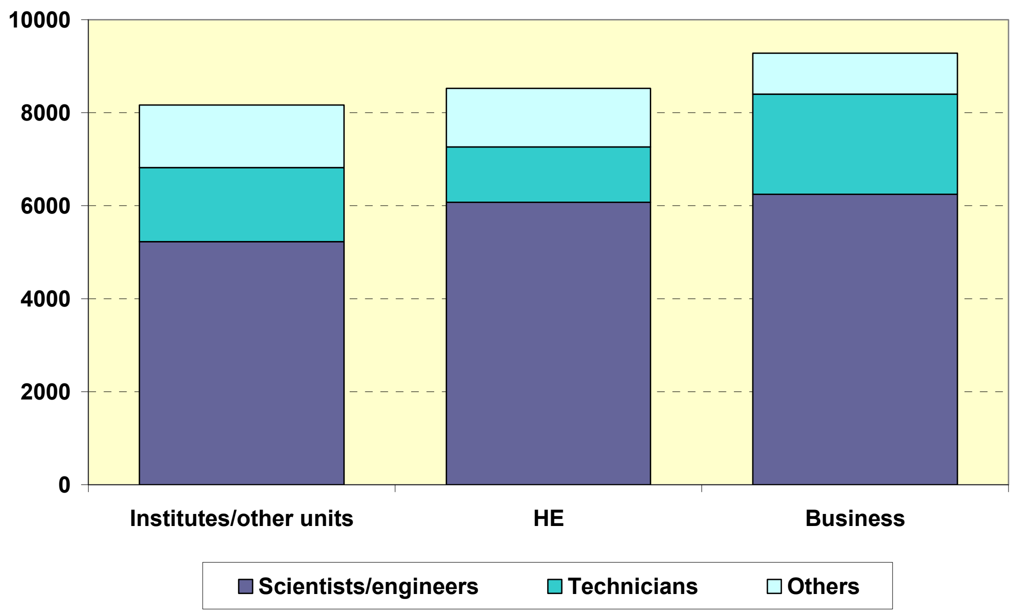
Source: Authors' calculation based on KSH data

Figure SA13 ***Distribution of researchers (FTE) by R&D performing sectors***



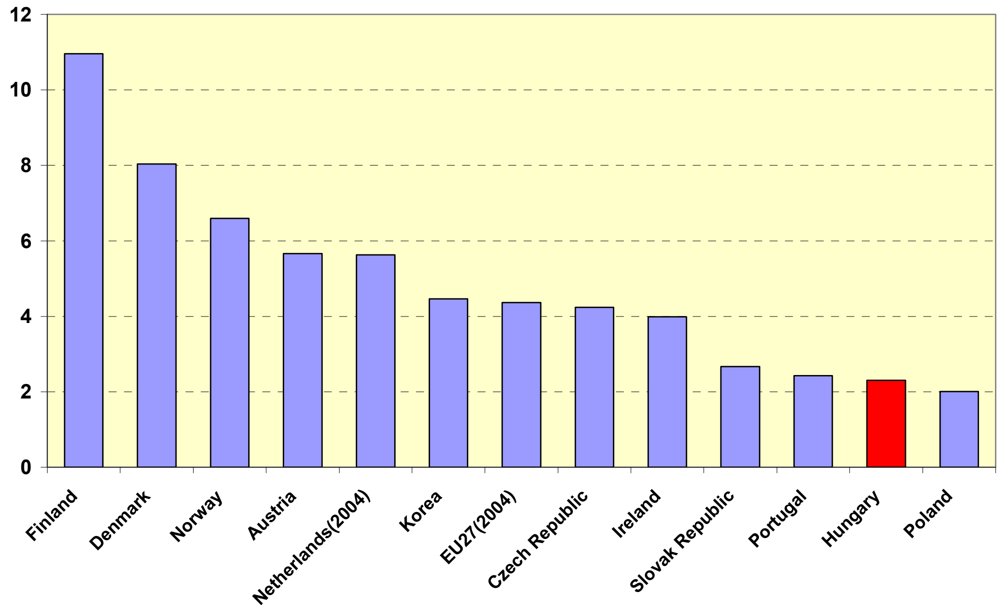
Source: OECD

Figure SA14 ***Number of personnel in R&D by sectors (2006) in Full-time Equivalent***



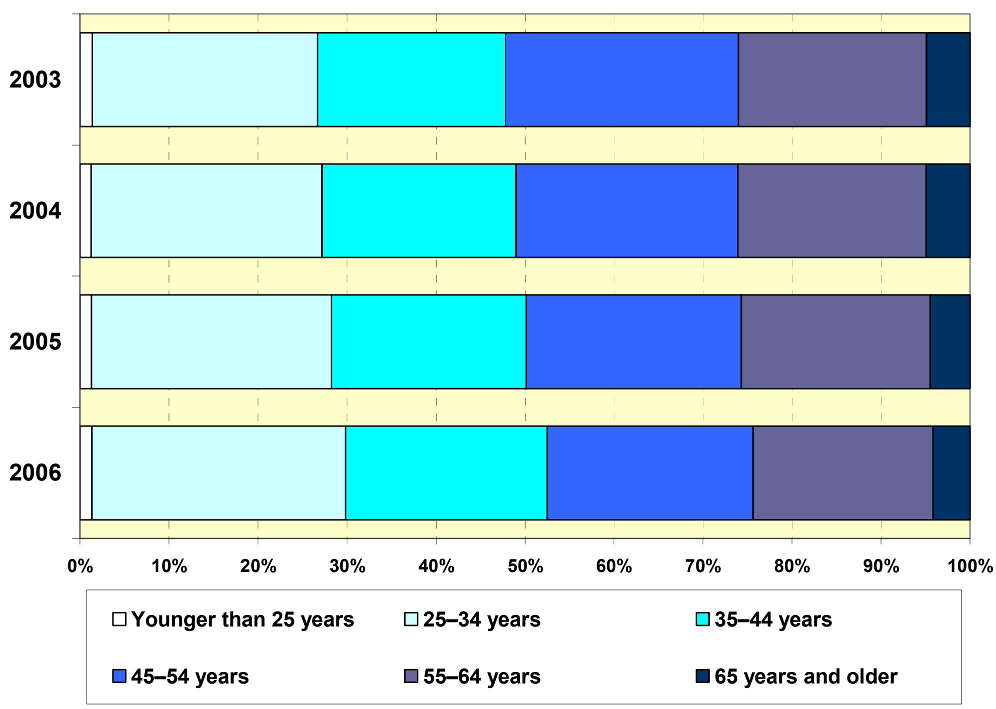
Source: KSH, Research and Development 2006

Figure SA15 ***Total R&D personnel (FTE) per thousand inhabitants (2005)***



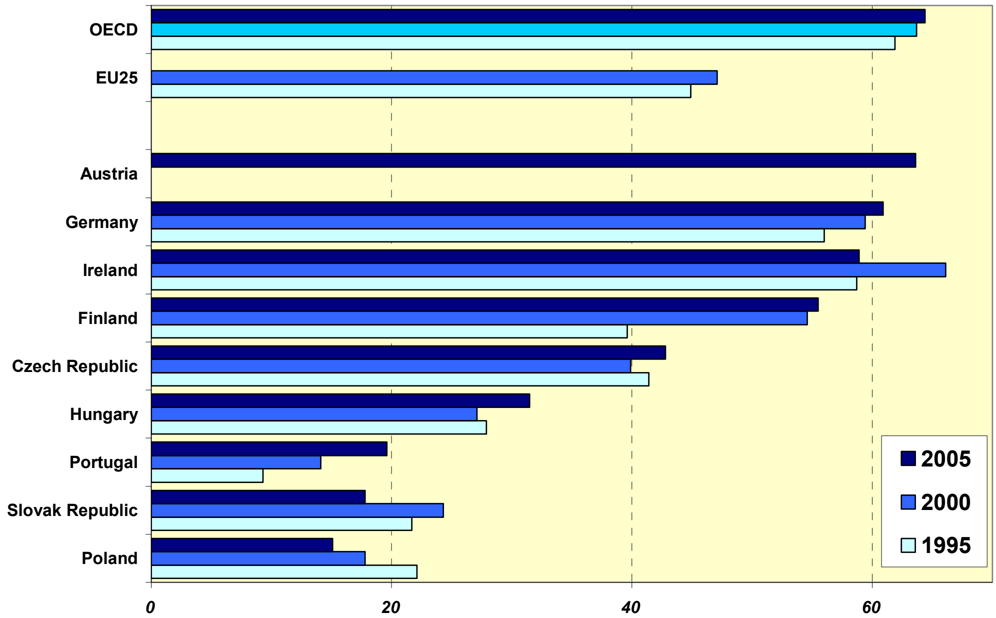
Source: OECD, Main Science and Technology Indicators, 2007

Figure SA16 ***Age distributions of researchers, 2003-2006***



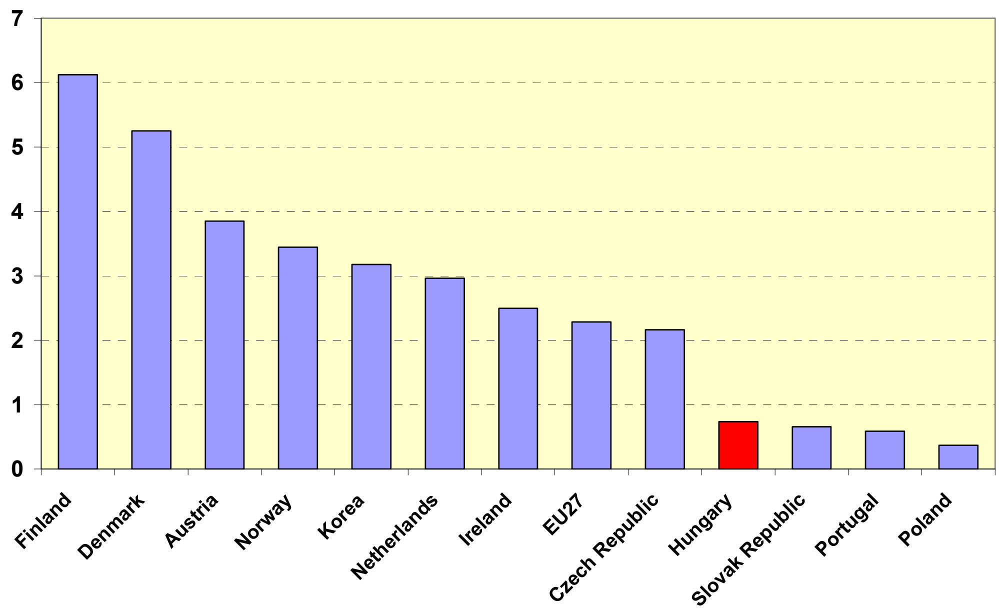
Source: KSH, Research and Development (various years)

Figure SA17 ***Business enterprise researchers (FTE) as percentage of national total, selected countries and years (%)***



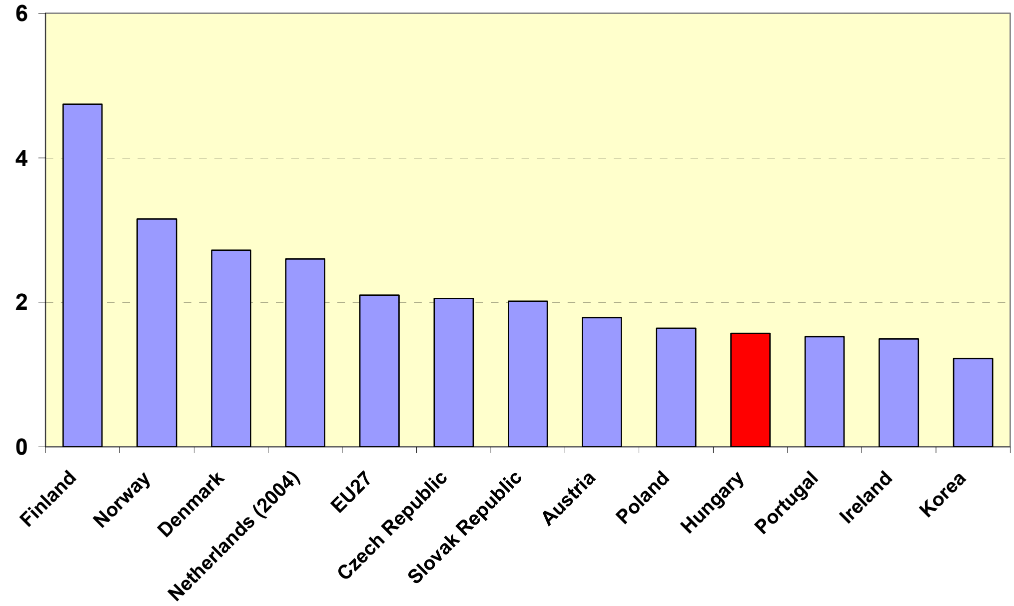
Source: OECD Main Science and Technology Indicators, 2007 online database

Figure SA18 ***Business Enterprises R&D personnel (FTE) per thousand inhabitants (2005)***



Source: Main Science and Technology Indicators, OECD, 2007a

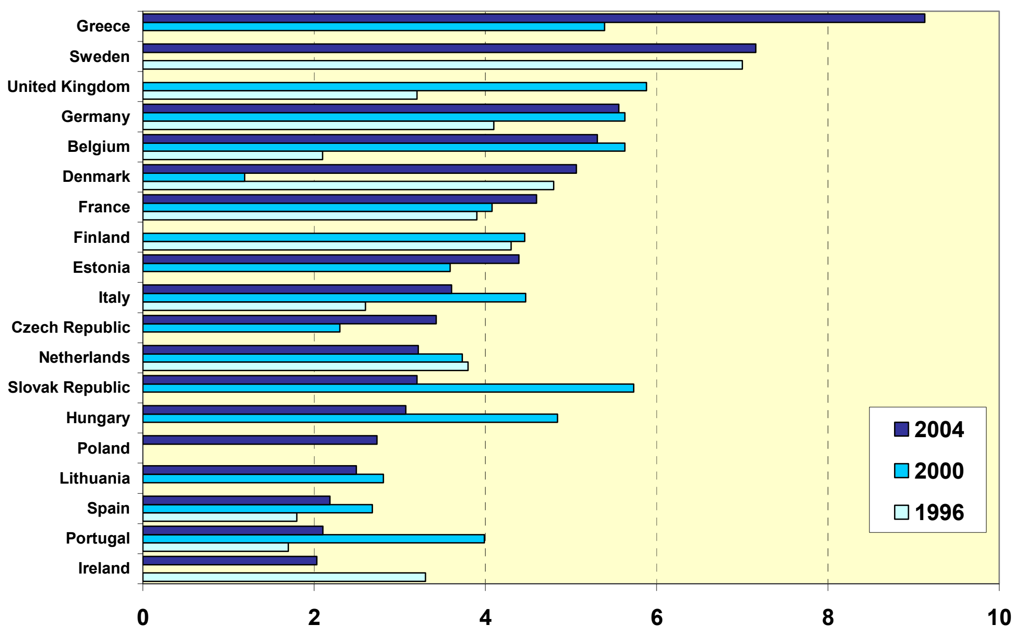
Figure SA19 ***Public R&D personnel per thousand inhabitants (2005)***



Source: Main Science and Technology Indicators, OECD, 2007a

Note: Public = R&D institutes and other research units + higher education; Data refer to 2004 by EU27 and Netherlands

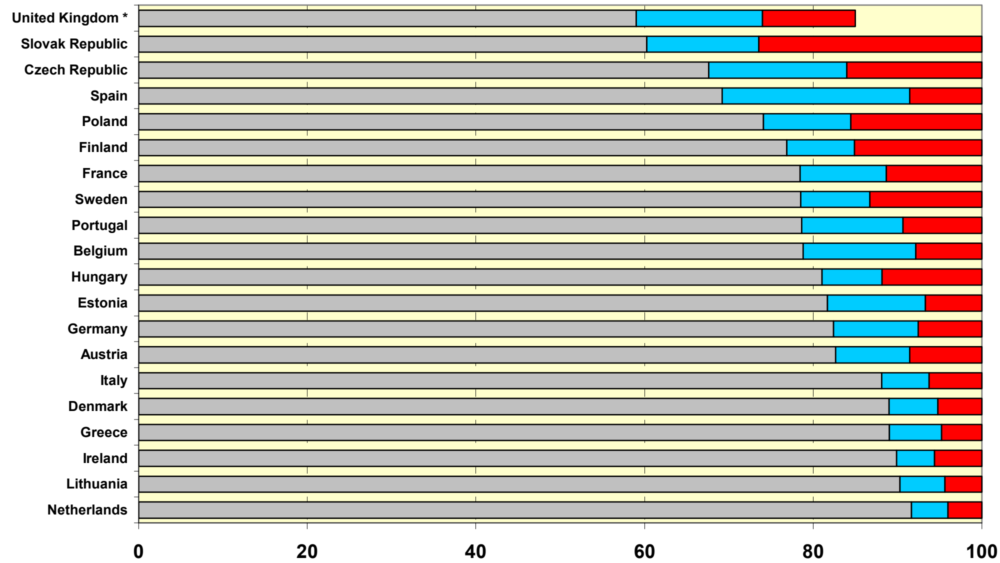
Figure SA20 ***Innovation expenditures as a percentage of turnover for innovative manufacturing firms in selected years* (%)***



Source: CIS3 and CIS4 data

* Calculations based on Eurostat data

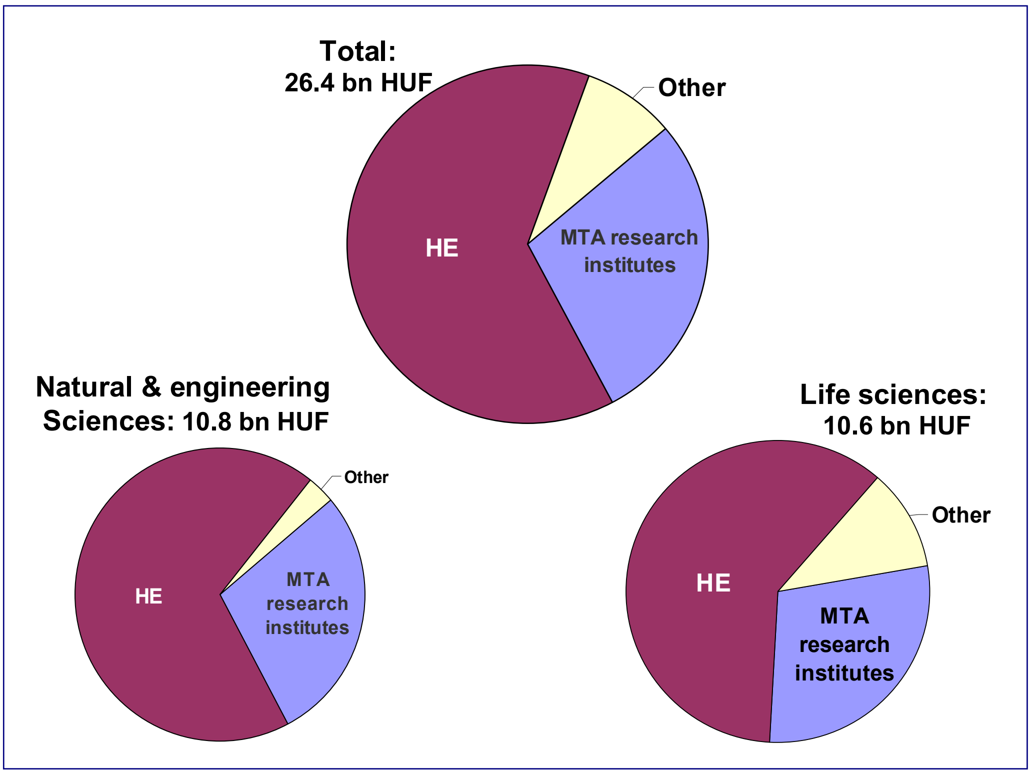
Figure SA21 ***Distribution of turnover by the degree of product novelty, selected countries, 2004 (%)***



Source: Calculation based on CIS4 data

* For the United Kingdom, a fourth category (significantly modified product) was also used

Figure SA22 ***Accumulated financial support provided by OTKA to research projects between 2003 and 2007***



Source: OTKA, 2007 November

ANNEX 1: MAIN INTERMEDIARY ORGANISATIONS IN THE HUNGARIAN INNOVATION SYSTEM

Financial intermediaries

The **Hungarian Venture Capital Association** (established in 1991) has 29 venture capital firm members – many of those are subsidiaries of international funds –, 33 associate members, which provide specialised services (mostly legal, accounting and financial), and 11 individual members.

Public funds are also invested following the basic principles of venture capital basis; the prominent player in this field is the state-owned **Corvinus First Innovation Venture Capital Fund**. EU funds will be also disbursed for these purposes: through the **Jeremie** initiative (Joint European Resources for Micro to Medium Enterprises) EUR 750 m will be available for SMEs in 2007-2013: EUR 180 m through a state-owned venture capital fund, the rest as loans and (equity) guarantees. The target group is SMEs, who cannot receive funding through standard banking procedures.

The **Hungarian Development Bank (MFB)**, a state-owned financial organisation is specialised in allocating funds from the government budget, and international (mostly EU) sources, as well as issuing bonds. The Bank focuses on the economic policy priorities of the government, and innovation, therefore, is not a priority in its strategy. The **Start Co.** was established in 2006 as a joint venture of the MFB and the Hungarian Foundation for Enterprise Promotion (MVA). It offers financial guarantees for Hungarian SMEs, and hence it is only an indirect player for innovation: its activity serves innovative enterprises in accordance with the other financial mechanisms that target innovative SMEs.

General innovation and technology transfer services

The **Regional Innovation Agencies** (RIÜ) in the seven Hungarian regions started to survey the innovation needs of their regions, co-operate and discuss regional innovation strategies with regional stakeholders, connect the different institutional actors and spend in a bidding frame on innovation co-operations (the amount used autonomously is on average about an annual EUR 3-4 m per region). RIÜs typically operate as organisational part of the Regional Development Agencies, except in Central Hungary.

The **Innostart** National and Business Innovation Centre was established in 1994 with Phare support, following the EU BIC model. Its mission is to identify innovative ideas, help their implementation and introduction to the market by providing professional services. Innostart has participated in 47 Hungarian and EU projects (using about EUR 2 m of public money), raising tens of millions of euro for its clients. It has organised training courses for more than 2500 participants. From 2000 Innostart is home to the Business Angel Club, where 9 of 67 project plans introduced could start with the help of external investors. Innostart runs a 6000 m^2 Business and Innovation Park, where more than 50 small and micro-firms are headquartered and incubated.

The **Institute of International Technology (NETI)** of the Theodore Puskás Foundation is pursuing several objectives, including the dissemination of advanced foreign technologies in Hungary, and the introduction of state-of-the-art Hungarian technologies on the international market (two-way know-how and technology transfer, partner mediation). Furthermore, its activities include consulting and technology audit.

The **Hungarian Science and Technology Foundation** (HSTF, founded in 1994 by the Ministry of Foreign Affairs) is the largest liaison office in the country. Originally specialised in administering international and bilateral scientific co-operations, it gradually became an internationally renowned co-ordinator and participant of EU projects, mostly in the fields of awareness-raising events, trainings, and food industry projects (for which it has been a National Contact Point since 2005). Its bridging activities are realised mostly in the form of joint proposals of different actors, trainings, and events.

MTA has traditionally very strong and broad relations with its partners all over the world. It runs the **HunASCO** office located in Brussels, representing MTA to the European Union and acts as an information and networking platform in Brussels.

Interest organisations and professional associations

The **Hungarian Innovation Association** (MISZ, established in 1990) is a lobbying group of companies, higher education and governmental R&D institutes, foundations, agencies, etc. with more than 600 members. Its activities are focused mainly on raising awareness for innovation (issuing a two-weekly newsletter, organising the annual Innovation Prize and Young Talents awards, publishing books on innovation management, organising conferences, etc.). There are also a growing number of direct bridging activities, like attracting business angels and venture capital, organising the annual Intellectual Product Fairs, where connections between inventors, consultants, legal advisors, universities, venture capitalists are established, and organising innovation management trainings.

The **Hungarian Association of IT Companies** (IVSZ, established in 1999) covers more than 75% of the annual output of the Hungarian ICT industry. It has 350 members with a balanced distribution of SMEs (over 250 members), large Hungarian companies (45 members) and multinationals (over 40 members) and some other ICT related organisations. IVSZ purposefully helps networking between its members.

The **Hungarian Association of Spin-off Companies** (MSVSZ) was established in 2006. Its intention is to enhance technology-transfer mechanisms, given the lack of special management methods, skills and experience in running a high-tech firm with global focus. “The HSA would like to influence the way students, PhDs, post-doctors and researchers active in technical and natural sciences think in order to understand and use the innovative market approach.” The association is not restricted strictly to classical spin-offs.

The **Hungarian Biotechnology Association** (MBSZ, established in 2003) seeks as much government support for the biotechnology sector as possible. In addition, the Association represents its members at major international conferences and exhibitions, facilitates networking between its members and contributes to the training of biotech professionals. Most of the HBA members are actively linked with universities and public research organisations.

The **Hungarian Chamber of Patent Attorneys** (established in 1996) is the public corporation of the industrial property representatives in Hungary. The Chamber has 148 members who are practicing at business associations as employed patent attorney (35), or pursue this activity in patent attorney offices (85) or as self-employed patent attorney (32).

The **Hungarian Federation of Technical and Scientific Societies** (MTESZ, established in 1948) is an umbrella organisation for 41 engineer associations and scientific societies. Its activity is focused on interest protection, consultation (with the central government, local authorities), assistance in preparing S&T project proposals, organising conferences, training, and protecting the engineering cultural heritage of Hungary.