European Commission

Peer Review of the Hungarian Research and Innovation system

Horizon 2020 Policy Support Facility

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate A — Policy Development and Coordination
Unit A4 — Analysis and monitoring of national research policies

Directorate-General for Research & Innovation
Directorate A — Policy Development and Coordination
Unit A4— Analysis and monitoring of national research policies

Contact (H2020 PSF Peer Review of Hungary):
Annamaria NEMETH, Coordinator of the Peer Review, Unit A4 – Annamaria.NEMETH@ec.europa.eu
Marnix SURGEON, Deputy Head of Unit A4 – Marnix.SURGEON@ec.europa.eu
Román ARJONA, Chief Economist and Head of Unit A4 - Roman.ARJONA-GRACIA@ec.europa.eu

Contact (H2020 PSF coordination team):
Román ARJONA, Chief Economist and Head of Unit A4 - Roman.ARJONA-GRACIA@ec.europa.eu
Stéphane VANKALCK, PSF Head of Sector, Unit A4 - Stéphane.VANKALCK@ec.europa.eu
Diana SENCZYSZYN, PSF Team Leader, Unit A4 - Diana.SENCZYSZYN@ec.europa.eu

RTD-PUBLICATIONS@ec.europa.eu
European Commission
B-1049 Brussels

Peer Review of the Hungarian Research and Innovation system

Horizon 2020 Policy Support Facility

Written by the independent panel of experts and national peers:

National Peers

Erja Heikkinen (Thematic expert for human resources for R&I - Ministry of Education and Culture, Finland)

Andrea Höglinger (Austrian Research Promotion Agency, Austria)

Urban Krajcar (Ministry of Education, Science and Sport, Slovenia)

Benoît Legaît (Ministry of Economy, France)

Independent Experts

Mark Ferguson (Chair – Director General Science Foundation Ireland and Chief Scientific Adviser to the Government of Ireland)

Krzysztof Klincewicz (Rapporteur and thematic expert for innovation in the business sector - University of Warsaw, Poland)

Jakob Edler (Thematic expert for R&I governance, funding and policy-making - University of Manchester, United Kingdom)

Marjan Oudeman (Thematic expert for science-industry cooperation - Utrecht University, Netherlands)

2016 Directorate-General for Research and Innovation EN

EUROPE DIRECT is a service to help you find answers to your questions about the European Union

Freephone number (*):
00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you)

Luxembourg: Publications Office of the European Union, 2016.

PDF ISBN: 978-92-79-61827-7 DOI: 10.2777/236994 KI-02-16-982-EN-N

TABLE OF CONTENTS

ABOUT THE PSF PEER REVIEW EXPERT PANEL 7

POLICY MESSAGES 10

EXECUTIVE SUMMARY 11

1. INTRODUCTION, AIM AND METHODOLOGY 15
   - 1.1. Policy Support Facility 15
   - 1.2. Aim and focus areas 15
   - 1.3. Methodology 15

2. OVERVIEW OF THE HUNGARIAN R&I SYSTEM 17
   - 2.1. Introduction 17
   - 2.2. The economic situation 17
   - 2.3. Overall governance 17
   - 2.4. The science system 18
   - 2.5. Innovation in the economy 18
   - 2.6. Science and the economy 18
   - 2.7. Human resources for R&I 19

3. R&I GOVERNANCE, FUNDING AND POLICY-MAKING 20
   - 3.1. Introduction 20
   - 3.2. Governance 20
   - 3.3. Public support to R&I activities 21
   - 3.4. Science-business links and innovation performance 22
   - 3.4. Prioritisation, strategic decision making, co-ordination and interaction 24
   - 3.5. More evidence-based policy-making, wider use of strategic intelligence and the development of a systematic evaluation culture 28
   - 3.6. R&I instrument mix 30
   - 3.7. European and international dimension of R&I policies 31
   - 3.8. Conclusions in relation to R&I governance, funding and policy-making 33
   - 3.9. Summary table 36

4. AVAILABILITY OF HUMAN RESOURCES FOR R&I 39
   - 4.1. Introduction 39
   - 4.2. Institutional diversity and HR implications 39
   - 4.3. Quantity and quality of research personnel for the Hungarian R&I system 43
   - 4.4. Careers in research and changes to the PhD curricula 47
   - 4.5. The impact of internationalisation on the human capital 49
   - 4.6. Summary table 52

5. FRAMEWORK CONDITIONS FOR INNOVATION IN THE BUSINESS SECTOR 55
   - 5.1. Introduction 55
   - 5.2. Institutional environment 55
   - 5.3. R&D activities of business enterprises 57
   - 5.4. Availability and distribution of R&I grants 62
   - 5.5. Design of R&D tax incentives 63
   - 5.6. Institutional and cultural support for entrepreneurship 65
   - 5.7. Availability of private capital for innovations 68
   - 5.8. Summary table 71

6. SCIENCE-INDUSTRY COOPERATION, TECHNOLOGY TRANSFER AND ENTREPRENEURSHIP 74
   - 6.1. Introduction 74
   - 6.2. Scope of science-industry cooperation in Hungary 74

6.3. Factors affecting the science-industry cooperation 75
6.4. Public support for the science-industry cooperation 78
6.5. Summary table 82
7. REFERENCES 84

LIST OF FIGURES

Figure 1. Sectors receiving government spending on R&D (m EUR), 2005-2014. 22

Figure 2. Innovation performance of Central and Eastern European countries, Summary Innovation Index. 23

Figure 3. Changes to innovation performance of Central and Eastern European countries, represented by growth rates of the Summary Innovation Index, 2008-2015. 23

Figure 4. Shares of R&D expenditures in GERD (Gross Expenditure on Research and Development) incurred by different R&D performing sectors, 2014. 40

Figure 5. Shares of R&D employment in different R&D performing sectors, 2014. 40

Figure 6. Changes in the numbers of organisations performing R&D in Hungary, 2004-2014 (data normalized with 100 as value from 2004). 43

Figure 7. Changes in the R&D expenditures of organisations representing different R&D performing sectors in Hungary, 2004-2014 (data normalized with 100 as value from 2004). 44

Figure 8 Changes in the numbers of researchers employed by R&D performing organisations from different sectors in Hungary, 2004-2014 (data normalized with 100 as value from 2004).....44

Figure 9. R&D personnel in higher education – comparison between historical data (1990-2014) and the target defined in the Higher Education Strategy for 2020. 46

Figure 10. The most problematic factors for doing business in Hungary, according to the survey administered by the World Economic Forum among business executives operating in Hungary, 2014. 56

Figure 11. Changes in the numbers of R&D units, size of R&D expenditures and counts of researchers employed by business enterprises in Hungary, 2004-2014 (data normalized with 100 as value from 2004).....57

Figure 12. Shares of companies performing R&D and their R&D expenditures classified by company size. 59

Figure 13. &D performance of companies in Hungary, depending on their ownership. 60

Figure 14. Technological readiness and business sophistication in selected Central and Eastern European countries, assessed by business executives surveyed by the World Economic Forum, 2014. 61

Figure 15. Survey data concerning entrepreneurial attitudes in Hungary, compared with the EU average. 65

Figure 16. Private equity and venture capital investments in Hungary, 2013-2014. 69

Figure 17. Knowledge transfer performance indicators for Hungary compared with the average values for the EU, 2011-2012. 75

Figure 18. Government expenditures on higher education sector per capita of R&D personnel in the sector, €, 2013. 76

LIST OF CASE STUDIES

Case study 1. Innovation 2020 - Ireland's National Strategy for Scientific Research, Development and Innovation 25

Case study 2. Foresight and stakeholder dialogues shaping R&I programmes in Poland..... 27

Case study 3. Austrian Platform for Research and Technology Policy Evaluation 29

Case study 4. International peer review in the Academy of Finland 33

Case study 5. Competitive project and institutional funding in Poland and Research Evaluation Framework in the UK 34

Case study 6. Increasing institutional financial and administrative autonomy – university reform in Finland 41

Case study 7. Short-term exchange of experienced research professionals in Finland..... 45

Case study 8. Supporting ERC applicants in Slovenia, Austria and Ireland 50

Case study 9. Manufacturing Extension Program (MEP), USA 61

Case study 10. Change of bankruptcy regulations for entrepreneurs (France) 66

Case study 11. StartupDelta (Netherlands)..... 67

Case study 12. Exemption of young companies from social security employer contribution (France) 67

Case study 13. R&I programmes with VCs (Poland) 70

Case study 14. The Catapult centres (UK) and the Institutes for Technological Research (France) 77

Case study 15. Enhancing doctorate holder careers in industry: the SFI Industry Fellowship (Ireland) and PoDoCo program (Finland) 79

Case study 16. Impact programme (Netherlands) 80

ABOUT THE PSF PEER REVIEW EXPERT PANEL

Jakob Edler (Germany/UK) is Professor of Innovation Policy and Strategy and Executive Director of the Manchester Institute of Innovation Research at the University of Manchester. He was previously leading the Department of Innovation Systems and Policy at the Fraunhofer Institute for Systems and Innovation Research, Germany. He has published widely on a range of issues in public policy for R&I as well as on strategic innovation management of companies. One of his key focus areas in recent years has been the study and conceptualization of demand-oriented policy approaches, with a focus on public procurement of innovation. Jakob has acted as consultant to the OECD, the World Bank, the Inter-American Development Bank, the World Intellectual Property Office, the European Commission, and numerous national and regional governments across Europe. He is member of the Austrian Council for Research and Technological Development and the German Academy for Science and Engineering and a Fellow of the Royal Society for the Encouragement of Arts, Manufactures and Commerce. He is also President of the European Forum for Studies of Policies for Research and Innovation (Eu-SPRI Forum). He was awarded his PhD in political science by the University of Mannheim (with distinction) and holds two master degrees from the University of Mannheim (Business Administration/Management and Political Science/Economic History). He was a Fulbright student at the Dartmouth College, New Hampshire, and had an internship at the European Commission, DG Research, Brussels during his doctoral studies.

Mark W.J. Ferguson (Ireland) is Director-General of Science Foundation Ireland and Chief Scientific Adviser to the Government of Ireland since 2012. Previously he was professor in life sciences at the University of Manchester (since 1984) and co-founder, CEO and Chairman of Renovo Group plc (1998-2011). He is the recipient of numerous international research awards including the 2002 European Science Prize (jointly), and is the author of 327 research papers and book chapters, 60 patent families and author/editor of 8 books. Mark graduated from the Queens University of Belfast with degrees in Dentistry (BDS 1st class honours), Anatomy and Embryology (BSc 1st class honours, PhD) and Medical Sciences (DMedSc), holds Fellowships from the Royal Colleges of Surgeons in Ireland (FFD), and Edinburgh (FDS) and is a Founding Fellow of the UK Academy of Medical Sciences (FMedSci). He is a member or Fellow of a number of learned Societies, and was made a "Commander of the British Empire" (CBE) by the Queen in 1999 for services to Health and Life Sciences.

Erja Heikkinen (Finland) has been with the Ministry of Education and Culture in Finland since 2005. She is currently heading the Science Policy Group of the Department of Higher Education and Science Policy. The group has both national and international responsibilities in developing the research and innovation system. Dr. Heikkinen switched from the academia to the public administration in 1995, when she started to develop the newly established Finnish graduate school system. She moved on in 1997 to the Finnish national supercomputing center CSC – IT center for science - where she was responsible for bioinformatics services. In 2001, Dr. Heikkinen joined the National Technology Agency Tekes, where her tasks involved funding of private and public organisations in research projects combining bioscience, medicine and ICT. Her training is in evolutionary biology with a PhD degree in population genetics.

Andrea Höglinger (Austria) is Head of Division European and International Programmes at the Austrian Research Promotion Agency (FFG) and acts as the Austrian National Contact Point Coordinator for Horizon 2020. She has been with the FFG since 2000 and was appointed Head of Division for European and International Programmes in 2011. FFG is the national funding agency for applied research and promotes research and innovation at national, European and international level. As Head of Division, she is actively involved in several EU-funded initiatives, mainly aiming at strengthening the international cooperation of research organisations. In a project of the EU Framework Programme, she was responsible for the development of an Austrian Training Academy for European Programmes. Currently she represents the Austrian NCPs in the EU-funded initiative "NCP – Academy", which brings together and implements trainings on cross-cutting issues for National Contact Points in Europe.

Krzysztof Klincewicz (Poland) is Professor at the Faculty of Management and Rector's Deputy for IP Management, University of Warsaw, Poland. He specializes in management of technology and innovation, with particular interest in strategies of technology firms and R&D management. Prior to joining the University, he had worked in high-tech industry in Poland, Finland and in the UK (1997-2004) and at the Tokyo Institute of Technology (2004-2006). Expert in analysing innovation policies of EU member states in the "ERAWATCH", "Research and Innovation Observatory" and "Stairway-to-Excellence" projects of the EC. Member of the UN Technology Executive Committee (2011-2015). Lead EU expert, negotiating climate technology development and transfer at the UNFCCC (2011-2015). Coordinator of experts in Green Technology Accelerator GreenEvo, established by the government of Poland to support environmental technology companies (2010-2013).

Urban Krajcar (Slovenia) is Director-General of Science Directorate at the Ministry of Education, Science and Sport by the Slovene Government. He started his career as the counsellor at the European Commission's Representation in Slovenia, where he was involved in the process of Slovenia's accession to the European Union. In 2009, he took the position of the Head of the Minister's Cabinet at the Government's Office for Local Self-Government and Regional Policy. In 2010 he joined the Ministry of Higher Education, Science and Technology, where he was the Head of Unit for Structural Funds, responsible for the implementation of major R&D instruments in the framework of EU Structural Funds, before moving to the current position in 2013.

Benoît Legaît (France) is Chairman of the Committee « Technology and Society » at the General Council for Economy (French Ministry for Economy), and referent for research and innovation. He was previously Director of Mines ParisTech, a well-known engineering school in France, as well as the Vice-President of the Conférence des Grandes Écoles. He also had extensive private sector experiences in consulting and managerial positions, having worked for Usinor, Institut Français du Petrole and BEICP-FRANLAB. Benoît Legaît was awarded with the National Order of Merit (1998), the Order of Academic Palms (2000) and the National Order of the Legion of Honour (2007).

Marjan Oudeman (Netherlands) is President of the Executive Board of Utrecht University in the Netherlands since July 2013. She is among others responsible for strategy and effective knowledge transfer of the university. She is also a non-executive board member of Solvay SA (Belgium), Statoil ASA (Norway) and SHV Holdings (Netherlands). Before joining Utrecht University, Marjan Oudeman was member of the Executive Committee of Tata Steel Europe (previously Corus Group plc) and as Executive Director, Strip Products Division responsible for all strip businesses in the UK, the Netherlands and other parts of the world (including relevant R&D activities). In 2010, she joined the Executive Committee of Akzo Nobel (Netherlands), where her areas of responsibility were HR, organizational development and the activities in BRIC countries. Between 2007-2010, she was also member of the Dutch Innovation Platform, a platform established to stimulate and accelerate innovations in the Netherlands, chaired by the Prime Minister with representatives of the government, science and industry.

PSF Team representative (observer, European Commission): Annamaria Nemeth, DG RTD, Unit A4 «Monitoring and analysis of national research policies"

LIST OF ABBREVIATIONS

Abbreviation	Explanation
BERD	Business Expenditures on Research and Development
DG RTD	Directorate-General for Research & Innovation, European Commission
ELI	Extreme Light Infrastructure
ERA	European Research Area
ERC	European Research Council
EU	European Union
EU-28	28 member states of the European Union
€	Euro
FDI	Foreign Direct Investment
FIEK	Higher Education and Industrial Cooperation Centres
FTE	Full-Time Equivalent
GBAORD	Government Budget Appropriations or Outlays on Research and Development
GDP	Gross Domestic Product
GEDI	Global Entrepreneurship and Development Index
GERD	Gross Expenditures on Research and Development
GINOP	Economic Development and Innovation Operational Programme, 2014-2020
HAS	Hungarian Academy of Sciences
HEIs	Higher Education Institutions
HIPO	Hungarian Intellectual Property Office
HUF	Hungarian Forint
H2020	Horizon 2020
ICT	Information and Communication Technologies
IP	Intellectual property
JEREMIE	Joint European Resources for Micro to Medium Enterprises
JPI	Joint Programming Initiative
JTI	Joint Technology Initiative
KKK	Strengthening Co-operative Research Centres
KTIA	Research and Technological Innovation Fund
NCP	National Contact Point for EU R&I Programmes
NETIS	Hungarian National Environmental Technology Innovation Strategy
NIH	National Innovation Office
NRDIO	National Research Development and Innovation Office
NTIT	National Science Policy and Innovation Board
OECD	Organization for Economic Cooperation and Development
OTKA	Scientific Research Fund
PCP	Pre-Commercial Procurement
PhD	Doctor of Philosophy
PPI	Public Procurement for Innovation
PSF	Policy Support Facility
RET	Regional Knowledge Centres at Universities
RIO	Research and Innovation Observatory
R&D	Research and Development
R&I	Research and Innovation
SMEs	Small and Medium-sized Enterprises
STEM	Science, Technology, Engineering and Mathematics
TTO	Technology Transfer Office
VAT	Value Added Tax
VC	Venture capital
VEKOP	Competitive Central Hungary Operational Programme, 2014-2020
WEF	World Economic Forum

POLICY MESSAGES

The PSF panel arrived at the following **seven Policy Messages**, which are further supported by a number of detailed recommendations presented in the Peer Review report.

The report explains in detail the rationale supporting each of these seven statements related to the R&I (Research and Innovation) policies in Hungary.

1. Hungary has a **vast science and innovation potential that can bring about a structural shift upwards in its economy**. While important progress has been made in strengthening Hungary's national science and innovation performance, the country has now a golden opportunity to build on the emerging collective feeling of a "new beginning" for its R&I system. It should better exploit its intellectual capital, the proven excellence in its science base and the presence of highly innovative international enterprises. However, success in making it happen will require a dedicated *will to reform* accompanied by sustained *increases in public funding* for R&D performers.

2. Hungary must **decide "what it wants" from its R&I system and "by when"**. It needs an R&I vision shared across government departments, understood by society and derived from a continuous dialogue with stakeholders. Hungary's R&I strengths should be an integral part of the country's economic agenda given their clear role as growth enablers. The R&I vision should be translated into a set of clear priorities for R&I policy and funding which would strategically focus resources on key areas of Hungarian strength.

3. The development of this shared vision will require **a structured involvement of stakeholders in overseeing the operations of the National Research, Development and Innovation Office (NRDIO)**, as well as further improvements of the Office's internal procedures to better accommodate inputs from stakeholders and advisory bodies. This shall contribute to increased transparency and responsibility. A formal platform for stakeholder involvement shall ensure due representation of key non-governmental and governmental stakeholders in the design and implementation of NRDIO's R&I actions. Moreover, Hungary's R&I programmes and instruments will benefit in quality and impact through their systematic, independent evaluation using international standards.

4. To **increase the quality and efficiency of its public R&I system**, Hungary's progressive and steady increase in its public R&D investment intensity should be combined with: improved processes for *evaluation and funding of R&I projects and proposals* in line with international peer review standards; an increasing *concentration of public R&I funding according to performance;* and *stronger collaboration by all actors in the system* to reduce fragmentation and maximise impact. The long-term consolidation of the Hungarian public R&I system will allow to build the necessary critical mass and attractiveness to reinforce public-private cooperation in R&I as well as the international reputation and attractiveness of Hungarian science and innovation.

5. **Hungary has talent!** The conditions and career prospects of researchers should become more attractive, notably those for young researchers. Universities should offer training that equips graduates with transferable skills. Open, merit-based recruitment and performance-based promotion practices are an unavoidable must.

6. **Innovate everywhere!** Hungary should **broaden its innovation base**, which is currently highly concentrated in a limited number of companies. It should support innovation in businesses of *all types and sizes* and throughout the innovation cycle. This requires putting in place **framework conditions that stimulate innovation, promote a risk taking culture and foster innovation demand** in order to create a true national innovation eco-system.

7. Stronger and more impactful **cooperation between the public R&I system and innovative businesses** is key for economic impact.

EXECUTIVE SUMMARY

This section explains the rationale behind the seven **policy messages** proposed by the Panel to redress the system's structural weaknesses and build on its existing and potential strengths. To derive those messages, the panel has fully utilized its up-to-date expertise on R&I policy formulation, implementation and evaluation, and good practice applied throughout Member States.

1. **Hungary has a vast science and innovation potential that can bring about a structural shift upwards in its economy. While important progress has been made in strengthening Hungary's national science and innovation performance, the country has now a golden opportunity to build on the emerging collective feeling of a "new beginning" for its R&I system. It should better exploit its intellectual capital, the proven excellence in its science base and the presence of highly innovative international enterprises. However, success in making it happen will require a dedicated will to reform accompanied by sustained increases in public funding for R&D performers.**

In recent years, the Hungarian R&I system has undergone major changes and reforms. More competition and transparency are matched with a progressively increased focus on scientific excellence and a higher concentration of resources on relevant areas. This generated the country's first successes in the EU's European Research Council, and in attracting more high-tech businesses and leading researchers.

However, much more needs to be done. The Peer Review panel identified deficiencies and worrying trends. Public R&I policy needs to improve in its design, implementation and evaluation. Hungary's human capital must be nurtured. Pockets of excellence should be supported and broadened. The instrument mix for policies and programmes must be conducive to the overall R&I goals of the country. The system must become more international, attractive and performance-based.

The public research system is under-funded and it is also highly fragmented across a number of universities, institutes of the Hungarian Academy of Sciences and sectoral institutes supervised by different ministries. The long-term consolidation of Hungary's public research potential will require stronger cooperation between those actors and more resources that can be used more effectively. It will also need a public R&D intensity level capable of better supporting public R&D performers and innovative businesses. Although policy-makers in Hungary attach great importance to R&I as drivers of growth, policy currently leads to low investments in science, uncompetitive academic salaries, and a lack of mechanisms to allocate institutional R&D funding in a competitive and performance-based manner to support excellence and impact.

The framework conditions for innovation in Hungary need a revamp. They should be capable of generating a stronger R&I performance with better connection to, and better anchorage in, the local science and innovation eco-system. Hungary has numerous examples of innovative firms but the overall level of innovativeness in the economy is very low. SMEs introduce few product or process innovations and the public spending for business R&D does not yield the expected results. This needs to be rethought.

2. **Hungary must decide "what it wants" from its R&I system and "by when". It needs an R&I vision shared across government departments, understood by society and derived from a continuous dialogue with stakeholders. Hungary's R&I strengths should be an integral part of the country's economic agenda given their clear role as growth enablers. The R&I vision should be translated into a set of clear priorities for R&I policy and funding which would strategically focus resources on key areas of Hungarian strength.**

The panel recommends that Hungary defines what the country wants from its R&I system in the short, medium and long term. Care must be taken to progress in building a system that is capable of being sustainable when the EU Structural Funds start to fade out naturally, as the country's regions move upwards in their development scale, as it is already the case for Central Hungary. The country faces overlapping R&I priorities in its multiple strategic documents and sectoral plans. Those are not yet fully aligned. A compact and up-to-date set of R&I priorities would prove most valuable to guide Hungary's R&I funding programmes towards providing solutions to the economic and societal challenges faced by the country, including health promotion, sustainability, climate change and digital culture. The priorities, to be agreed with stakeholders, should encourage synergies between the relevant sectoral policies and funding schemes of the government departments involved.

The priority-setting process should be systematic and part of the system's culture. It should be informed by appropriate foresight exercises and get conducted at regular intervals, e.g. every five

years. A broad spectrum of stakeholders should be consulted (universities, research institutes, companies, researchers, entrepreneurs) in view of the design and the implementation of R&I programmes.

3. The development of this shared vision will require a structured involvement of stakeholders in overseeing the operations of the National Research, Development and Innovation Office (NRDIO), as well as further improvements of the Office's internal procedures to better accommodate inputs from stakeholders and advisory bodies. This shall contribute to increased transparency and responsibility. A formal platform for stakeholder involvement shall ensure due representation of key non-governmental and governmental stakeholders in the design and implementation of NRDIO's R&I actions. Moreover, Hungary's R&I programmes and instruments will benefit in quality and impact through their systematic independent evaluation using international standards.

Empowering stakeholders in priority-setting and monitoring of policy actions will increase the evidence-base for policy and induce broader support for structural reforms of the R&I system. The panel proposes that the Hungarian government considers setting up a supervisory board of the National Research, Development and Innovation Office with direct participation of governmental and non-governmental stakeholders. The Office should also elaborate procedures for its existing advisory bodies (the International Advisory Board, the Board of Scientific Councils and the Innovation Board) to better accommodate their inputs into the country's R&I policies.

Hungary needs to reinforce its evidence base for its R&I policy-making. The design of R&I strategies, programmes and instruments will benefit from increased use of foresight exercises. The last use of those exercises in the country, for a policy purpose, dates back to the beginning of the 2000s. No systematic attempts have been made to develop a shared understanding of the R&I challenges, opportunities and priorities ahead in the years to come, for Hungary and in relation to its partner countries and international competitors.

Furthermore, the Hungarian R&I system suffers from a poor evaluation culture and from a persistent lack of independent, external, programme-level and instrument-level evaluations. The legal obligation to carry out such evaluations exists since 2004, but know-how, international best practice and independent expertise is not exploited via regular reviews. This negatively impacts the design of R&I programmes and skews the learning curve for policy-making in R&I. It is the panel's opinion that the systematic and meaningful international evaluation of the whole set of national R&I programmes can lead to substantial incremental improvements in R&I. At least a compact set of core R&I programmes, that should remain stable over time in order to assure the system's predictability for beneficiaries, should benefit from such evaluations.

Output and impact evaluations should be transparent, regular, involve independent international peers and experts, and provide feedback to programme beneficiaries. In both the academic and industrial arena, Hungary can take advantage of pre-existing international evaluations.

4. To increase the quality and efficiency of its public R&I system, Hungary's progressive and steady increase in its public R&D investment intensity should be combined with: improved processes for evaluation and funding of R&I projects and proposals in line with international peer review standards; an increasing concentration of public R&I funding according to performance; and stronger collaboration by all actors in the system to reduce fragmentation and maximise impact. The long-term consolidation of the Hungarian public R&I system will allow to build the necessary critical mass and attractiveness to reinforce public-private cooperation in R&I as well as the international reputation and attractiveness of Hungarian science and innovation.

Funding for public R&D performers has decreased in Hungary in recent years. As a result Hungary is now fifth from last in public R&D spending in the EU as share of GDP (only Romania, Bulgaria, Cyprus and Malta have lower public R&D intensities). The government funding for public universities and the institutes of the Hungarian Academy of Sciences has suffered. However, the Hungarian government does invest heavily in business R&D. With 0.19% of its GDP in direct support for businesses R&D, Hungary has the second highest share among 35 OECD and EU-28 countries, surpassed only by Slovenia. At the same time, according to data provided by NRDIO, only 12.3% of the Office's annual budget for 2016 was dedicated to finance fundamental research.

The panel is of the opinion that in order for Hungary's R&I system to reinforce its capacity, its impact and its connection to economic progress, the government should progressively increase its public funding of R&D as a percentage of GDP. This should permit to maintain the R&I programmes currently co-funded from the EU's Structural Funds and to expand the portfolio of support measures with the goal of reaching a public R&D intensity close to or higher than 0.5% by 2020.

This should come hand in hand with an increased allocation of R&I funding via competitive and performance-based programmes, both for institutions and individuals.

Institutional R&D funding in Hungary is not linked to performance, scientific excellence or impact. Progressively concentrating resources based on rewarding institutional and team or individual performance will reduce the system's fragmentation and dispersion. Moreover, funding should be distributed not just competitively but also with rigorous review processes in line with international standards in order to ensure transparency and predictability. When measuring the scientific performance of researchers, notably in view of appointments and career development, universities and the Hungarian Academy of Sciences should not only give credit to criteria focussed on scientific publications but also to exposure to science-business cooperation in the broadest sense.

Business R&D funding programmes should be reviewed in terms of priority areas, eligibility criteria and selection modalities. Funding of business R&D should be aligned to the overall R&I policy priorities, it should guarantee impartiality, swift time-to-grant and the bureaucratic burden for applicants should be minimised. Existing R&D and innovation tax incentives should undergo a review to ensure appropriateness and fitness-for-purpose for different industries and firm sizes.

Moreover, the panel recommends that Hungary continues its financial support for projects based on proposals submitted to the Horizon 2020's European Research Council (ERC) that have been positively screened by international peer reviewers but are finally not funded by the ERC. Likewise, public-private co-investments in start-up companies could be made following evaluation by, for example, private venture capitalists willing to invest their own funds alongside those of the state.

5. Hungary has talent! The conditions and career prospects of researchers should become more attractive, notably those for young researchers. Universities should offer training that equips graduates with transferable skills. Open, merit-based recruitment and performance-based promotion practices are an unavoidable must.

The success of a country depends on its people. It is highly important for Hungary to nurture its higher education system to generate in the long-run an adequate number of graduates with adequate skills for R&I. This starts at schools that should increasingly apply modern curricula taught by enthusiastic and well-respected teachers, with adequate salaries. Science, Technology, Engineering and Mathematics (STEM) play a particularly relevant role for the development of Hungary's science and innovation system, already from the early stages of the education cycles. Systematic outreach events and education campaigns to encourage new generations to study STEM at school and university will pay off.

Hungarian universities should also increasingly develop and implement curricula with a high dose of entrepreneurial, managerial and transferable skills to provide new generations with the tools and competences for the digital society. Universities and institutes of the Hungarian Academy of Sciences should ensure open, transparent and merit-based recruitment and performance-based promotion practices. Doctoral students should benefit from improved career conditions and from innovative doctoral training that equips them with transferable skills. Scholarships should be allocated competitively. Doctoral students should be granted sufficient time for research and for interaction with their academic supervisors. The salary levels of researchers in Hungary should become increasingly competitive in relation to other countries and comparable across the system. Performance-based salary top-ups for researchers in the public sector should be considered.

Talented Hungarian researchers, and notably young ones, should be supported in their internationally-oriented careers in Hungary as well as in returning to the national R&I system from the diaspora. Programmes should cater for the attraction of foreign talent using best international practice in promoting healthy brain circulation. The Hungarian diaspora should be engaged via appropriate networks for dialogue and cooperation. This can include awareness raising events with the participation of the diaspora and the local R&I community and the use of the expertise of the diaspora researchers for mentoring, placement and collaboration activities with local researchers.

Cooperation between universities, and between universities and institutes of the Hungarian Academy of Sciences, should be actively encouraged using collaborative grant programmes, joint appointments of researchers and professors, shared administration and "accommodation" of projects and activities and distributed campuses. It is also crucial to increase the attractiveness of science and innovation careers by putting in place appropriate incentives to reward researchers' mobility between business and public sector and address the salary disparities between both sectors.

6. Innovate everywhere! Hungary should broaden its innovation base, which is currently highly concentrated in a limited number of companies. It should support innovation in businesses of all types and sizes and throughout the innovation cycle. This requires putting in place framework conditions that stimulate innovation, promote a risk taking culture and foster innovation demand in order to create a true national innovation eco-system.

Not all innovation in Hungary is science-based. Public programmes supporting business R&D should therefore also focus on quality R&D projects with innovation and commercial impact. Funding for innovations already accounts for the majority of NRDIO's budgets. Support measures that cover direct grant funding for business R&I but also tax incentives, strategic advice, training, physical accommodation for start-ups and scale-ups are important for the Hungarian R&I system. Business R&D programmes must focus on priority areas and be driven by clear eligibility and selection criteria. Openness, confidentiality, increased flexibility for project implementation, and shorter time-to-grant drive successful programmes. Low bureaucracy is crucial for applicants. Funding should cover the whole innovation cycle, avoiding gaps for fast-growing firms. Programmes should foster multi-disciplinarity to address challenges that go beyond a single technology.

Entrepreneurial education and training must be available both in schools and universities. The funds collected through the innovation levy should be redistributed for R&I purposes. However, the levy should not become the exclusive source of funding for business R&D activities. The panel considers that existing tax allowances and generous R&D tax incentives should be reviewed and their appropriateness for different industries and firm needs (start-ups, scale-ups, companies intensive in R&I, exporting companies, traditional firms) be revisited. Hungarian bankruptcy laws should be revised, too, to permit a culture of 'good failure' for Hungarian innovative entrepreneurs.

Hungary must develop its innovation eco-system on the basis of adequate physical infrastructure. The creation and development of common laboratories between universities and industry, innovation spaces, incubators, accelerators, and science parks should be promoted. The provision of "soft service" support (e.g. advice, training, guidance, information) to entrepreneurs and to companies across all industries, types and sizes is an asset. The successes of entrepreneurs should be rewarded through prizes, media campaigns and public exposure.

7. Stronger and more impactful cooperation between the public R&I system and innovative businesses is key for economic impact.

Achieving strong economic impact from the Hungarian R&I system requires reinforced cooperation between universities, institutes of the Hungarian Academy of Sciences and industry, including at the level of individual entrepreneurs. The panel thinks that such cooperation should be promoted through targeted means that include: the design of dedicated grant programmes to foster the mobility of researchers to industry and vice versa, as well as closer-to-market research; the provision of appropriate physical infrastructures (e.g. shared laboratories, incubators, accelerators, science parks, innovation clusters); the introduction of transparent and adequate incentives for inter-sectoral mobility including adequate appointment and promotion criteria in the public sector to recognise the value of business exposure for researchers; the involvement of private sector representatives in the governance of public sector R&I performers; and the promotion of knowledge transfer programmes at institutional and system level.

The design of support measures to stimulate science-industry cooperation should take into account the lessons learned from past experiences and from existing policy actions, including the results of the independent evaluations of programmes and the views of stakeholders, including both beneficiaries and non-users of these support measures. Hungary should learn as well from successful European schemes supporting science-industry cooperation. National support schemes for science-business cooperation should undergo regular impact evaluations in order to promote their further incremental improvement.

1. INTRODUCTION, AIM AND METHODOLOGY

1.1. Policy Support Facility

The Policy Support Facility (PSF) is a tool set up by the European Commission – DG Research & Innovation – under Horizon 2020, the EU's funding programme for research and innovation (R&I), to support EU Member States and countries associated to Horizon 2020 in improving the design, implementation and evaluation of national R&I policies.

The Peer Reviews of national R&I systems are one of the main services offered by the PSF. Peer Reviews constitute an in-depth assessment of a country's R&I system carried out by a panel of international experts and policy practitioners at the country's demand. The Panel formulates concrete and operational recommendations to the national authorities on the reforms which are necessary to improve and strengthen the quality of the national R&I system.

The peer reviewed country can also request a Pre-Peer Review to prepare the Peer Review, as it was done by Hungary.[1]

1.2. Aim and focus areas

The Hungarian authorities expressed their interest for a Pre-Peer Review and a subsequent Peer Review of their R&I system by a letter of the President of the Hungarian National Research, Development and Innovation Office (NRDIO), on 16 December 2014.

The Pre-Peer Review of Hungary took place between May and October 2015 and provided a first assessment of the strengths and weaknesses of Hungary's R&I system, allowing for the identification of areas in need of in-depth evaluation and recommendations in the subsequent Peer Review.

In their letter of 5 November 2015, in line with the findings of the Pre-Peer Review, the Hungarian authorities confirmed a number of focus areas for the Peer Review, which are in need of in-depth evaluation and recommendations for further structural changes.

In compliance with this request, the aim of the Peer Review presented in this report is to provide external advice and recommendations to the Hungarian authorities on possible reforms to undertake within the framework of the finalisation of the ongoing restructuring of the Hungarian national R&I governance and funding system.

The **focus areas** of the Peer Review were the following:

1. **R&I governance and policy-making;**
2. **Availability of human resources for R&I;**
3. **Framework conditions for innovation in the business sector; and**
4. **Science-industry cooperation, technology transfer and entrepreneurship.**

The chapters in this report address each of these four topics. These chapters present a situational analysis with extensive empirical evidence, identify bottlenecks and make a series of detailed policy recommendations, supported by relevant examples of good practices from other countries and additional justifications.

1.3. Methodology

The Peer Review was carried out by a Panel of four independent experts acting in their personal capacity and four peer reviewers, policy-makers or funding agency representatives from Austria, Finland, France and Slovenia.

The PSF panel conducted two field visits in Budapest from *24 to 26 February 2016* and from *18 to 20 April 2016*. On the basis of the various documents analysed, as well as in-depth discussions with various stakeholders and experts during the field visits, the PSF panel drafted the present report.

---

[1] The Pre-Peer Review report of the Hungarian R&I system is available (also for the public) at the joint Research and Innovation Observatory (RIO) - Horizon 2020 Policy Support Facility (PSF) website: https://rio.jrc.ec.europa.eu/en/library/horizon-2020-policy-support-facility-pre-peer-review-hungarian-research-and-innovation.

Information set

The PSF panel interviewed altogether representatives of **more than 50 organisations** (hereafter referred to as stakeholders), including R&I performers, intermediary organisations in the R&I system and public administration bodies. The selection of interviewees covered a wide variety of organisations from different regions of the country, industries or scientific disciplines, sizes and track records[2].

As regards R&D performers, **both beneficiaries of public R&I funding and individuals or organisations not receiving public support** were interviewed. For some of the organisations, interviews involved several representatives (in order to broaden the scope of the information provided) or interviews were carried out more than once, when the PSF panel considered it necessary to deepen their understanding of certain topics.

Interviews were carried out **by the entire PSF panel unsupervised by third parties** and the identity of interviewees is not revealed in the report. The data provided by these interviewees were supplemented with the available documentary sources and compared across various interviews, with any discrepancies explored through follow-up contacts.

Besides drawing on the extensive set of interviews, the PSF panel analysed **quantitative data and qualitative information** from Hungarian and international sources, relevant previous reports, strategies, legal documents and news releases. Some documents, available only in Hungarian, were translated into English for the PSF panel. The "References" section of the report (section 7) lists the documents that were cited in the report or analysed during the process.

Follow-up to the Peer Review

The panel would like to emphasise that, in line with the PSF principles, it is the **country's responsibility to ensure the follow-up to the Peer Review as well as the potential implementation of its recommendations** through concrete reforms. In rolling out these reforms, the Hungarian authorities can continue to call upon the PSF for support and envisage the assessment of the implementation of the panel recommendations within a three-year time span through a PSF post-Peer Review.

The PSF panel would like to **warmly thank the Hungarian stakeholders** for their willingness to engage in discussions, provide additional data and inspire the work of the panel. We are also grateful to the team of the National Research, Development and Innovation Office for their excellent support and cooperation in carrying out this Peer Review project.

The preparation of the report and the work of the PSF panel would not have been possible without the guidance, expertise and help provided by the officials of the EC DG RTD acting within the framework of the Horizon 2020 Policy Support Facility. The panel would like to express its gratitude to Ms. Annamaria Nemeth from EC DG RTD for her excellent continuous support of its work. Her understanding of the Hungarian R&I system, familiarity with policy documents, legal frameworks and available data sources enabled the panel to adequately prepare for the country visits and engage in meaningful discussions with Hungarian stakeholders, as well as improve the interpretation of the collected data.

[2] The interviewed organisations included:

- Public sector organisations: 5 ministries of the Hungarian government, the Prime Minister's Office, National Research, Development and Innovation Office, Hungarian Intellectual Property Office, Hungarian Development Bank;
- Public R&D performers: 8 public universities (including vice-rectors, chancellors, researchers, doctoral students and representatives of Technology Transfer Offices), 9 institutes and research centres of the Hungarian Academy of Sciences, 1 sectoral research institute;
- Private R&D performers: 3 private higher education institutes or educational establishments, 9 large high-tech companies, 4 chambers of commerce or industry associations and numerous start-up companies;
- Support organisations: 3 consulting companies, 5 innovation incubators, accelerators or cluster organisations, 1 labour union.

2. OVERVIEW OF THE HUNGARIAN R&I SYSTEM

2.1. Introduction

The Hungarian Research and Innovation (R&I) system is in a period of catching up, yet it has made considerable progress over the past decade. **It shows a number of key strengths, but at the same time is confronted with serious challenges in terms of performance, governance and its ability to create impact**.

A thorough analysis of the strengths, weaknesses, opportunities and threats was presented in the "Horizon 2020 Policy Support Facility Pre-Peer Review Report" (Ranga, Ortega-Argiles and Bartzokas, 2015).

This short initial chapter aims to contextualise the following analytical chapters of the report. It provides a snapshot of the overall economic situation of the country and subsequently highlights what the panel sees as main strengths and weaknesses in the key areas of R&I governance, the science system, the link between science and economy, and finally the human resources for R&I.

2.2. The economic situation

In the last three years the economy of Hungary has been growing, but the growth rate in 2015 has slowed down and thus, the recovery is slower than in other Central and Eastern European countries (EC, 2016a, p. 4). In 2015, the real GDP grew by 2.9% after having increased by 3.7% in 2014, and the economic growth forecast for 2016 was 2.5% (EC, 2016c, p. 98), but in the first quarter of 2016, the GDP has actually decreased by 0.8% on a quarter-to-quarter basis. This deceleration could be attributed to a decrease in absorbing EU funds and in external demand conditions influencing the Hungarian economy (EC, 2016c, p. 98). The country is perceived as having a "moderate" growth potential due to the low increases in factor productivity (EC, 2016a, p. 7). The high level of public debt in relation to the country's GDP remains an important challenge, although there have been significant declines in the fiscal deficit and in the government debt to GDP ratio (EC, 2016a, p. 5).

The **labour market** has shown considerable improvements, with an unemployment rate of 6.75%, down from a level of about 11% in 2010-2012. According to economic forecasts, employment can be expected to grow thanks to more jobs being created in the private sector and the public works scheme of the government (EC, 2016c, p. 98). Foreign direct investments play an important role in the Hungarian economy, and there are differences in productivity and innovativeness between the local subsidiaries of multinational companies and the large number of smaller, Hungarian-owned companies, which tend to be characterised by comparatively worse performance (this **'dual' character of the economy** is also typical for other transition countries in the Central and Eastern Europe).

Against this macroeconomic background, the evolution of the **research and innovation performance** of the country has been by and large positive. The gross expenditures on Research and Development (GERD) have grown over the last two decades, and the achievement of the Europe 2020 national R&D intensity target related is feasible. However, the bulk of the GERD growth in recent years was due to private sector spending, which increased strongly, also in relation to international competitors. Moreover, the importance of the EU Structural Funds as a source of public spending on R&D has grown considerably in recent years.

Hungary is a "moderate innovator" according to the **European Innovation Scoreboard 2016** (EC, 2016d, p. 63). The country's performance has improved between 2008 and 2015, although Hungary still performs below the EU average for all dimensions of the summary innovation index of the Scoreboard and nearly for all of its indicators. Notably, although its relative strengths are observed for licence and patent revenues from abroad and exports of medium and high tech goods, its relative weaknesses lie with community designs and non-EU doctoral graduates.

2.3. Overall governance

Regarding the overall governance of R&I policy, **a long period of instability appears now to have come to an end**. The *National Research and Development Office* (NRDIO, *Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal*) is the entity responsible for distributing science and innovation funding. It is also the entity responsible for R&I policy-making and, as such, it is confronted with the on-going challenges of: embedding research and innovation in the overall policy mix of Hungary; fostering science-based and non-science-based innovations; and ensuring the direct and flexible interaction of NRDIO with firms and scientific organisations.

Non-science-based innovations seem particularly relevant for Hungary, although traditionally support was primarily provided for scientific research. Some actors in the R&I system might in fact

underestimate the importance of **innovations not driven by science**. Furthermore, the system shows a deficit of stakeholder involvement, unclear and weak priority-setting for research, industry-oriented funding and human capital, as well as poor strategic intelligence due to the limited use of foresight and evaluation practices. It must however be acknowledged that NRDIO demonstrated the will for improvements, initiating the present Peer Review, and the Office is still at the early stage of its organisational development.

2.4. The science system

In comparison to other Central and Eastern European countries, Hungary has a number of strong assets in its science system. For example, it is highly successful in Horizon 2020's European Research Council, in which the **Hungarian Academy of Sciences** (HAS, *Magyar Tudományos Akadémia*) and some of the **largest public universities and private universities** are demonstrating that there exist important pockets of scientific excellence in the country.

In terms of **scientific outputs**, Hungary is well connected internationally, as shown by its very good share of international co-publications and co-patents. However, the overall share of Hungarian scientific publications belonging to the world's 10% most cited publications is not higher, but similar, to the shares of other Central and Eastern European countries, and remains lower than the shares of most other OECD countries (EC, 2016b, p. 70, and OECD, 2015a, p. 106).

The **investment in public science is low**, both in terms of research funding and in terms of salaries for academics, and most of the institutional research funding is not performance-based. Despite very good efforts of consolidation in the HAS and some examples of cooperation between research teams from universities and the institutes of HAS, there is still a **high level of fragmentation in the public science system** with considerable differences as regards the importance of research across universities. Furthermore, there is **no systematic co-ordination with EU level policies**, and Hungary has yet to prepare explicit strategies or declarations guiding the European Research Area (ERA) Roadmap. At the same time, several measures have been adopted to better align the Hungarian policies with the EU-wide initiatives, including support schemes for applicants of the European Research Council, Horizon 2020 SME Instrument and Horizon 2020 Teaming for Excellence.

2.5. Innovation in the economy

As for the role of innovation in the economy, Hungary has been on an upward trajectory in terms of **business expenditure** on R&D and innovation performance, due to a large extent to the strong presence of foreign firms investing in R&D.

The country has a comparatively **high level of public support for R&D performed by business enterprises** (EC, 2016b, pp. 34-35), with both indirect and direct funding measures, partly funded via a unique tax called "innovation levy" (*innovációs járulék*) (0.3% of taxable revenues of medium-sized and large companies). Furthermore, innovative firms in Hungary (and in particular: large firms) tend to collaborate widely with academic organisations.

However, across the entire economy, the share of innovative companies is very low in international comparison (EC, 2016b, p. 84); and thus the overall innovation capability across the system is poor with **innovation activities being concentrated in a small number of large foreign-owned firms**. The effects of the generous public funding for business R&D activities are hampered by non-conducive framework conditions for research and innovation (EC, 2016b, pp. 87-97), notably in relation to the ease of doing business, barriers to entrepreneurship, intellectual property protection, or ease of access to loans. High administrative burdens and uncertainty (e.g. concerning the tax credit eligibility), a lack of "soft", non-financial support for innovation across the system (including e.g. training, mentoring, promotion of good practices), limited availability of venture capital and a culture that is adverse to risk taking or failure, are also hampering Hungary's performance in innovation. Hungary's performance in the ease of starting a business and in contract enforcement are above the EU average (EC, 2016b, pp. 87-97).

2.6. Science and the economy

As regards the interaction between science and industry, the country shows a **mixed picture**. On the one hand, the level of cooperation between innovative firms and scientific organisations (EC, 2016b, p. 58), and the shares of private funding of public science are relatively high, and some good examples can be found, e.g. of dual training schemes bringing universities and industry closer together. On the other hand, there are only **few examples of long-term cooperative structures and initiatives**, such as competence centres linking science and industry, but new support measures offered by NRDIO aim to finance collaborative initiatives involving scientific organisations and companies. Despite some positive examples, Technology Transfer Offices still have limited relevance across the system.

The focus of public funding programmes on scientific excellence is not matched by a similar focus on economic or societal impacts, limiting the potential orientation of scientists – and university graduates– towards R&I activities in the business sector. This is also reflected in a relatively poor development of the so-called **"third mission" of universities** (involving their broader interactions with society), as well as in the **challenging administrative procedures and governance processes of universities**, which remain an obstacle to broad and open inter-sectoral cooperation.

2.7. Human resources for R&I

In terms of human resources in the R&I system, Hungary has a **good share of excellent and highly motivated researchers**, with pockets of genuine global excellence. However, the relative number of researchers across the system and the production of new graduates from tertiary education and new doctoral graduates is low (EC, 2016b, p. 41 and p. 43), with Hungary performing well below the EU average in the EU headline target on the tertiary attainment of 30-34 year olds (EC, 2016b, p. 44), and incentives for research careers remain limited.

The Hungarian R&I system is challenged by deficiencies in the education system at all levels, endangering the availability of highly trained individuals in the STEM areas and showing a poor build-up of entrepreneurial spirit, with for example low and decreasing performance of the share of individuals with high computer skills (EC, 2016b, p. 46).

In addition, **no performance-based differentiation of remuneration and career advancement** was identified by the panel as being systematically pursued. In addition, the average level of **salaries of academics** is poor.

Recognising the challenges ahead, excellent human capacities in R&I have the highest priority in strategies at various levels of the system, and a number of good initiatives set incentives in the right direction, above all the Momentum (*Lendület*) programme and attempts to implement more performance-based career trajectories. Nevertheless, the size and impact of the Momentum programme is limited, as it only supports a small number of excellent research teams and does not seem to be able to revert the negative balance of brain circulation. In addition, the overall human resource planning for R&I lacks foresight and forecasting processes to support the desired changes.

3. R&I GOVERNANCE, FUNDING AND POLICY-MAKING

3.1. Introduction

The following chapter presents the institutional and financial basis for the overall governance of R&I policy in Hungary. In terms of the **governance of the system**, the country is at a major crossroads. For many years, the Hungarian system has gone through continuous changes of responsibilities, priorities and funding approaches. Various historical and recent reports (OECD, 2008, p. 15; Dőry, 2015, p. 4) as well as the interviews with Hungarian stakeholders indicate that there has been a **lack of stability and clarity** in the overall governance.

Many of the interviewed stakeholders, representing groups as diverse as public research organisations, universities, business enterprises and intermediary support organisations complained about the **perceived lack of transparency and rigour in the past**, with frequent changes of direction and expectations as to priorities and responsibilities. Consequently, there is no clear understanding as to what exactly Hungary wants to get out of its R&I system, and there is no sense of long-term planning, which is highly disruptive to build capacity in the Hungarian science and innovation base.

According to the interviewees, this has led to a feeling of **overall uncertainty** across the system. At the same time, with the establishment of the **National Research, Development and Innovation Office** (NRDIO), *Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal*, there is now a widespread expectation for more stability in the system, as indicated by the stakeholders interviewed for the Peer Review project. Other significant policy moves such as the launch of competitive calls drawing on the EU Structural Funds 2014-2020 have also provided positive developments. The sound implementation of reforms to sustain those trend changes is eagerly expected by the science and innovation community.

3.2. Governance

Within its broad remit for R&I, the major focus of NRDIO, confirmed in the Panel's interviews with the Office, is **to increase the excellence and competitiveness of the Hungarian science system** by distributing competitive project funding and launching other relevant initiatives. This focus responds to existing challenges, as there are indeed structural weaknesses in the funding of the science system.[3]

Both for public sector scientists as well as for firms, this **Office has developed into a one-stop-shop** for the various forms and purposes of funding. In an international comparison, the Hungarian approach seems exceptional because of the scope of vertical and horizontal integration of responsibilities within NRDIO. Horizontally, NRDIO is responsible for science *and* for innovation funding, including the bulk of the EU Structural Funds distributed for these purposes. Vertically, the NRDIO integrates almost all political responsibilities and the accompanying accountability for designing, implementing, evaluating and reforming the support measures. In short, NRDIO assumes the double role of R&I policy-maker and R&I funder in Hungary.

While in most countries, science and innovation agencies that deliver policy do so on behalf of a principal (a ministry responsible for R&I), the President of NRDIO reports directly to the Parliament and NRDIO is also directly subordinate to the Prime Minister's Office (Act LXXVI of 2014, Section 8). It is therefore **not accountable to other relevant ministries** (with the exception of the Prime Minister's Office, which coordinates the work of the government). NRDIO coordinates activities targeting Hungary's regions, centralising the project selection processes and taking over the tasks that used to be carried out by regional agencies in the previous financial perspective of the EU.

Overall, the **NRDIO has a major responsibility in the system**. **This is exceptional in comparison to other European countries**. This unique role might increase the effectiveness and efficiency of R&I governance in the system. However, this increase should not happen to the detriment of, for example, external control over the decision-making processes in science and innovation or lack of connection with the overall political priorities of the country.

[3]The strives for scientific excellence and competitiveness also guide the actions of the Hungarian Academy of Sciences (and its network of research institutes) and of the Ministry for Human Capacities (overseeing the universities), although they use different measures to achieve these aims.

The panel recognises that ***this unique position of NRDIO offers opportunities, but it also poses challenges***, as the Office is responsible for policy-making, funding, programming and interactions with stakeholders at the same time.

The **centralisation** of R&I funding, planning and decision-making capacity, reflected in the unique responsibilities of NRDIO represents **a number of risks for the Office** and notably:

- becoming potentially disconnected from the overall political strategy and priorities of the government (including in relation to the government's efforts in science and innovation in other sectors such as agriculture, education, environment, health and industry);

- turning into an excessively inward-looking institution;

- and lacking reliance on external advice, engagement and control.

It remains to be ensured, through NRDIO's own activities and appropriate mobilisation of other institutions that stakeholders throughout the country perceive NRDIO as their **valued and trusted partner for R&I support**. In addition, NRDIO's policy-making should remain synergistic with the overall political priorities and policy mix of the country, while respecting NRDIO's role in building capacity and pushing forward the national science and innovation system of Hungary.

There is currently no evidence that meaningful **external advice** has largely supported the Office in performing its comprehensive functions. While a number of advisory bodies to NRDIO are foreseen in the system, the International Advisory Board[4] of NRDIO met only once so far and there is no record of the National Science Policy and Innovation Board (NTIT)[5], which is a parliamentary body, meeting ever during the past 5 years. Based on Act LXXVI of 2014, NRDIO appoints its Innovation Board, but the Board's role is not precisely defined and its members are selected by NRDIO.

NRDIO does not have a supervisory board, influencing its strategic directions and approving major decisions or other forms of external control that would ensure the checks and balances appropriate in relation to the extensive responsibilities and budgets overseen by NRDIO. The only exception concerns the implementation of measures based on the EU Structural Funds, where the Office responds to the Ministry for National Economy, which hosts the managing authority for operational programmes in the 2014-2020 financial perspective. The Ministry also prepared the national R&I strategy in 2013, offering high-level guidance for the operations of NRDIO. Moreover, the president of NRDIO reports directly to the Parliament, and NRDIO is directly supervised by the Prime Minister's Office, which coordinates the work of the government, including linkages with other sectoral ministries.

3.3. Public support to R&I activities

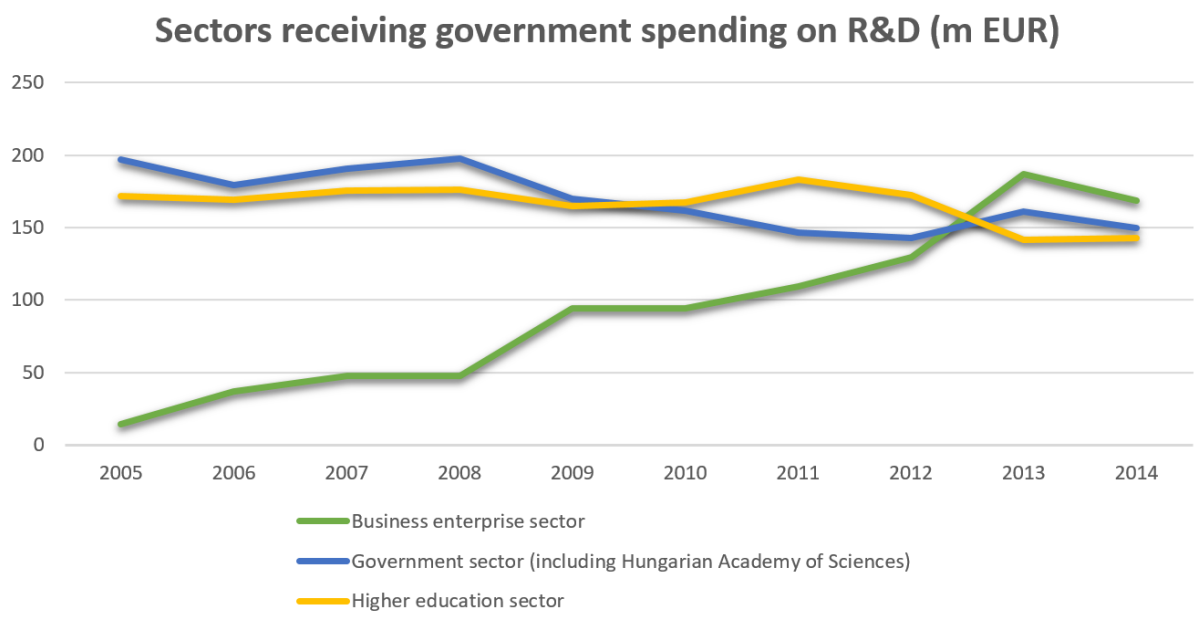
Looking to the trends in public funding since 2005, **Hungary clearly stands out for its willingness to focus its public support towards business R&D** to the detriment of public R&D (Ranga, Ortega_Argiles, Bartzokas, 2015).

Indeed, as shown on Figure 1, between the years 2005 and 2014, a very substantial **increase in public R&D funding to the Hungarian business sector** was coupled with **decreases of governmental funding for public science** organisations (universities and Hungarian Academy of Sciences).

[4] The International Advisory Board of NRDIO (*Nemzetközi Tudományos Tanácsadó Testület*) does not have decision-making, monitoring or controlling powers.

[5]The National Science Policy and Innovation Board (NTIT, *Nemzeti Tudománypolitikai és Innovációs Testület*) is a parliamentary body established by the government decree No. 116/2013. The president of the NTIT is the prime minister, and the co-chairman is the president of the Hungarian Academy of Sciences (MTA). The mandate of the Board is to provide advice, evaluate and make strategic recommendations on R&I programmes, their sustainable funding and evaluation methodologies.

Figure 1. Sectors receiving government spending on R&D (m EUR), 2005-2014.



Source of data: Eurostat (2016).

As a result, among all EU Member States, **Hungary is now fifth from last in public R&D expenditures** (i.e. expenditures on R&D performed in the public sector) expressed as a percentage of GDP (EC, 2016b): only Romania, Bulgaria, Cyprus and Malta have lower public R&D intensities.

This situation presents significant challenges particularly for the higher education sector. The **salaries** of academics are *low* and **conditions of project funding** are *suboptimal* because of a lack of sufficient "overheads" and a general poor financial endowment of many public universities. Besides, only a small percentage of the university funds are based on competitive project funding (Ministry for Human Capacities, 2014, p. 27) and the institutional research funding at universities is not performance-based, contrary to the situation in many other European countries (Hicks, 2012; Jonkers and Zacharewicz, 2016).

By contrast, the **Hungarian government invests heavily in business R&D**. With 0.19% of its GDP spent for direct support to business R&D, the country has the second highest share of public spending on business R&D in relation to GDP, both among 35 OECD countries (OECD, 2015b) and the EU Member States, in both cases only surpassed by Slovenia (OECD, 2015b and EC, 2016b, p. 34). In addition, indirect funding to business R&D through tax incentives represented 0.13% of its GDP in 2013. Looking to total public support to business R&D (direct + indirect) as a share of GDP, Hungary stands at the third rank among EU Member States (after France and Slovenia) and fourth rank among OECD countries (as South Korea stands first) (OECD, 2015b and EC, 2016b, p. 34).

3.4. Science-business links and innovation performance

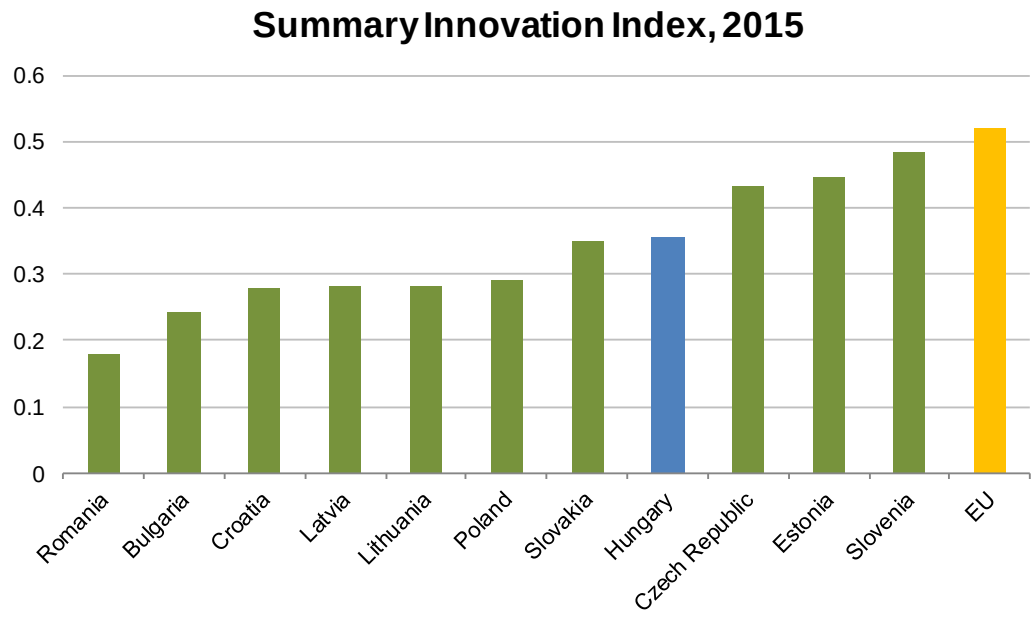
Furthermore, the level of **cooperation between innovative business enterprises[6] and public science performers** – indicated by the origin of innovation sources – is similar to the levels observed in Austria, Spain and the UK, and higher than in other Central and Eastern European countries (OECD, 2015a, p. 142 and p. 144; Havas, 2015).

However, the **resulting innovation performance** across the economy is mixed. On the one hand, the economic effects of innovation are reported as moderately high in the EU European Innovation Scoreboard (EC, 2016d, p. 63). For most innovation indicators, the performance has improved, a highlight being the employment in fast growing firms in innovative sectors, which is above the EU average (EC, 2016b, p. 63; OECD, 2015a, p. 192). On the other hand, however, in the latest overall ranking of innovation performance the country has a middle position amongst the moderate innovators (see: Figure 2), with comparable countries like the Czech Republic or Estonia being well

[6] Innovative firms are defined here as firms that have introduced a product or process innovation (OECD, 2015a, p. 142).

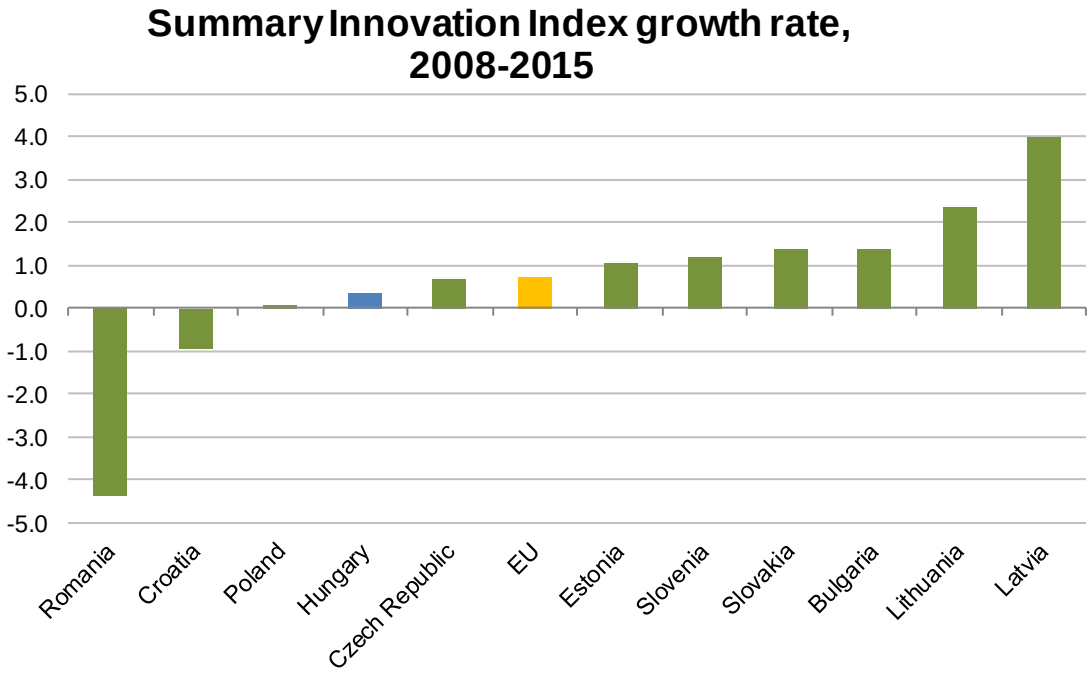
ahead (EC, 2016d, p. 6), and the growth rate in this overall innovation indicator is moderate (see: Figure 3).

Figure 2. Innovation performance of Central and Eastern European countries, Summary Innovation Index.



Source of data: EC (2016, p. 94).

Figure 3. Changes to innovation performance of Central and Eastern European countries, represented by growth rates of the Summary Innovation Index, 2008-2015.



Source of data: EC (2016, p. 94).

Moreover, the **innovativeness across all firms** in the economy is very low (EC, 2016b, p. 84). In terms of the share of innovative companies in the economy's sectors, Hungary occupies the last place in manufacturing and the third but last in the service sector[7] (OECD, 2015a, p. 163). The performance of SMEs in terms of product and process innovations is among the poorest across all European Innovation Scoreboard indicators of the country (EC, 2016d, p. 63). The public and private spending on R&D and innovation does therefore not appear to have the desired broad effect on stimulating increased innovation performance across the whole economy. In this situation, any science-based strategy is likely to have beneficial effects only for a small part of the Hungarian economy, and the real challenge is the **broadening of Hungary's innovation capacity and innovation performance across the entire economy**.

In addition, much of the innovative activity in any economy, as it is typically the case in economies that are still catching up, is performed **without a meaningful and coherent connection to the science system**. 60% of all innovative firms in Hungary indicate market sources as highly important for innovation, compared to 15% of firms that rate the public sector research or the government as sources of innovation (OECD, 2015a, p. 142). Especially for SMEs, the share of *innovative* companies cooperating with the science base is considerably lower than the share of companies collaborating with clients and customers (OECD, 2015a, p. 143).

For a country trying to catch up with more advanced economies, the ability of the economy to innovate through its own means, to use forefront process technologies and management techniques and to employ highly skilled workforce (across all levels of qualifications) are major requirements, all of which are not immediately linked to the science base. In these situations, **support for non-science-based innovations is also important, as well as for science-industry co-operation**, including through well-functioning knowledge transfer mechanisms, which may include offices dedicated to knowledge transfer, start-up funds, appropriate incentive structures and abilities to work with and for the industry.[8]

Recommendation 1: *Hungary must progressively and steadily increase its support towards public R&D performers in order to reach by 2020 a public R&D intensity higher than 0.5% of GDP (from the current level of 0.38%). To raise the country's share of innovative companies and broaden the support for innovation across the economy, public funding for business R&D should support more indigenous companies and non-science based innovations, as well as stimulate knowledge transfer.*

3.5. Prioritisation, strategic decision making, co-ordination and interaction

R&I policy in any country is faced with the **challenge of prioritisation**. Smaller countries in particular need to decide if they strive to focus on certain sectors, technology areas, knowledge fields or societal challenges, or whether they intend to develop their system with more reliance on bottom-up input. In general terms, priorities set a focus for budgets and activities, align those activities across the whole spectrum of the R&I system, bundle forces, and help expectation management as to future foci of investment and opportunities.

Hungary lists various **sets of priorities** in its strategic documents and sectoral plans, yet those do not seem to be aligned and neither to fully percolate through policy implementation. An extensive list of national and sectoral R&I strategies and programmes was included in the Pre-Peer Review report (Ranga, Ortega-Argiles and Bartzokas, 2015, p. 23). The R&I Strategy, the Smart Specialisation Strategy and the Industrial Development Strategy include overlapping but different catalogues of priorities.

The R&I Strategy "Investment in the future. National Research and Development and Innovation Strategy (2013-2020)" (Ministry for National Economy, 2013)[9] enshrines a number of "**horizontal**

[7] See: OECD (2015a, p. 163). The indicator is the percentage of manufacturing / service firms which had implemented "product or process and marketing or organisational innovation".

[8] No thorough evaluations of the existing policy instruments to foster innovation could be identified in Hungary (see below), and therefore, no final assessment of the effectiveness and efficiency of the R&I policies is possible. Nevertheless, against the background outlined above, the Hungarian innovation policy has a lasting challenge in uplifting the innovation activity across the breadth of the economy.

[9] The R&I Strategy offers a comprehensive overview of the challenges and opportunities in the Hungarian R&I system. It envisages the increase of gross domestic expenditures on R&D to 1.8% by 2020 and 3% by 2030 (Ministry for National Economy, 2013, p. 29). The document has accurately identified the lack of "engines of R&D" in Hungary as the root cause of other systemic problems, including relatively weak knowledge bases, shortcomings in inter- and intra-sectoral knowledge flows and barriers to knowledge utilization by business enterprises (Ministry for National Economy, 2013, p. 23). Some of specific challenges identified in the present

priorities" (referring to the plans to identify smart specialisation), and lists a number of very concrete, small-scale "priorities"[10]. 83 objectives proposed in the Strategy formed a comprehensive framework addressing multiple aspects of the R&I system (Ministry for National Economy, 2013, pp. 31-39). The framework was complex, with multiple high-level objectives but no specific implementation guidelines or prioritisation of possible actions. According to the Strategy, these objectives were supposed to be transposed into specific support measures, including instruments financed from the EU Structural Funds, 2014-2020. As of May 2016, many of these objectives have not yet been addressed by policy actions, while **the development and implementation of some R&I policies in Hungary seem to remain disjoint from the Strategy**.

The National Smart Specialisation Strategy, co-ordinated by NRDIO, outlines three national specialisations (systems science, smart production and sustainable society), which are very broad and almost all-encompassing. It also lists six "national sectoral priorities", focused on specific sectors or technological areas, two "horizontal priorities" (including ICT and inclusive and sustainable society with viable environment) and a number of "smart technologies". The Industrial Development Strategy (the so-called "Irinyi Plan"), prepared by the Ministry for National Economy, has a different set of "strategic pillars" and a list of prioritised sectors[11]. At the time of the Peer Review project, the „Irinyi Plan" was not published and the PSF panel did not have access to the document, but only its summary. **Owing to the existence of these varying catalogues of priorities, there is only limited "thematic" or challenge-oriented programming in the funding of research and innovation in place that would be in line with the identified priorities**. NRDIO has launched first thematic R&I calls, and declares that it will monitor the topics of co-funded R&I projects to map the thematic areas and further improve its portfolio of support measures.

Case study 1: Innovation 2020 - Ireland's National Strategy for Scientific Research, Development and Innovation

Ireland's National Strategy for Research, Development and Innovation (https://www.djei.ie/en/Publications/Publication-files/Innovation-2020.pdf) was developed following widespread consultation with the academic and industrial communities and considerable discussion and coordination across all relevant government departments and agencies. The focus is on achieving: excellence, talent and impact.

The document describes what Ireland wants to achieve out of its research, development and innovation system for the next five years and sets key priorities and performance indicators. The strategy establishes a coordination and monitoring committee and regular reports on progress are submitted quarterly to the government cabinet on achieving the goals set.

This national innovation strategy follows on from a national process, again involving stakeholder consultation, to determine research priorities for Ireland (https://www.djei.ie/en/Publications/Publication-files/Research-Prioritisation.pdf). Each relevant government department or agency then links its own strategy with the national strategy, see e.g. Science Foundation Ireland's strategic plan "Agenda 2020" (http://www.sfi.ie/assets/files/downloads/News%20and%20Events/AGENDA%202020.pdf).

Key messages for Hungary:

- National strategy specifying what a country wants from its research, development and innovation system.
- The initiative has a number of crucial process principles such as the prioritisation of recommendations, wide stakeholder consultation and systematic consultation across government departments.
- It is implemented through a coordinated implementation committee and supported by quarterly reports and progress to government cabinet.

---

report coincide with the "main problem areas of RDI in Hungary", identified in the Strategy (Ministry for National Economy, 2013, p. 23).

[10] The prioritised interventions are: investments in ELI (Extreme Light Infrastructure) in Szeged, the pharmaceutical industry, the ICT sector, the automotive industry, environmental RDI, R&D in the agricultural and food sectors, energy and health R&I (Ministry for National Economy, 2013, p. 56). The R&I Strategy was prepared by the Ministry for National Economy before the establishment of NRDIO.

[11] The prioritised sectors are: motor vehicle manufacturing, manufacturing of specialized machinery and equipment, health industry, tourism, food industry, green economy, information and communication industry and defence industry. The list will be further developed and potentially expanded in the implementation programme of the „Irinyi Plan".

- Clear Key Performance Indicators are used for government, research funders, research performers, industry and other actors.
- Individual government departments and agencies link their strategies to the national strategy.

Furthermore, no **systematic priority setting process** could be observed in Hungary, a process that leads to explicit choices and gives a rationale for these choices. The only indication for a documented priority setting process including stakeholder involvement is within the National Smart Specialisation Strategy, which was formalised to follow the guidelines of the European Commission as an ex-ante conditionality for accessing the EU Structural Funds, 2014-2020.

Recommendation 2: *Hungary must decide what it wants from its research and innovation system in the short, medium and long term. It should forge closer links between this resulting vision, the goals in existing and future R&I strategies, and the political priorities of the government.*

Recommendation 3: *The Hungarian government must develop a compact and up-to-date set of R&I priorities to guide the national R&I funding programmes. These priorities should target economic and societal challenges and benefit from synergies with relevant sectoral policies in areas such as transport, health, energy or environment. They should be clearly and adequately reflected in Hungary's R&I programmes and percolate through programme implementation and funding streams. Their implementation shall be facilitated by appropriate Key Performance Indicators to measure the success of the strategy and its implementing programmes.*

The national discourse about R&I policies, strategies and priorities is limited and cannot be widely heard. The panel notes that the **involvement of stakeholders in priority-setting** is suboptimal and the interviewed stakeholders representing public and private R&D organisations confirmed the lack of broader, meaningful consultation. NRDIO involves expert panels in the evaluation of scientific project applications and has appointed the Innovation Board consisting of selected R&I performers (but its role remains undefined). The lack of consultation is particularly visible when it comes to the relationship with **other policy areas**, such as transport, health, energy or environment. Some of these areas have their own, dedicated strategic plans, e.g. the National Environmental Technology Innovation Strategy (NETIS) (Ministry of Rural Development, 2012). There is no co-ordination nor integration between these sectoral programmes and the national R&I strategy. In many OECD countries, R&I policy is increasingly being understood not only as enabling more effective knowledge production and generation of innovations, but also contributing to societally defined goals (Kuhlmann and Rip, 2015). This link to the challenge-driven policy in conjunction with the co-ordination between different ministries is not visible in Hungary.

The above-described lack of systematic prioritisation also means that Hungary has not engaged in in-depth reflections and discussions that would **identify a limited set of societal challenges as the guiding orientation for R&I funding**, and which could also serve as a means for cross-governmental focus and coordination. Initiative and funding schemes of different ministries are not coordinated or designed to purposefully complement each other, so there are no visible attempts to address certain grand challenges by R&I policies and develop the related capabilities and technologies. Hungary does not explicitly target selected economic and societal challenges with R&I programmes, and the use of thematic funding, allowing the country to focus on selected areas, is limited in comparison to the generic R&I funding. Effective consultations could centre around the social, economic and ecological needs of the country, with various groups of stakeholders benefiting from opportunities to articulate their views and interests, and to comment on the proposed priorities and planned actions. Such a consensus-based process could orchestrate a broad support for the national R&I strategy.

Recommendation 4: *In deciding priority goals and in designing new R&I programmes, in reviewing their progress and in refining or developing existing programmes, the Hungarian government should consult with a wide group of relevant stakeholders, including companies (large, small, national and international), universities, the Academy of Sciences, entrepreneurs, civil servants (e.g. in the health sector) and the public at large. Prioritisation should be informed by an appropriate foresight exercise and get conducted at regular intervals, e.g. every five years. Stakeholders should be involved in ensuring Hungarian research integrity and transparency in the allocation of public R&I funding and in project selection procedures.*

Furthermore, various stakeholders in the R&I system, including both R&D performers as well as representatives of other governmental bodies defining and implementing sectoral policies that include or impact the R&I activities, do not have a formal forum for exchanging views or jointly contributing to the development and implementation of policies. **At present, neither NRDIO nor specific R&I programmes have any supervisory boards involving a broad stakeholder representation**, and the use of advisory bodies in the Hungarian R&I system is very limited (see also: footnotes no. 3 and 4 in section 3.2 of this report).

Particularly problematic is **the lack of direct involvement of stakeholders and representatives of other government departments** (with the exception of the Prime Minister's Office and the Ministry for National Economy) **in overseeing the design and implementation of R&I measures offered by NRDIO**. A **formal platform for stakeholder dialogue**, such as e.g. a supervisory board with a balanced representation of diverse stakeholder groups and some of the board members selected by the stakeholders themselves, could be a practical step towards increasing this involvement.

It would help articulate the diversity of interests, consider possibilities of balancing and prioritising the complementary or conflicting expectations, and ensure that future developments of R&I policies or specific policy instruments take into account the intellectual inputs, opinions and interests of various stakeholders, integrate relevant efforts in different sectors and strive for coherence and joint support of the R&I priorities and agreed actions. It would also add an important element of dialogue to the current, excessively centralised R&I system in Hungary.

Recommendation 5: *A formal platform for stakeholder involvement should be developed to establish a participatory process of nurturing synergies, dialogue and advice on R&I and to ensure stakeholder ownership and oversight of NRDIO activities. This platform can take the form of a supervisory board of NRDIO that includes broad representation of stakeholders of the Hungarian R&I system, including representatives of relevant governmental departments.*

Case study 2: Foresight and stakeholder dialogues shaping R&I programmes in Poland

Priorities for Poland's R&I policy were defined on the basis of nation-wide foresight exercises and consultations with stakeholders. In 2006-2009, the "National Foresight Programme Poland 2020" identified the most promising, future-oriented R&D themes and strategic directions for public R&D funding programmes. Its results were supplemented by "Technological Foresight of Industry – Insight 2030" (2010-2012), focused on the identification of key technologies for the Polish industry in the perspective until 2030. Both foresight projects involved broad representation of scientific and industrial stakeholders.

The Polish government used the outcomes of these foresights for the preparation of the Smart Specialisation Strategy, contrasting the future-oriented, visionary proposals with historical indicators including economic and patent data. Preliminary results of this analysis were used by the government to stimulate stakeholder dialogue, which helped select the priority areas for R&I funding. Each of these areas is further elaborated by a dedicated workgroup, consisting of experts nominated by relevant stakeholders and recommending to the government specific actions, related to the selected technological field.

In addition, the government contracted the World Bank to carry out an independent, nation-wide evaluation of the identified smart specialisations, which included a large number of interviews with business enterprises from various Polish regions (both R&I performers and companies deemed not yet innovative). Stakeholders representing a prioritised industry can also submit their proposed research agenda, which will be evaluated, modified and negotiated with the R&I funding agency as the basis for a "sectoral programme", with competitive calls for proposals related to topics defined in the research agendas. As of April 2016, 6 such sectoral programmes were established.

Key messages for Hungary:

- Priorities and specialisations identified jointly with stakeholders increase the commercial benefits and future orientation of the R&I programmes.
- Consultations with stakeholders and foresight projects take a long time and should not be organised merely to satisfy the formal requirements for launching a new support scheme.
- Stakeholders can be important sources of inspiration for new, thematic R&I funding programmes, but their proposed research agendas need to be reviewed and renegotiated in order to avoid policy capture and maximize the economic and innovative impacts.

3.6. More evidence-based policy-making, wider use of strategic intelligence and the development of a systematic evaluation culture

The design, implementation and constant improvement of research and innovation policies necessitate support through **strategic intelligence**, i.e. the use of objective methodologies and evidence in transparent and interactive ways. This includes the **use of foresight** in support of strategy priority setting. More than 15 years ago, Hungary conducted a foresight[12] exercise (Havas, 2003).

Since then, except for the exercise to define the smart specialisation strategy, there have been **no systematic initiatives in place or planned that would establish a broader stakeholder dialogue** to develop a joint understanding of challenges, opportunities and priorities. Based on the analysed documents and stakeholder interviews, no planned foresight activities or other forms of strategic intelligence could be identified. NRDIO governance does not include a supervisory board that would promote the long-term involvement of stakeholders in the planning and execution of the Office's activities.

Moreover, it is important for R&I policy developments that **programmes and support measures get evaluated**. Evaluation uses objective methods to assess the effectiveness and efficiency of specific measures so that policy-makers and broader stakeholders can learn to improve policy, and programme managers are held to account. Despite a legal obligation to conduct programme evaluations, which was introduced in 2004, the **evaluation culture and practice to ensure accountability, transparency, and learning in R&I policy, is poor,** especially at the programme level. A recent review of R&I policy concluded that Hungary had little experience in design, implementation and evaluation of R&I strategies (EVAL-INNO, 2014, p. 28).

The availability of **formal evaluation reports for R&I policies, programmes or support measures** and the visibility of those evaluations in the R&I policy discourse in Hungary remain limited. A general review of the policies was carried out by the OECD 8 years ago (OECD, 2008). Another example is the programme evaluation, prepared 6 years ago for the Research and Technology Innovation Fund (Ernst & Young and GKI, 2010). The external evaluators highlighted the limited availability and inconsistencies of data that were made available for the evaluation project (Ernst & Young and GKI, 2010, p. 1), and gave a low rating of the overall governance and implementation modalities of the Fund, highlighting the limited involvement of the advisory and coordination bodies in R&I policy-making as well as imperfect monitoring (Ernst & Young and GKI, 2010, p. 2).

Yet another evaluation report documents the international peer review of the Scientific Research Fund (OTKA, *Országos Tudományos Kutatási Alapprogramok*)[13], conducted by the European Science Foundation (ESF, 2014). It commented on the proposal evaluation practices within the Fund, praised the administration for being highly competent and efficient in supporting the beneficiaries as well as having in principle the appropriate procedures and selection criteria in place, with the involvement of the scientific community in the decision making.

However, the report suggested to further improve and to "review its selection procedures **with regards to fairness and impartiality**" (ESF, 2014, p. 26) (for further discussion of challenges related to **shortcomings in R&I project selection procedures**, see: section 5.4). Results of the above-mentioned OTKA evaluation report indicate also limited cultural and procedural support for research integrity. Another evaluation conducted in recent years concerned the supporting mechanisms for EU-level funding (NIH, 2014).

The overall number of external evaluations of R&I programmes and institutions in Hungary remains very limited. According to explanations provided by NRDIO, the Hungarian government acknowledges this challenge and prepares a dedicated regulation concerning the evaluation of R&I programmes. Moreover, the Monitoring Committee of EU-funded Operational Programmes (2014-2020) is expected to approve a comprehensive plan for monitoring and evaluation of these programmes.

[12] Foresight is an interactive, participatory approach to discuss possible or desirable future developments, their drivers and their consequences. It is used to improve mutual understanding of stakeholders across the system and to design future-oriented policy strategies.

[13] OTKA is currently integrated into the operations of NRDIO.

Recommendation 6: *The panel supports a move towards increased evidence-based policy-making, including through the use of foresight and through the systematic evaluation of R&I policies, programmes and support measures. It calls for evaluations of the outputs and outcomes of programmes and projects to be managed in a clear and transparent way and to be delivered in a timely and efficient fashion, giving due publicity to them and eliminating undue bureaucracy.*

An internal analysis prepared by the National Innovation Office[14] confirmed – somehow self-critically – the need for better evaluation (NIH, 2012). The report examined the uptake, use and governance of various instruments administered by the Office. It analysed the existing funding databases and surveys conducted in the past. **The evaluation found positive effects of the innovation levy**[15], **especially for larger companies and for selected sectors**. However, it criticised frequent changes in funding schemes, the stagnation of public funding levels based on the innovation levy and the lack of coordination of schemes as challenges for the R&I system. It also reported on the findings of the National Court of Auditors regarding uncertainties around the annual activity planning, irregularities with the management of the R&D fund and lack of transparency in decision making. The main recommendations asked for a more explicit and unified strategy, with more stability, strategic monitoring and evaluation (NIH, 2012).

Finally, the National Innovation Office concluded in another evaluation report (NIH, 2013a) that despite the development and positive elements of the Hungarian R&I evaluation system, it is facing **serious evaluation challenges**, including the lack of embedding the evaluation in the programming and management process, poor utilisation of evaluation results in the policy process and more generally, a lack of skilled R&I evaluators and related networks.

Overall, while **there are examples of very good programme management practices**, the quantity and quality of evaluations in the Hungarian R&I system seem unsatisfactory, and room remains for improvement. Thus, the system lacks the necessary transparency and R&I policy-makers do not benefit from important learning opportunities. In terms of *ex ante* evaluation of project proposals, at least in the area of scientific research, there are some encouraging practices in place, albeit with further room for improvement, including among others the possibility of using international peers.

Recommendation 7: *All priority R&I programmes should be rigorously evaluated at appropriate times using international reviews and standards. The outputs of those programmes should be evaluated against their objectives and funding. The systematic and meaningful international evaluation of the whole set of national R&I programmes should lead to incremental improvements of a core set of programmes that should remain stable over time to assure system predictability.*

Case study 3: Austrian Platform for Research and Technology Policy Evaluation

Evaluation is an important input for the development of strategic policy intelligence. It is however important that evaluations are taken seriously by policy-makers, that they are not considered a "necessary evil" nor meaninglessly ritualised and that they are regularly planned, implemented, discussed and taken-up within the policy cycles. It is essential to create the appropriate culture across the system as well as supporting structures and conditions to facilitate the reflection and utilisation of evaluation results.

An example for a national policy support structure is the Austrian Platform for Research and Technology Policy Evaluation (www.fteval.at), whose mission is to develop and maintain a culture of evaluation. The members of the platform include all relevant ministries and agencies dealing with R&I, several research organisations and professional providers of evaluations. As a policy-learning platform, it provides several services which contribute to more awareness about the need

[14] National Innovation Office (NIH, *Nemzeti Innovációs Hivatal*) was the predecessor of NRDIO, operating between 2010 and 2014.

[15] Innovation levy (*innovációs járulék*) is an obligatory quarterly payment, incurred by all medium-sized and large companies in Hungary and paid to the National Custom and Tax Administration, which subsequently transfers the amount to NRDIO as the basis for the National Research, Development and Innovation Fund, which is the main source of the state funding for R&I, supplementing the EU Structural Funds. The levy amounts to 0.3% of the tax base and provides a sustainable source of R&I financing, redistributed to business enterprises and scientific organisations. More info on the innovation levy is provided in section 5.5 of the report.

for and possibilities of evaluations, and which support to harmonise evaluation approaches across several ministries and agencies and a more reflected and comprehensive take-up of evaluation findings and recommendations.

The platform organises regular meetings and an evaluation journal for evaluation practitioners, academics and policy-makers in agencies and ministries. For many years now, the platform has been operating in a favourable framework: programme evaluations are required by soft laws; external evaluations are a common practice (often including foreign experts); in-house monitoring systems of the funding agencies can be used as input for external evaluations; common evaluation standards have been co-developed stipulating a 'code of conduct'; no 'lowest price' automatism but best value approach is in place; domestic R&I evaluation expertise has been nurtured; all evaluation reports are publicly available. This evaluation practice and environment is to a large degree a result of the establishment and activities of the platform itself.

Key messages for Hungary:

- As an important component of strategic R&I policy intelligence, evaluations must be respected and should be utilised by the highest level of policy-making and policy-delivery.
- Evaluations are to be based on sound evidence combined with a fair judgement of independent experts.
- Evaluations should not be ad-hoc (although sometimes necessary), but regularly planned and sufficiently budgeted.
- Evaluations should be based on commonly agreed procedural standards to guarantee a transparent use.
- A conducive evaluation culture and evaluation framework has to be developed, and an organised platform of practitioners, policy-makers and policy implementers is a very helpful tool to support learning, to build up a relevant community and link it to international communities, to build up peer pressure regarding good practice and thus to establish a favourable evaluation culture.

3.7. R&I instrument mix

The **instrument mix** planned in the R&I Strategy (Ministry for National Economy, 2013, p. 46-47) addresses – in principle – the range of different needs for the knowledge base and businesses, but as argued before, not all elements included in the Strategy have been implemented so far (see: section 3.3 of this report and footnote 7). **The R&I Strategy, developed by the Ministry for National Economy, does not seem to directly guide the current activities of NRDIO, which offered a different set of priorities and approaches in the Smart Specialisation Strategy**.

The country applies a **very broad mix of support measures**. The majority of instruments are direct interventions, targeting the generation of knowledge and innovation (supply-side measures), comprised of a mix of different grant schemes and financial instruments, including equity investments, loans and guarantees (for further comments on the implementation and evaluation of these measures, see sections 5.4 and 5.7 of the report). NRDIO administers currently both the grants for scientific research and the development of innovations by private sector actors, and a significant share of these schemes is financed from the EU Structural Funds. In addition, **business enterprises can benefit from indirect support measures**: tax incentives for R&D (see below), and the government distributes institutional funding to public research organisations, including the Hungarian Academy of Sciences and universities (without directly linking the overall amount of funding allocated to specific institutions to their scientific performance).

The most notable development, as in many other OECD countries, is the **increased willingness to develop and implement demand-side innovation policy measures**, such as public procurement of innovation (PPI) and pre-commercial procurement (PCP)[16]. If these measures were implemented as outlined in the R&I Strategy (Ministry for National Economy, 2013, p. 48), they could form an important second pillar of the R&I policy mix in Hungary. However, many of those schemes are only in their beginnings or are still to be designed. Empirical studies suggest that demand-side measures, which become increasingly important in many European countries, come with severe implementation challenges (Uyarra, 2013; Rigby, 2013). They demand highly transparent procedures alongside low levels of corruption (Edler, 2011)[17], in addition to the build-

[16] Public procurement of innovation (PPI) is the idea to use the spending of public bodies on products and services to induce innovation in the supplying industry and to create a market for the diffusion of innovations. Pre-commercial procurement programmes (PCP) are funding schemes to support firms developing solution to problems defined by government. However, PCP does not entail the actual purchase of the solutions.

[17] A study of 127,776 public procurement contracts in Hungary from 2009-2015 suggested that in the analysed period, competition and transparency were weakened, with an increased number of procurements carried out with only one proponent and no competition, rising price distortion and corruption risks (CRCB, 2016). These

up of skills of the public administration and the willingness to take risks and to learn in the public sector (Uyarra et al., 2014). The planned PCP measure is already delayed in Hungary compared with the implementation timescales declared in the R&I strategy[18].

Recommendation 8: *Further develop and implement pre-commercial public procurement and public procurement of innovation to stimulate and reward research, development and innovation. This evolution shall be accompanied by the necessary institutional changes.*

In terms of **indirect versus direct R&I funding**, Hungary follows the approach of many European countries and has declared its intention to further increase the share of indirect funding (Ministry for National Economy, 2013). Total public support for business R&D, composed of direct and indirect funding, has increased throughout the crisis period in most EU Member States[19]. In other countries, tax incentives also play an important role in supporting R&D, though the amounts disbursed through tax incentives are lower than direct government funding (EC, 2016b, pp. 34-35). In the literature, a number of advantages are associated with tax incentives, most of all the simplicity of implementation and uptake (Köhler, Rammer and Laredo, 2012). However, the implementation and use of tax incentives for research face a number of challenges.

In Hungary, the **tax incentives are only used by a small number of taxpayers** (Ministry for National Economy, 2013, p. 4). The definition of what constitutes an eligible research expense seems overly complex for many stakeholders, whereby the Hungarian Intellectual Property Office (HIPO, *Szelleni Tulajdon Nemzeti Hivatala*) has a support system in place to help firms comply with the scheme. Furthermore, the more a country shifts towards indirect funding, the less R&I funding can actually support the build-up of cooperation, interaction and thematic orientation, as the Hungarian tax incentives are not designed to selectively address specific areas or desired forms of cooperation[20]. Detailed discussions of the Hungarian R&D tax incentives will be offered in the section 5.5 of the report. As already highlighted in section 3.3, the R&I instrument mix is not adequately aligned with numerous horizontal priorities of the government, including among others health, energy, transport and environment, which are guided by separate strategies and support measures.

Recommendation 9: *The R&I instrument mix for policies and programmes across the government departments and agencies should be aligned with the overall R&I objectives. The following basic principles should be respected: policy coherence and synergy between the R&I actions of the various government departments to ensure efficiency in the policy delivery of the objectives; due coverage of cross-cutting issues key for the science base of the country such as the development of skilled human capital; balance across regions and between direct and indirect R&I support.*

3.8. European and international dimension of R&I policies

One further dimension of R&I governance is the **coordination between national priorities and the EU-level programmes**. The limited *thematic* funding programming in Hungary curtails the possibilities of synergies and coordination between national and European initiatives. FP7 and Horizon 2020 figures show that Hungarian researchers have a good level of participation in EU programmes, not only regarding the European Research Council, where the country has been the most successful of all countries in the Central and Eastern Europe[21], but also in some of the H2020 "Societal challenges".

negative tendencies could pose major challenges for the successful implementation of demand-side support for innovations in Hungary.

[18] The pilot introduction of pre-commercial procurement is planned for November 2016, with funding based GINOP 2.2.3 support measure.

[19] Particularly strong increases are noticeable in Slovenia, Belgium, Ireland, Estonia, Hungary, France, Portugal and Austria. In all these countries except Estonia, R&D fiscal incentives play a key role.

[20] Hungarian business enterprises benefit from tax allowances on the Corporate Taxation and Dividend Tax related to the costs of in-house R&D activities, as well as to the expenses of firms for contracted R&D that was carried out by universities or the Hungarian Academy of Sciences (Act LXXXI of 1996 on Corporate Taxation and Dividend Tax, para. 7.(1)t and 7(17)).

[21] Out of 56 ERC grantees for the eight Central and Eastern European countries that hosted ERC grantees (BU, CZ, EE, HU, PL, RO, SI, SL), 23 were hosted in Hungarian institutions, followed by 13 in Poland and 9 in the Czech Republic (https://erc.europa.eu/projects-and-results/statistics).

However, the **Hungarian applicant success rate in H2020 is still below the EU average**. The success rate is about 9.3% (EU-28 average: 12.5%), with a total EU financial contribution awarded to Hungary of €87.65m (based on e-CORDA database, as of 3 May 2016). The data show nevertheless positive tendencies and by looking at the ERC results as well as at the involvement of Hungarian organisations in coordination of H2020 projects, one can notice further potential that could be strengthened and supported with a strategic alignment and coordination between national and European programmes. With 63 Horizon 2020 projects coordinated by Hungarian organisations (including ERC grants), Hungary is a visible player at the EU level[22]. The country is particularly well represented in the "Societal challenges" pillar of H2020, with 23 project coordinations[23]. In some areas, however, even when considering the high competition in H2020, there is a noticeable difference concerning numbers of proposals above and below the threshold[24], indicating that a number of submitted proposals were of below-average quality[25]. Several instruments target H2020 applicants on the national level. Dedicated funding is made available by NRDIO for applicants of ERC grants and H2020 SME Instrument, who were positively evaluated but not awarded grants. Furthermore, beneficiaries of H2020 Teaming for Excellence calls receive co-funding in Hungary.

Hungary is in the process of **developing a national ERA Roadmap**, i.e. a strategy that defines how the country seeks to take advantage of the existing European Research Area initiatives and how the national programmes and priorities are aligned with the EU-level strategic directions. The country has a number of relevant international activities, such as bilateral agreements as well as participations or observer statuses in ERA-Nets, JPIs and JTIs. So far, the country does not have a systematic strategy to define the relationships between national and EU-level programmes, thus supporting prioritisation of international activities.

An internal analysis of the National Innovation Office (NIH, 2014), predecessor of NRDIO, found that **support for participation in EU programmes was essential**, and in high demand by stakeholders. It recommended a range of administrative improvements, such as accessibility and user-friendliness of the system, and opportunities to increase the synergies between Hungarian support measures and EU schemes, including the possibility of funding proposals that were highly rated at the EU level, but did not get EU funding.

As regards the international R&I collaboration of Hungary, the picture is mixed. Hungary is engaged in a number of international initiatives and organisations. The share of publications and patents with foreign co-authors belongs to the highest in OECD countries (OECD, 2015a, p. 130 and p. 138). Furthermore, the country has set up a network of attaches for science in seven of its embassies. The locations covered are: Belgium (for the EU level activities), Japan, Germany, United States, UK, Israel and Russia. The attaches are supposed to engage in "science for policy" initiatives, i.e. using scientific cooperation for diplomatic and political purposes, as well as in "policy for science" initiatives. However, as in many countries (Edler, 2007), there is no well-established link to take advantage of those attaches in a systematic way, e.g. in order to detect the co-operation potential, or to take advantage of foreign policy initiatives of the other country, and thus the potential of scientific attaches is not fully exploited. The networking skills of Hungarian R&I performers (including large companies and SMEs) do not yet allow them to influence the EU-level decision-making processes in various thematic programme committees and other international fora. In addition, there is no clear strategy to align with countries of the region in order to build a critical mass around shared concerns or competencies[26].

[22] Based on e-CORDA database, as of March 2016, Hungary coordinates 63 projects in Horizon 2020, Czech Republic has 31 coordinations and Poland: 78.

[23] In „Societal challenges" of H2020, Hungary coordinates 23 projects, Czech Republic: 6 projects and Poland: 18 projects (based on e-CORDA database, March 2016).

[24] For example in "Secure, clean and efficient energy", there were 294 proposals from Hungarian applicants, with only 44 evaluated above the threshold, and 19 main-listed for funding. In other areas, like "Health, demographic change and wellbeing" and „Europe in a changing world – inclusive, innovative and reflective societies", the gap between the proposals above and below the threshold is much smaller.

[25] Due to the fact that H2020 application processes require an investment of time and efforts, it is important that based on detailed analyses, tailor-made support services are available for the different target groups (coordinators, partners, universities, SMEs, etc.). Generating a detailed overview of the differences between proposals above and below the threshold, in particular for the applied coordinations, would support an efficient allocation of resources for support services and could be one of the priorities further elaborated within the national ERA Roadmap.

[26] The identified initiatives involving the Visegrad Group countries (Czech Republic, Poland and Slovakia) still have a relatively small scale and seem to be in their infancies.

Case study 4: International peer review in the Academy of Finland

The Academy of Finland (the Finnish research council) is the main Finnish public source of competitive funding for scientific research. Researchers and researcher groups can apply for funding to conduct scientifically ambitious projects and to support career in research. Applications are screened using a high-level international peer reviewing process to identify the best and most promising projects. In the case of applications for multi-year research grants, a written review report by an expert panel is asked for. The panel submits one review report per each applicant. The decision making process takes place in the Academy and the primary criterion for funding is the outcome of international peer review. The number of funding decisions and the amount of funding depends on the budgets available. More information is available at: http://www.aka.fi/en/review-and-funding-decisions/ Similar international peer reviews are used by many R&I funding agencies, e.g. Science Foundation Ireland uses only international peer reviewers for all of its competitive research grant programmes.

Key messages for Hungary:

- Directing competitive research funding to the best projects is facilitated by formal international peer review.
- International peer review of research grants and researcher career funding instrument applications increases the transparency and objectivity of the public research funding system.
- International peer review allows the quality of a country's R&I system to be benchmarked against international standards thereby maintaining and enhancing national practices, particularly in priority areas.
- International peer review is part of a broader internationalisation strategy.

Recommendation 10: *The panel considers that Hungary should boost the internationalisation of its R&I system. First, Hungary must expand its use of international expertise and best international practice in the design and implementation of its R&I programmes (including programme and project evaluation). Second, government departments and agencies should learn from leading international programmes and transpose best practice nationally when feasible and with the necessary tuning. Third, the potential of the Horizon 2020 National Contact Points network and the network of Hungarian scientific attachés abroad should be leveraged to increase Hungarian participation in European initiatives. Finally, Hungary should continue the good practice of supporting researchers and entrepreneurs that are awarded the "Seal of Excellence" by Horizon 2020 (proposals positively evaluated within the programme, but not funded due to lack of budget).*

3.9. Conclusions in relation to R&I governance, funding and policy-making

After a period of instability in the governance of the Hungarian R&I system, an opportunity emerges now to place R&I support in the political agenda, at the highest level. There is a **sense of a new beginning across the system**, and a number of new initiatives are underway, including the design and implementation of an elaborated policy mix for the knowledge base and for innovation. It is too early to tell how the new structures and initiatives will deliver a better and more stable governance and funding of R&I, but the signals are encouraging. The system would nevertheless benefit from further strengthening the prioritisation, transparency, procedural compliance as well as broad, structured involvement of stakeholders in defining and supervising R&I policies.

At the same time, the **funding for public science is very low by international comparison**, with low institutional funding and **too little competitive project funding**[27]. In addition, most of

[27] In accordance with OECD recommendations, public funding for R&D can be divided into institutional and project funding. **Institutional R&D funding** is provided by the government or its agencies to a given institution, which redistributes the available amounts of money among their researchers and preserves the freedom to decide for which specific purposes and internal R&D projects the funding should be allocated. **Project R&D funding** is offered by the public administration to specific individuals or teams, performing named and defined R&D projects, usually resulting from submitted and evaluated proposals. Project R&D funding can be considered **competitive** if the selection of proposals results from calls available to multiple R&I performers. Institutional funding is **competitive** or **performance-based** if the institutional R&D budgets are allocated by the government based on institutional assessments, peer reviews of historical performance of the institutions and their future R&D potential, or quantitative measures such as e.g. counts of publications, citations, patents, licensing agreements, spin-offs created etc. Institutional funding allocated merely on the basis of numbers of students or R&D employees is not considered competitive but referred to as **block funding**. For more information about the definitions and international diversity of R&D funding, see: van Steen (2012) and Jonkers and Zacharewicz (2016).

the institutional funding **is not performance-based**, even though there are numerous pockets of excellence, accompanied by a good participation of Hungarian researchers in the EU-level programmes.

Recommendation 11: *Hungary must increase the share of public research and innovation funding awarded by competitive, performance-based programmes at both the individual and institutional level. Funds, including overheads, must be used solely for research and innovation purposes.*

Case study 5: Competitive project and institutional funding in Poland and Research Evaluation Framework in the UK

The United Kingdom was the first country to introduce a Research Assessment Exercise, now called Research Evaluation Framework (REF). This approach assesses universities and units within them (faculties, schools) against a set of criteria. The assessment is based on submissions of organisations, outlining their research strategies, their research environment and their research output. All of this is assessed by peer groups and each organisation is scored. The result of the exercise determines the share of annually 2 billion GBP institutional research funding that organisations receive. The independence of the peers and the obligation to assess the quality of publications and not merely use the impact factor of the journals in which they appear has proved to be essential. In the last exercise from 2014, the impact of research has become a major dimension of the assessment, whereby each organisation had to submit a number of impact cases, following a given template and backed up by concrete, tangible evidence. The REF has become the main steering mechanism of research in the UK, determining organisational strategies. Criticism of the system includes strategic recruitment behaviour, publication strategies favouring a limited number of journals with high impact factor, artificially slicing of output into multiple articles and putting heterodox and multi-disciplinary research at a disadvantage because of disciplinary oriented peer review. However, the REF and its predecessors have led to an excellence-oriented and accountable research system in the UK.

Poland followed a similar principle and shifted its system towards distributing a substantial share of its R&I budget using competitive, performance-based mechanisms. The importance of performance-based funding was at the core of the reform of the Polish science and higher education system in 2010-2011. The legislation obliged the government to distribute at least 50% of the R&I budget as competitive project funding by 2020, linked institutional funding to research excellence and established an institutional assessment mechanism that directly involves the scientific community. Institutional funding is divided among scientific organisations based on the outcomes of regular, nation-wide institutional assessments. Thematic panels of experts of the Committee for Evaluation of Scientific Research Institutions (KEJN) compare university departments and research institutes from each discipline, using quantitative criteria, including counts of high-impact articles, patents, revenues from industry cooperation and external R&D funding, normalized by numbers of R&D employees of an organization. This institutional assessment is transparent and directly influences the future funding, acting as an important motivator for scientific organisations. In 2014, 65.14% of the national R&I budget was distributed through competitive calls for proposals by two government R&D agencies, focused respectively on fundamental and applied research, with both generic and thematic funding schemes.

Key messages for Hungary:

- Institutional funding complements competitive funding (distributed as research grants), and can be allocated competitively in ways promoting research excellence.
- Performance based funding systems do have merits in terms of accountability and establishing incentives for all academics to improve the quality of output.
- Performance based systems need a very careful design and implementation to avoid adverse effects on research variety and strategic gaming.
- Transition towards an R&I funding system linked to performance measures requires synchronised changes to both institutional and project funding.

The **public R&I funding has been lopsided in recent years towards supporting business R&D**. While innovative companies in Hungary show positive performance and good cooperation activities, also in international comparisons, the share of innovative companies in the national economy is still very limited. As of now, the funding of the business sector has not resulted in uplifting the breadth of the Hungarian economy in terms of innovation.

The **prioritisation in R&I should be made clear**, and the catalogues of thematic and horizontal priorities in different areas of R&I policy should be better coordinated. The government-wide coordination should be strengthened, with systematic consultation of relevant stakeholders, and R&I policy dialogue with the broader public. Hungary should develop a R&I strategy that would more explicitly target societal challenges. The country should pursue more thematic rather than generic R&I funding, and the national funding programmes should be better coordinated with programmes available at the EU level.

The recommended use of **evidence-based, participatory and interactive methods or processes** to improve the build-up of strategic programming and to evaluate programmes will stimulate the learning across the R&I system.

3.10. Summary table

R&I governance, funding and policy-making	
STRENGTHS	**WEAKNESSES**
+ increased importance of R&I policies for the government with the creation of NRDIO	– unstable R&I governance
+ multi-annual national R&I strategy adopted in 2013, followed by Smart Specialisation Strategy and Operational Programmes, including substantial financial allocations for R&I	– only moderate improvements of overall innovation indicators between 2007 and 2014
	– lack of systematic priority setting process
	– only limited dialogue with stakeholders when defining policies, strategies and priorities for R&I
	– industrial and R&I priorities defined in policy documents are not aligned
	– lack of direct relations between R&I policy and other, sectoral policies such as transport, health, energy or environment
	– Hungarian R&I strategy not targeting directly societal challenges
+ NRDIO having the potential to become a one-stop-shop for R&I funding	– limited importance of advisory bodies in R&I area – fragmentation of R&I governance despite the official leading role of NRDIO
	– lack of R&I evaluation culture and practices
	– only limited thematic funding, with most support measures offering generic funding – linearity of R&I processes, including chasm between fundamental and applied research
+ high share of public spending on business R&D	– low level of public R&D expenditure in comparison to other EU countries and their further decline in recent years
	– low funding for public science
	– low salaries of academics
+ high shares of innovative business enterprises cooperating with scientific organisations	– low share of innovative companies in the national economy
+ high shares of publications and patents with foreign co-authors	– institutional funding of universities is not linked to performance measures
+ higher numbers of ERC beneficiaries	– no visible coordination of R&I programmes

than other Central and Eastern European countries	between the national and the EU levels

RECOMMENDATIONS

- ✓ **Recommendation 1:** Hungary must progressively and steadily increase its support towards public R&D performers in order to reach by 2020 a public R&D intensity higher than 0.5% of GDP (from the current level of 0.38%). To raise the country's share of innovative companies and broaden the support for innovation across the economy, public funding for business R&D should support more indigenous companies and non-science based innovations, as well as stimulate knowledge transfer.

- ✓ **Recommendation 2:** Hungary must decide what it wants from its research and innovation system in the short, medium and long term. It should forge closer links between this resulting vision, the goals in existing and future R&I strategies, and the political priorities of the government.

- ✓ **Recommendation 3:** The Hungarian government must develop a compact and up-to-date set of R&I priorities to guide the national R&I funding programmes. These priorities should target economic and societal challenges and benefit from synergies with relevant sectoral policies in areas such as transport, health, energy or environment. They should be clearly and adequately reflected in Hungary's R&I programmes and percolate through programme implementation and funding streams. Their implementation shall be facilitated by appropriate Key Performance Indicators to measure the success of the strategy and its implementing programmes.

- ✓ **Recommendation 4:** In deciding priority goals and in designing new R&I programmes, in reviewing their progress and in refining or developing existing programmes, the Hungarian government should consult with a wide group of relevant stakeholders, including companies (large, small, national and international), universities, the Academy of Sciences, entrepreneurs, civil servants (e.g. in the health sector) and the public at large. Prioritisation should be informed by an appropriate foresight exercise and get conducted at regular intervals, e.g. every five years. Stakeholders should be involved in ensuring Hungarian research integrity and transparency in the allocation of public R&I funding and in project selection procedures.

- ✓ **Recommendation 5:** A formal platform for stakeholder involvement should be developed to establish a participatory process of nurturing synergies, dialogue and advice on R&I and to ensure stakeholder ownership and oversight of NRDIO activities. This platform can take the form of a supervisory board of NRDIO that includes broad representation of stakeholders of the Hungarian R&I system, including representatives of relevant governmental departments.

- ✓ **Recommendation 6:** The panel supports a move towards increased evidence-based policy-making, including through the use of foresight and through the systematic evaluation of R&I policies, programmes and support measures. It calls for evaluations of the outputs and outcomes of programmes and projects to be managed in a clear and transparent way and to be delivered in a timely and efficient fashion, giving due publicity to them and eliminating undue bureaucracy.

- ✓ **Recommendation 7:** All priority R&I programmes should be rigorously evaluated at appropriate times using international reviews and standards. The outputs of those programmes should be evaluated against their objectives and funding. The systematic and meaningful international evaluation of the whole set of national R&I programmes should lead to incremental improvements of a core set of programmes that should remain stable over time to assure system predictability.

- ✓ **Recommendation 8:** Further develop and implement pre-commercial public procurement and public procurement of innovation to stimulate and reward research, development and innovation. This evolution shall be accompanied by the necessary institutional changes.

- ✓ **Recommendation 9:** The R&I instrument mix for policies and programmes across the government departments and agencies should be aligned with the overall R&I

objectives. The following basic principles should be respected: policy coherence and synergy between the R&I actions of the various government departments to ensure efficiency in the policy delivery of the objectives; due coverage of cross-cutting issues key for the science base of the country such as the development of skilled human capital; balance across regions and between direct and indirect R&I support.

- ✓ **Recommendation 10**: The panel considers that Hungary should boost the internationalisation of its R&I system. First, Hungary must expand its use of international expertise and best international practice in the design and implementation of its R&I programmes (including programme and project evaluation). Second, government departments and agencies should learn from leading international programmes and transpose best practice nationally when feasible and with the necessary tuning. Third, the potential of the Horizon 2020 National Contact Points network and the network of Hungarian scientific attachés abroad should be leveraged to increase Hungarian participation in European initiatives. Finally, Hungary should continue the good practice of supporting researchers and entrepreneurs that are awarded the "Seal of Excellence" by Horizon 2020 (proposals positively evaluated within the programme, but not funded due to lack of budget).

- ✓ **Recommendation 11:** Hungary must increase the share of public research and innovation funding awarded by competitive, performance-based programmes at both the individual and institutional level. Funds, including overheads, must be used solely for research and innovation purposes.

4. AVAILABILITY OF HUMAN RESOURCES FOR R&I

4.1. Introduction

The present chapter focuses on the availability of human resources (HR) in the R&I system, including students, scientists, private sector researchers and engineers. **The quantity of such professionals, as well as the quality of knowledge and skills, has a significant impact on the innovation performance of Hungary and might bring about additional challenges in the future**.

This chapter discusses the **institutional diversity of R&I in Hungary and its HR implications**, as different types of organisations tend to attract disparate groups of R&D personnel. Subsequently, the quantity and quality of human resources in the Hungarian R&I system is analysed, including the role of education at various levels. Additional attention is paid to individuals pursuing research careers in the public science system and to doctoral studies.

Finally, the chapter looks into the **impacts of internationalisation on human capital, including the phenomenon of brain drain**, affecting the R&I system. The chapter offers an overview of existing, quantitative data, additionally supported by opinions of interviewees in the Peer Review project, which helped to identify bottlenecks in the area in question and comment on the relevance, effectiveness and efficiency of the measures currently adopted by the Hungarian government to meet the growing demands for R&D personnel and anticipate future developments.

4.2. Institutional diversity and HR implications

In the Hungarian research and innovation system, **several types of research institutions with differing research and personnel profiles** can be recognised:

- universities, whose research intensity varies between disciplines and institutions[28];
- the Hungarian Academy of Sciences (HAS, *Magyar Tudományos Akadémia*), with institutes covering diverse scientific disciplines and carrying out fundamental and applied research[29];
- other public research institutes operating under the supervision of selected ministries (e.g. the National Agricultural Research and Innovation Centre, *Nemzeti Agrárkutatási és Innovációs Központ*);
- large companies, employing research personnel with both master and PhD degrees;
- small and medium size enterprises that are not seen as prominent R&D players;
- innovative start-ups and spin-offs.

These six groups of research actors are differently positioned in terms of attractiveness as employers of R&D personnel. Figure 4 presents the shares of R&D expenditures incurred by these actors, and Figure 5 reveals the sectoral shares of R&D employees. This boils partly down to the compensation levels, but also to the opportunities to concentrate on research work, the appreciation received for doing research, ability to collaborate with other researchers and the availability of transparent career tracks.

The panel's interviews with various Hungarian stakeholders supported a **consistent interpretation that compensation levels in universities are not competitive in comparison to the other organisational types**. Remuneration of researchers employed by some institutes of

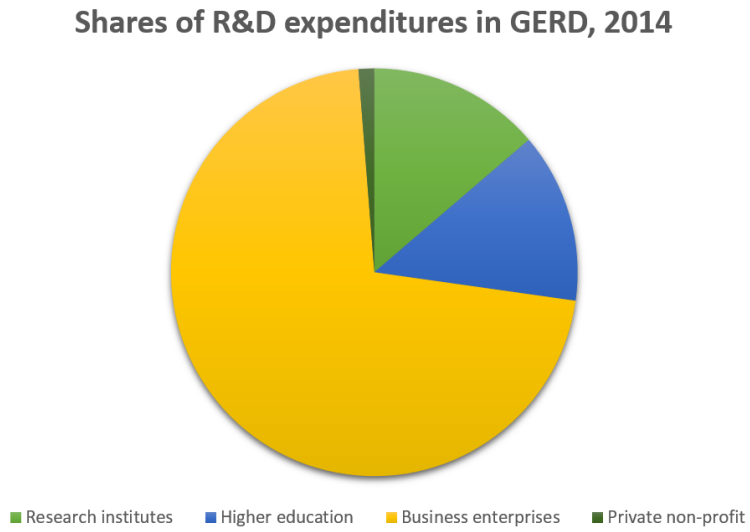
[28] There are 67 higher education institutions in Hungary, including 30 state colleges and universities and 37 private higher education institutes and religious colleges. Only about 15 universities actively carry out R&D activities, and a small number of universities account for the majority of the student population. **Hungarian universities receive public funding linked primarily to their teaching activities**, tend to have small research units interested primarily in basic research and **their budgets do not allow them to engage in long-term R&D initiatives**.

[29] Institutes of the Hungarian Academy of Sciences are heterogeneous, different in sizes, scientific impacts, access to funding and managerial approaches. Some of them were established through mergers or incorporation of research teams from institutes that were closed down. In the socialist times, HAS used to be a prestigious scientific institution focused on fundamental research, but nowadays some of its institutes are increasingly engaging in applied research as well. As Figure 1 in section 3.2 of the report reveals, **HAS benefits from substantial amounts of government financing, comparable with the R&D funding earmarked by the government for the entire university system in Hungary**.

the Hungarian Academy of Sciences seems to be higher than at universities, but still insufficient to compete against salary conditions offered to researchers in Western European countries. *However, the panel found it difficult to identify up-to-date, reliable and meaningful data on the salaries that could be presented to back-up these opinions.*

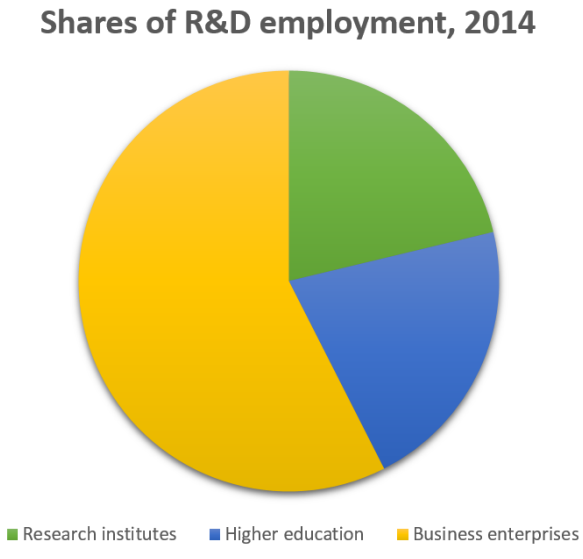
The **distribution of R&D expenditures among the main players** in the Hungarian R&I system is as follows: 13.49% in universities in 2014, 13.74% in government-owned research organisations (mainly in the institutes of the Hungarian Academy of Sciences), and 71.52% in the private sector (Eurostat, 2016). It must therefore be noted that 136 public research organisations (including institutes of the Hungarian Academy of Sciences) attract the amount of public R&D funding comparable to the entire university system in Hungary (which includes 1,288 research units: faculties and other R&D establishments) (KSH, 2015b). The counts of research units at both universities and public research organisations are substantial, contributing to the fragmentation of national research landscape, lack of critical mass in many fields of research and unfavourable distribution of intellectual and financial resources among these units, triggering competition rather than collaboration.

Figure 4. Shares of R&D expenditures in GERD (Gross Expenditure on Research and Development) incurred by different R&D performing sectors, 2014.



Source of data: Eurostat (2016).

Figure 5. Shares of R&D employment in different R&D performing sectors, 2014.



Source of data: Eurostat (2016).

Even though the **shares of R&D employment**, expressed in full-time equivalent and presented in Figure 5, are similar for universities and public research institutes, there are significant differences in levels of R&D expenditure per R&D personnel employed (headcount). In 2014, the registered R&D expenditure of Hungarian higher education institutes per one R&D employee amounted to approx. €8,593 (2,652,337 HUF), while the R&D expenditure of research institutes was more than twice as high at approx. €20,936 (6,462,096 HUF) (KSH, 2015b; KSH, 2015c), thus offering better financial conditions for carrying out R&D activities.

There are at least three factors restricting the attainment of Hungary's R&I objectives from an HR perspective, namely:

- the ***limited connection between higher education and research*** in a system where the emphasis of research activities in the public sector is placed on the Hungarian Academy of Sciences not universities, while important intellectual resources are shared between numerous institutions;

- the ***lack of a foresight, forecasting and planning*** of how many higher education degree holders representing specific research disciplines are needed by the labour market and what particular skill sets are needed by employers representing various industries;

- the ***low level of investment in higher education*** - Hungary is the 4th from the last OECD country in spending on higher education as a percentage of GDP (OECD, 2015a, p. 96).

The recent Hungarian **Higher Education Strategy** (Ministry for Human Capacities, 2014) outlined the missions of academic institutions as passing onto students the specialist knowledge that is relevant for the labour market, generating research results that are beneficial for the society and the national economy, and acting as regional catalysts. The strategy highlighted the **lack of cooperation between institutions defining the educational programmes**. It also pointed to insufficient competition between these educational programmes, which in turn would stimulate the increase in the quality of education and research. The strategy views cooperation and competition in this context as tools that could ensure better performance and success of the higher education sector. This interpretation of the impacts of higher education institutions remains in line with the understanding of these impacts in many other European countries.

The **Higher Education Strategy (2014) outlines clear directions for changing the funding model of universities** in order to transition from an input-based approach towards one more focused on outputs (performance-based system). Performance indicators and their desirable levels would be defined for the institutions by the government and by trying to meet the goals, institutions would enhance their operations both qualitatively and quantitatively e.g. by means of cooperation and incentivised competition. The strategy (2014) presented some of the possible indicators that would be taken into account, such as: the number of doctoral students, the number of degrees conferred in the three higher education cycles and the number of researchers awarded financial support.

However, as of 2016, the institutional funding is not yet performance-based and it is not clear when such a system will be implemented. The higher education institutions in Hungary enjoy administrative autonomy in various areas, including the recruitment of researchers, choice of scientific research topics and the development of study curricula (Deloitte, 2014, p. 14), but their autonomy is constrained by the limited availability of institutional funding. Substantial parts of the funding made available to public universities by the government are earmarked for education, and institutional R&D funding for the HEI sector is scarce, thus restricting the abilities to embark on ambitious research initiatives.

Case study 6: Increasing institutional financial and administrative autonomy – university reform in Finland

At the turn of the millennium, the European Higher Education Area (EHEA) was developed, governments agreed on the Bologna process and adopted the Lisbon strategy. The modernisation agendas of higher education institutions were drafted across Europe. In 2002, the university rectors in Finland approached the Finnish government with a request for a new financial autonomy toolbox to be able to participate in the development in Europe and in a more global context. in 2005, the university rectors renewed their plea arguing that in order to survive in the global competition, national university development plan is needed. This was to be done in collaboration between universities, the state of Finland and the industry and commerce.

The Finnish government communicated a resolution on the structural development of the public research system in April 2005 and in the governmental programme 2007-2010, universities were paid detailed attention. The Universities Act (558/2009) separated universities from the state

sector (now they are separate legal entities under the public law or foundations) and renewed the governance structures of universities e.g. by introducing external members in the boards of universities.

On average, two thirds of the budgets of universities are allocated from the budget of the State of Finland (ca. €2b a year). Universities are free to use this funding to conduct the tasks given to them in the Act (research, education based on research, societal outreach). According to the closing of the books, universities altogether spend roughly one fourth of this direct state funding on research.

The renewal is currently being evaluated (to be published in August 2016), but it is obvious that universities in general have more financial freedom (variety in the financial tools for different purposes including commercialisation of research), have more connections with the surrounding society, also outside of the borders of the country, and plan their operations in a more strategic manner than when they still belonged to the state budget economy.

Key messages for Hungary:

- Connecting higher education and research in universities' tasks supported by state funding is a building block for high quality higher education.
- A flexible lump sum of state funding and autonomy allows universities to decide on using the funding and facilitates the profiling of institutions.
- International collaboration is easier if an institution has a right to decide on its priorities.
- In an autonomous institution, decision making and being responsible for the outcomes takes place in the same organisation.

Recommendation 12: *Increase the responsibility and accountability of public research and innovation performers (universities and the Hungarian Academy of Sciences) to support their commitment towards the national R&I policy goals. This move should be accompanied by the better availability of public funding for R&D for researchers at both universities and the Hungarian Academy of Sciences, who should face equal opportunities to carry out ambitious R&I projects and get rewarded for their scientific excellence and research performance. However, this increased responsibility and accountability should come hand in hand with significantly increased performance-based funding for these institutions. The monitoring, evaluation and publication by the government of the performance of individual institutions against Key Performance Indicators should become a reality. Successful institutions should be allowed to expand or merge and unsuccessful institutions should be allowed to close or be absorbed by other organisations.*

Research efforts by universities and HAS are not sufficiently well coordinated, creating a **disconnected R&D landscape with scattered, small-scale research initiatives**. The fragmentation of resources weakens the ability to develop an internationally competitive science base and decreases the attractiveness of the public R&I system for external collaboration. Limited funding for universities and HAS makes the public research system even less attractive as partners for the industry. Public expenditures on R&D available for universities and HAS have been decreasing since 2009, putting at risk the sustainability of the public research systems. HEIs that do not maintain cooperation with business partners are adversely affected by financial hurdles. Against this structure, no critical mass can be achieved in key R&I areas, and the fragmentation also limits the potential for specialisation, making it harder to identify the specific expertise, which the industrial partners might require.

Elements of multidisciplinary and multi-sectoral approaches and collaborative efforts are emerging in the Hungarian R&I system, as observed during interviews with various participants of the system, carried out for the Peer Review project. However, the **research efforts tend to be carried out separately from technology development and innovation activities**. Groups of actors in the R&I system assume their traditional roles, with universities and the Hungarian Academy of Sciences predominantly involved in the scientific research, while companies pursue new product developments, with only limited research content.

In June 2016, the Ministry for Human Capacities and the Hungarian Academy of Sciences signed an agreement to **deepen the cooperation between HAS and universities**, including through the establishment of joint research groups and shared access to research infrastructures. The need to bring these two types of research institutions closer to one another is thus recognised by the government, but the tangible results of these efforts are not yet clearly identifiable.

Recommendation 13: *Cooperation between universities, and between universities and institutes of the Hungarian Academy of Sciences, should be actively encouraged using grant programmes, joint appointments of researchers and professors, shared administration and "accommodation" of projects and activities as well as distributed campuses.*

4.3. Quantity and quality of research personnel for the Hungarian R&I system

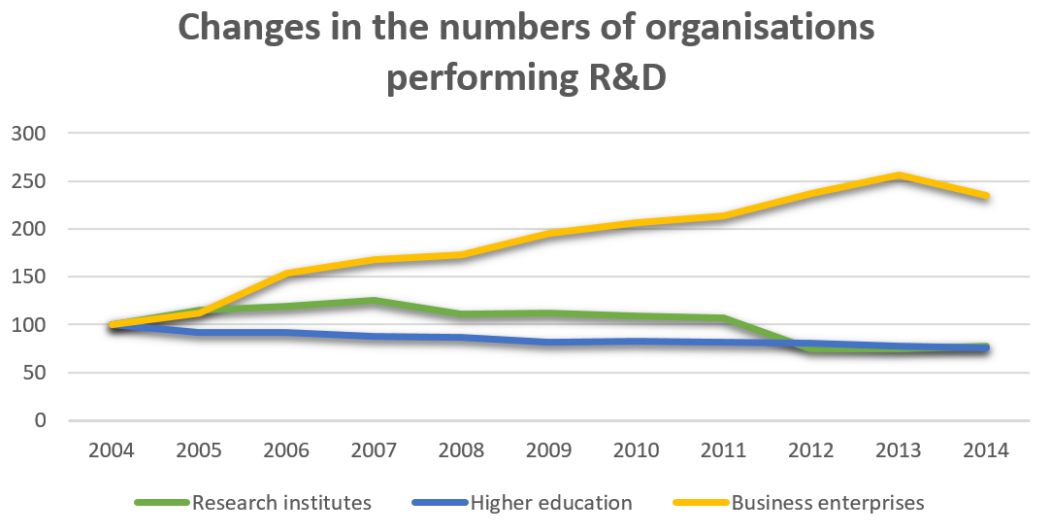
The **share of the Hungarian population aged 30-34 having completed tertiary education** was 34.19% in 2014, compared with the EU-28 average of 37.9%, and only 9 EU Member States had lower shares (Eurostat, 2016). The **number of doctoral degrees** conferred in 2012 was 1,242, and only 25% of these were in STEM (Science, Technology, Engineering and Mathematics) disciplines that in general represent the core of private sector R&D.

In the Hungarian R&I system, **the majority of research personnel do not have doctoral degrees**, and the share of all graduates of tertiary type A or advanced research programme in STEM was only 6% in 2012 (OECD, 2016a). One third of researchers in the R&D personnel worked in the fields of humanities and social sciences in 2012 and only 30.9% of all researchers (headcount) were women, compared with 33% in the entire EU-28 (Eurostat, 2016). The share of doctoral-level graduates in engineering, manufacturing and construction is one of the lowest among OECD countries (OECD, 2016a). The counts of researchers per one thousand employees (5.9 in 2014, for all educational backgrounds) and the numbers of researchers with PhDs (total headcount 13,868 in 2012) are low in comparison to other EU countries (OECD, 2016a), even though the Hungarian population of researchers has increased within a decade by a factor of 1.6 (from 3.59 per 1,000 employees in 2004 to 5.9 in 2014).

The growth has been the fastest in the **private sector where R&D personnel** (expressed as full-time equivalent, FTE) **has tripled in ten years** (from 6,704 in 2004 to 22,244 in 2014) and accounts for 58.3% of the total R&D personnel population (38,163 FTE in 2013) (OECD, 2016a). In the private sector, these increases concern both researchers (with a higher education degree) and technicians. **For the higher education sector and public research institutions, the stocks of R&D personnel have remained at the levels as of 2004.**

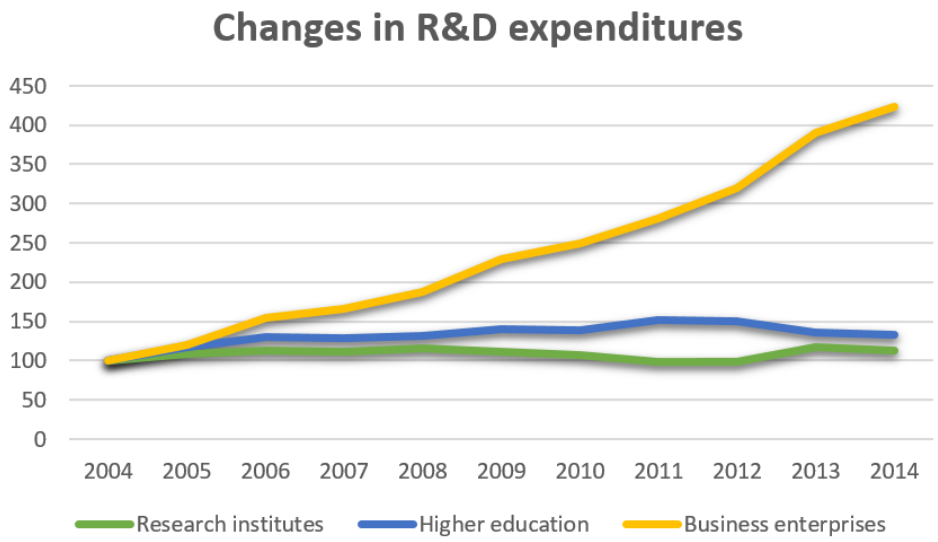
Since 2004, **Hungary has experienced constant increases in the R&D activities performed by business enterprises**, expressed in terms of the count of R&D performing organisations (Figure 6), the incurred R&D expenditures (Figure 4) and particularly in terms of employment of researchers (Figure 7). This positive tendency is not matched by higher education and research institutes, which have suffered from slow growth in R&D spending and decreases in R&D employment. Some of these decreases could however be linked to the downsizing or closing down of poorly performing organisations, and thus increasing the scientific productivity of the public science sector.

Figure 6. Changes in the numbers of organisations performing R&D in Hungary, 2004-2014 (data normalized with 100 as value from 2004).



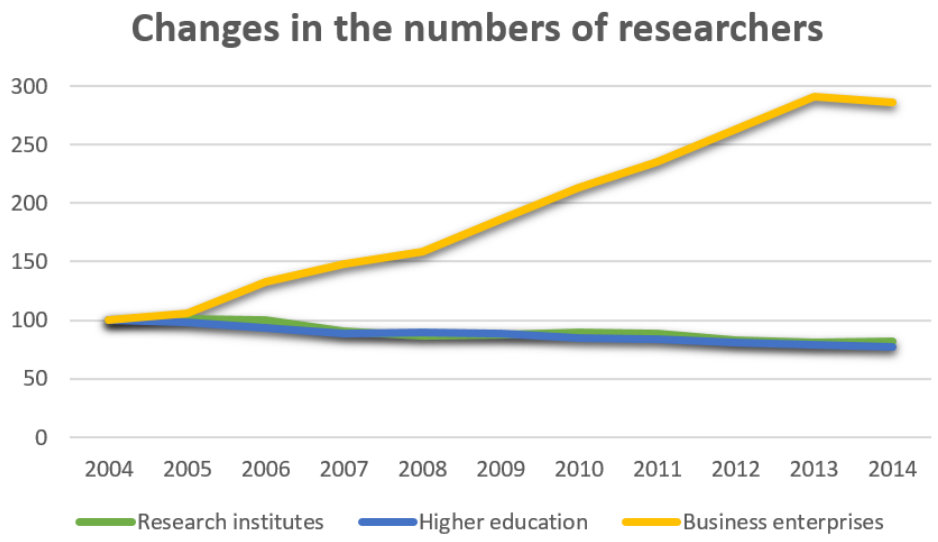
Source of data: KSH (2015a).

Figure 7. Changes in the R&D expenditures of organisations representing different R&D performing sectors in Hungary, 2004-2014 (data normalized with 100 as value from 2004).



Source of data: KSH (2015a).

Figure 8 Changes in the numbers of researchers employed by R&D performing organisations from different sectors in Hungary, 2004-2014 (data normalized with 100 as value from 2004).



Source of data: KSH (2015a).

The **growth of R&D personnel (FTE) in the private sector has not been supported by dedicated grants, but there are tax incentive schemes in place which foster private R&D employment**, including the reduction of the compulsory social security contributions for highly skilled R&D employees (holding PhDs or doctoral candidates), introduced by the Act CLVI of 2011. These indirect measures contribute towards enhancing the private sector R&D employment, but given the observed dynamics, it is unlikely that these measures alone could explain the growth from recent years, as the increases started before 2011 (see: Figure 8) and the measure subsidised only 1,437 R&D employees as of May 2015 (see also: footnote 28 below).

According to interviews with scientists, conducted for the Peer Review project, if a researcher leaves the academic sector to start a company, and subsequently fails in business, the person would not be able to find her or his way back to academia due to the **limited number of academic positions, lack of arrangements supporting the inter-sectoral mobility and the**

stigma of failure[30]. The **mobility of experienced researchers between the private and the public** sector is also complicated due to the **disparities in salary levels**.

There are **few policy measures in Hungary that would recognise and promote the role of researchers with PhDs within the society**, particularly outside of the academic sector. The government offers a dedicated tax allowance for highly-skilled R&D employees of business enterprises, with an opportunity of reducing the payroll costs by deducting social security contributions for R&D employees holding PhD degrees of doctoral students, but the number of beneficiaries is relatively small and there is little role for researchers with doctoral degrees in the SME sector[31].

While it is on the agenda of the Ministry for Human Capacities in 2016 to reshuffle the structure and lengths of doctoral programmes and improve their quality by strengthening the research base for PhD education and enhancing the supervision of thesis work, **these changes are mainly planned for academic purposes and for internationalising the Hungarian research system**. Apart from direct research work related to applied R&D or innovation activities, which are carried out only by some doctoral candidates, in the national higher education strategy (Ministry for Human Capacities, 2014), a PhD degree is not seen as contributing towards the competitiveness of the country in general.

Case study 7: Short-term exchange of experienced research professionals in Finland

Both the Academy of Finland (the Finnish research council) and Tekes (the national innovation funding agency) have funded a programme, where top researchers in science and technology from all over the world have been exposed to the Finnish research and innovation system in a part-time manner. In the arrangement, the Finnish researcher community has been fertilized with new ideas and collaborative structures. The programme, called FiDiPro (the Finland Distinguished Professor Programme, www.fidipro.fi), has provided competitive grants to projects recruiting highly experienced scientists, who are able to commit to long-term cooperation with a Finnish university or a research institute. In addition to professors, also younger fellows have been appointed. While experiences have mainly been positive, it has proved to be challenging to maintain the influence of the collaboration after the part-time contract ends.

Key messages for Hungary:

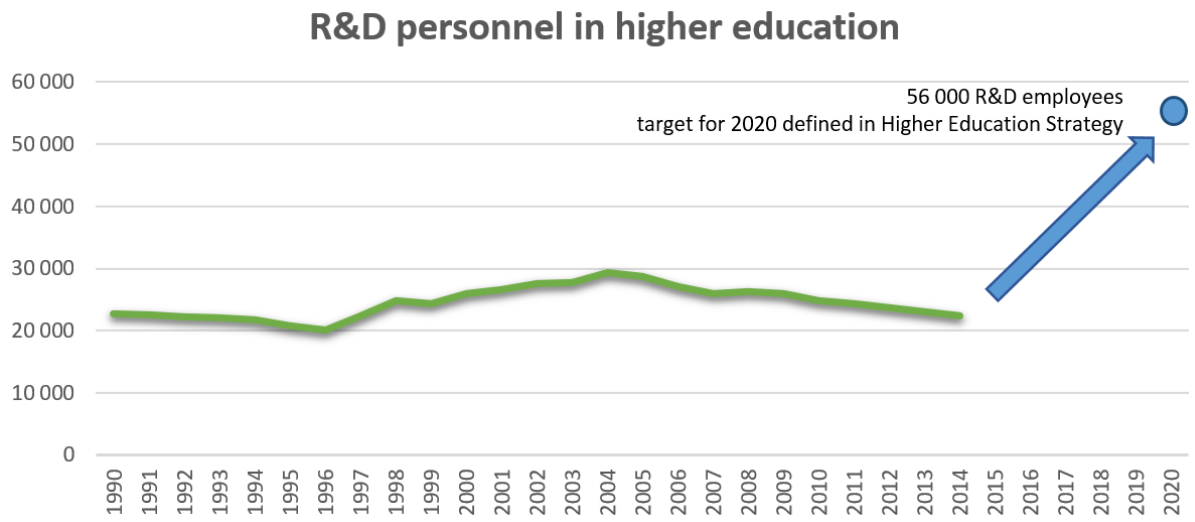
- Internationalisation of the research community is enhanced with short-term and temporary solutions.
- Tools and procedures used are beneficial both for researchers and organisations.
- Ensuring long-term effects of short-term solutions is part of the planning.
- Some fields have special features to be taken into account, e.g. medical doctors and the maintenance of clinical skills.

In the Higher Education Strategy (2014), the **government has set a goal of increasing the counts of R&D personnel employed by HEIs** to 56,000 in 2020 (FTE) from the level of 23,647 in 2012 (KSH, 2015b). In addition, there is a target of having 12 R&D employees per one thousand employees by 2020 from the level of 8 registered in 2011 (Ministry for Human Capacities, 2014, p. 35). Regrettably, the actual development so far has been in the other direction, as the indicator's value in 2014 was only 5.9 R&D personnel per 1,000 employees. Comparatively, the average figure for EU-28 was 12.1 R&D personnel per 1,000 employees in 2011 and 12.7 in 2014 (Eurostat, 2016). The target defined by the government for 2020 is difficult to meet, as evidenced by Figure 9. The private sector employs PhD degree holders, but the academic sector (both universities and the Hungarian Academy of Sciences) has not increased its research employment (OECD, 2016a). The continued outflow of highly skilled professionals to higher-income countries, which has intensified in recent years, leads to a further erosion of the public research base.

[30] See also: section 5.6 of the report.

[31] The data on the beneficiaries of tax allowance for highly-skilled R&D employees, provided by the Hungarian government, the allowance was used in May 2015 by: 100 micro-firms (with 1-9 employees) and affected 147 highly-skilled employees; 102 firms with 10-49 employees (271 PhDs or doctoral students), 31 companies with 50-249 employees (160 R&D personnel) and 15 large companies (859 highly-skilled R&D employees).

Figure 9. R&D personnel in higher education – comparison between historical data (1990-2014) and the target defined in the Higher Education Strategy for 2020.



Sources of data: KSH (2015b), Ministry for Human Capacities (2014).

Recommendation 14: *Further nurture Hungary's higher education system in order to generate in the long-run an adequate number of graduates with adequate skills for conducting R&I. Science, Technology, Engineering and Mathematics (STEM) studies play a particularly relevant role for the development of Hungary's science and innovation system. Systematic outreach events and education campaigns to encourage Hungarian new generations to study STEM subjects at school and university will pay off. It is also crucial to increase the attractiveness of science and innovation careers by putting in place appropriate incentives that reward researchers' mobility between the business and the public sector and address the wide salary disparities between both sectors.*

Meeting the quantitative targets defined by the Higher Education Strategy (Ministry for Human Capacities, 2014) would require **recognising the importance of research not only in PhD education, but also in the other education levels**, and incentivising the R&D performing organisations to join forces. There are no targets related to increasing the share of PhD degree holders among R&D personnel nor incentives for organisations – be they public or private – to hire, share and compensate the best educated workforce. An OECD analysis points also to the mismatch between fields popular among university students and demanded by the industry (OECD, 2016b, p. 46), and low responsiveness of educational institutions to the labour market signals (OECD, 2016b, p. 97), which in the long term can be expected to also restrict the availability of researchers.

Another problem, affecting the business enterprises, results from **limited investments in skills development and capacity building of employees**, and these investments are needed to absorb new technologies and generate innovations. In 2010, only 49% of Hungarian companies were training their employees, compared with the average of 66% for EU-28 (EC, 2015b, p. 12).

Developing the educational system in a holistic manner is a timely topic in many European countries. Thus, not surprisingly, a recurring theme in the panel's interviews with the Hungarian stakeholders was the need to look at the education, higher education and research systems as a whole, so that the improvement and modernisation of education and training in schools becomes a prerequisite for a better performing higher education sector.

*The imperative to **improve the status of school teachers in the Hungarian society** was also mentioned by stakeholders representing different interest groups. However, it was not within the remit of the present Peer Review to address these issues in detail.*

Recommendation 15: *Hungary should harness the potential of its highly educated R&I human resource base. It must ensure that its universities offer adequate and up-to-date training in entrepreneurship and transferable skills so that Hungarian students get equipped with competences that are fit-for-the-future. Mentoring and exchange programmes between academia and industry, such as "business PhDs" can be most valuable in this respect.*

4.4. Careers in research and changes to the PhD curricula

Graduate education and careers in research do not seem to be attractive for the young researchers in Hungary. *The Peer Review panel had difficulties in finding meaningful quantitative data on the current levels of salaries of R&D personnel in the public and private sectors, including starting salaries and remuneration of experienced researchers.* Nevertheless, the interviewed stakeholders representing different sectors and types of organisations were consistent in maintaining that the salaries of academics in Hungary are low in comparison to other sectors, temporary contracts are typical for younger researchers and opportunities for more predictable career tracks are better in the private sector.

Legal regulations define the minimum levels of base salaries that universities could pay to scientists, e.g. an assistant lecturer could receive €564 gross monthly, and a professor: €1,411. Remuneration at some of the institutes of the Hungarian Academy of Sciences is better than at the universities, but still not competitive in comparison to Western European countries. The **societal appreciation of researchers working for public R&D organisations is unsatisfactory**, and the awareness of these problems discourages the most talented young people from pursuing scientific careers, as is already visible in their choices of disciplines studied (higher popularity of economics, law and management than STEM).

Recommendation 16: *Ensure that the salary levels of researchers are competitive and comparable across the system. Introduce performance-based salary incentives for researchers working in the public sector (universities and the Hungarian Academy of Sciences).*

Careers in research are different for employees having a master degree and those with a PhD: the R&D personnel structures of large companies centre on the master level personnel, while in the universities and the Academy, the shares of PhD holders are bigger.

Even though the Hungarian doctoral education formally involves three-year long programmes, the **average age of a newly graduated PhD is 39 years**, according to a survey administered by the Hungarian Central Statistical Office in 2010 (KSH, 2011, p. 1). Drop-out rates for doctoral students are high – in 2013, only 22% of a cohort that started doctoral studies, were able to complete them (Ministry for Human Capacities, 2014, p. 35). Moreover, the time needed to complete a doctoral degree is too long, and it takes on average 7.5 years to finish a PhD (KSH, 2011, p. 1).

The **Higher Education Strategy from 2014 did not consider the competences needed by PhD holders** in their professional careers nor the competences that could directly boost the competitiveness of the country, particularly knowledge and practical skills that could be used outside the academia or the largest R&D-performing companies.

In the Strategy, the government recognised the **need to restructure the Hungarian doctoral education system and increase the attractiveness and quality** of these studies. According to the Ministry for Human Capacities, starting from the autumn of 2016, Hungarian universities will provide redesigned doctoral programmes, lasting 4 years (i.e. one additional year compared with the existing programmes), but shortening the compulsory course work and offering more time for research. When implemented, this change is likely to shorten the relatively long time-to-degree and speed up the PhDs entry into the working life as independent researchers, but its impacts will only be noticeable in the long run. Due to the reshuffling of the structures of doctoral programmes, universities are also expected to redesign the curricula contents in order to meet the needs of the society.

The reform of doctoral education is expected to have implications for the time-to-degree and study funding. Important issues are: how the tuition fees and other costs incurred by universities are covered and whether doctoral students are financially supported. Currently, the Hungarian government makes annual decisions about the fields with fully-funded study places for all higher education degree cycles, and individual HEIs decide about tuition fees based on the

existing regulations. Tuition fees are moderate in international comparison. The numerous interviews carried out for the Peer Review project did not offer clarity as to whether the contents and forms of doctoral education are harmonised between different institutions conferring PhD degrees in the same discipline, and the mechanisms for providing public or private funding to universities organising doctoral programmes were not within the scope of the PSF panel work. Nevertheless, when designing the new four-year doctoral programmes, the universities should take into account the need to ensure transparency in student admissions and award of scholarships, and to adequately structure programmes in order to satisfy the intended learning outcomes, which would not only guarantee advanced knowledge of the research field, but also make the education "future-proof" by equipping the doctoral candidates with transversal skills desirable in the R&I system. The use of independent, external accreditation mechanisms could also ensure the highest standards of doctoral education.

Recruitment procedures in Hungarian higher education institutions and HAS do not meet all of the internationally recognised standards for open and merit-based recruitment. All job vacancies in the public science sector are published online accompanied by the selection criteria, and feedback is given to applicants alongside the right to appeal the selection decision. Nevertheless, there are no uniform policies regarding the use of selection panels and their composition, and the employers are not obliged to prove that the recruitment procedures were open and transparent (Deloitte, 2014, p. 8-9).

Recommendation 17: *Increase the attractiveness of research careers in Hungarian academia. Universities and institutes of the Hungarian Academy of Sciences should ensure open, transparent and merit-based recruitment as well as performance-based promotion practices. Doctoral students should benefit from improved career conditions and from innovative doctoral training that equips them with transferable skills. Scholarships should be allocated competitively. Doctoral students should be granted sufficient time for research and for interaction with their academic supervisors.*

The government decree No. 395/2015[32], which lists **criteria for assessing the performance of individual researchers in their scientific careers**, does not offer incentives to engage in industry collaboration or technology transfer. Based on the decree, employees of higher education institutions undergo regular performance reviews using the following criteria: educational and research performance; other activities linked to educational activity, such as thesis supervision; publishing and patenting of research results; public activities; science promotion and participation in conferences; involvement in fund raising and grant implementation; active contribution to talent development and doctoral courses; results of student evaluations of the teaching activities.

The researchers at HEIs are **not evaluated for their community outreach, commercialisation of research results, or entrepreneurial activities**. Researchers working at the institutes of the Hungarian Academy of Sciences are in turn evaluated based on procedures and criteria defined by internal regulations, and could not benefit from uniform standards applicable also to university employees.

Recommendation 18: *When measuring the scientific performance of researchers, notably in view of appointments and career development, universities and the Hungarian Academy of Sciences should not just give credit to criteria focussed on scientific publications. Exposure to science-business cooperation in the broadest sense should also be addressed, e.g. relevant expertise in the commercialisation of research results and patenting, membership of industry advisory boards, or exposure to cooperation with business or entrepreneurial activities. In addition, scientists should be given due recognition for their work including via prizes, media campaigns and dissemination events, as well as financial and non-financial rewards for outstanding performers.*

[32] Decree on the implementation of the Act XXXIII of 1992 on the employment status of public sector workers in the higher education and on certain issues of employment in higher education institutions.

4.5. The impact of internationalisation on the human capital

The **internationalisation of the Hungarian R&I system**, which influences for example the way that higher education operates or the degree of collaboration and the embeddedness of the national science system in international networks of peers, is a most relevant element to foster scientific excellence and the innovativeness of R&D-performing organisations.

17.54% of the gross expenditures on R&D are covered from international sources, with higher education institutions having 12.23% of their budgets funded from abroad, governmental research institutes – 15.84% and business enterprises – 19.17% (Eurostat, 2016).

The extent of **involvement of foreign Human Resources in Science and Technology in Hungary is low** (Eurostat, 2009, p. 91). The Higher Education Strategy (Ministry for Human Capacities, 2014) highlighted the need to strengthen institutional relations as a way of increasing the international position of the Hungarian R&I system, as well as to contribute to the mobility of students, lecturers and researchers. The strategy outlined plans to introduce dedicated funding instruments to address these challenges.

However, it did not discuss **how the young talented researchers in Hungary would be supported to carry out an internationally-oriented career in Hungary or what other measures would be used to encourage them to return** to Hungary after their post-doctoral research abroad. A dedicated support measure (GINOP 2.3.1) is intended to deepen international R&I relations, by providing co-funding for projects, initiatives, research infrastructures and preparation of proposals, including for Horizon 2020, Joint Technology Initiatives and ERC grants.

According to the Erasmus higher education statistics, **there were more incoming than outgoing students benefiting from the Erasmus programmes in Hungary** (4,764 incoming versus 4,025 outgoing students in 2014) (EC, 2015a). The numbers of incoming students have increased over time, whereas the outgoing student counts have fluctuated over the years. In the student exchange, four of the five most active Hungarian organisations maintain a balance between the numbers of sending and receiving exchange students, and three countries collaborating with Hungary top the rankings for both sending and receiving students (Germany, France and Spain) (EC, 2015a). **As for the staff mobility, in the academic year of 2013-2014, there were more outgoing (1,816) than incoming persons (1,672)** (EC, 2015a).

This problem of ***brain drain*** was brought up in many of the interviews carried out by the Peer Review panel. On the one hand, it was presented as a concern that the most talented young students and researchers are primarily seeking options to leave the country. The general perception was that the number of such young talents emigrating from Hungary is on the rise, and that a scientific career in other countries was a tempting option for promising researchers. *It is too early to evaluate the actual extent and broad impacts of the scientific brain drain and no reliable quantitative data are available.* On the other hand, some interviewees pointed also to examples of acknowledged Hungarian scholars who had returned to Hungary for various career-related or private reasons. The panel was exposed to an array of views on the outbound and inbound mobility of researchers. **This is a complex issue and since the panel was unable to analyse the phenomenon using solid, quantitative data, it is suggested that the situation should be further analysed by the Hungarian government in order to pro-actively shape the future of the R&I system.** Meanwhile, the Hungarian government could also promote positive brain circulation, including longer visits of foreign-based researchers (regardless of their nationality).

Recommendation 19: *Talented Hungarian researchers, and notably the young generation, should be supported in carrying out internationally-oriented careers in Hungary as well as in returning to the national R&I system from the diaspora. Programmes should also cater for the attraction of foreign talent. Best international practice in promoting healthy brain circulation should be explored.*

The Hungarian Academy of Sciences established the **Momentum (*Lendület*) programme** for **talented young researchers** by offering them grants that support their R&D projects and the establishment of a research team. The programme has initially been designed to support the brain gain by **bringing top researchers working abroad back to Hungary**. The grant provides funding to the principal investigator, which is used to cover his or her salary, personnel costs and operational expenditures over a fixed period of time. Meanwhile, more than 100 research groups have received funding from the programme.

The Momentum programme has succeeded in strengthening the options for top-level researchers interested in returning to Hungary, but its scope remains limited, salaries of principal investigators

covered by project budgets are still lower than in many foreign countries and the future of a newly-created research team supported by a Momentum grant is uncertain once the project is finished. Moreover, there are tensions between the Momentum's beneficiaries and other talented researchers who could not benefit from that funding, as reported by interviewees in the Peer Review project.

Recommendation 20: *Maintain and expand the current Momentum programme. Introduce a new programme to allow existing Momentum awardees, towards the end of their current awards, to compete openly for new funding in BOTH universities and the Hungarian Academy of Sciences – so as to allow productive researchers to build on their successes by joining the national R&I system.*

Case study 8: Supporting ERC applicants in Slovenia, Austria and Ireland

Slovenian Research Agency co-finances the so-called Complementary Scheme for applicants from Slovenian research organizations who were positively assessed by ERC, but not approved for funding. The Agency would co-finance projects, which will be carried out mainly in Slovenia, taking into account budgetary resources. The so-called adjusted projects are limited in scope and duration, but on the other hand, they enhance the opportunities for those researchers otherwise not approved for co-financing. The Agency provides between 25% and 50% of the budget requested in the original ERC application, depending on the type of ERC programme (ERC Starting Grant, Consolidator Grand or Advanced Grant) and results of the ERC evaluation. Altogether 34 projects were funded so far, with 10 projects supported in the year of 2015 and one additional project beginning this year.

From the beginning of the ERC operations, the Austrian Science Fund (FWF) implemented measures aiming at optimal synergy between its long-standing excellence programme "START Prize", which addresses researchers in an early or middle stage of their career, and the ERC. Applicants to the START Prize that are formally eligible to apply for an ERC Starting Grant are obliged to apply to the ERC Starting Grant in parallel. If both proposals are funded, a precedence is given to the ERC Starting Grant. Around 25% of START Prize awardees have also received an ERC Grant.

Science Foundation Ireland has two specific schemes to support applicants to the European Research Council. The SFI ERC Development Programme (http://www.sfi.ie/funding/funding-calls/open-calls/sfi-erc-development-programme.html) automatically funds applicants to the ERC, whose application has been judged fundable by the ERC, but who were not funded due to lack of ERC budget. SFI requires no further peer review. The applicant simply has to indicate an appropriate budget and actions (typically addressing reviewers' comments) for up to two years of funding. Applicants must also reapply to the ERC. This programme is open to applicants in Ireland who have applied for their ERC award to be held in an Irish institution. It is also applicable to applicants who originally applied for their award to be held at a different European institution but who are willing to relocate to Ireland and to resubmit their award to be held at an Irish institution. The ERC Support Programme (http://www.sfi.ie/funding/funding-calls/open-calls/sfi-erc-support-programme.html) is a grant made by Science Foundation Ireland to successful ERC award holders. This grant is made automatically as an overhead payment and allows the individual and institution to provide appropriate support for the ERC holder, e.g. modifications to physical accommodation, additional equipment, administrative support, etc. Typically, a portion of the award is used by the institution to further encourage applications to the European Research Council.

Key messages for Hungary:

- Schemes targeting ERC applicants encourage more successful applications to ERC.
- They encourage researchers to perform their research in the home country and participate both in the ERC and national funding schemes.
- The support for excellent ERC applicants is administratively simple and encourages scientific institutions to offer further support for ERC applicants and awardees.

Recommendation 21: *Continue the national scheme funding applicants from Hungarian universities and the Hungarian Academy of Sciences that have been judged fundable by the European Research Council (ERC) but who were not funded by the ERC due to insufficient budget.*

There are no indications that the government actively contemplates actions to structure the diasporas **of Hungarian researchers residing outside of the country** with a view to, for example, their support for the internationalisation of the Hungarian research community. These issues are also not covered by the Higher Education Strategy (Ministry for Human Capacities, 2014). Hungary could benefit from the return of the skilled emigrants, but a survey from 2014 indicated that only **about 10% of them would consider coming back to the home country**, given framework conditions for science, and the government subsidies covering resettlement costs and small parts of salaries are not financially attractive to young and skilled professionals (OECD, 2016b, p. 108).

Recommendation 22: *Systematic reforms should address the attractiveness of the Hungarian R&I system for researchers operating abroad, including in terms of careers, remuneration and science-business mobility. The Hungarian diaspora should be engaged by building appropriate networks for dialogue and cooperation. This can include awareness raising events with the participation of the diaspora and the local R&I community. Use the expertise of the diaspora researchers for mentoring, placement and collaboration activities with local researchers. Provide incentives for diaspora researchers to act as "ambassadors" of Hungary's R&I potential.*

4.6. Summary table

Availability of human resources for R&I	
STRENGTHS	**WEAKNESSES**
+ Higher Education Strategy correctly identifying some of the challenges related to Human Resources for R&I	– ambitious quantitative targets, set by the government, related to increasing the counts of researchers by 2020 are not realistic
	– lack of foresight, forecasting and planning of HR for R&I
	– low level of investment in higher education
+ plans to transition towards a performance-based system at universities	– current lack of incentives to improve performance of public sector researchers
	– public research separated from innovation activities, with only limited attempts at multidisciplinary or multi-sectoral approaches
	– focus of research activities placed on the Hungarian Academy of Sciences, and not enough on universities
+ planned improvements of the doctoral study system	– lack of policy measures promoting the broader roles of researchers within the society, outside of the academic sector
+ balance between incoming and outgoing students in Erasmus programmes in Hungary	– outflow of talented researchers to foreign countries
+ Momentum programme increasing the attractiveness of research careers for young people	– careers in public research do not seem attractive for most young people in Hungary
+ strong growth in numbers of researchers in the private sector	– insufficient numbers of students, graduates and PhDs in STEM disciplines
	– low counts of researchers per one thousand employees, with stagnation in employment of researchers in public sector
+ tax incentive supporting employment of PhDs by industry	– low starting salaries in universities in comparison to other employers

RECOMMENDATIONS

- ✓ **Recommendation 12:** Increase the responsibility and accountability of public research and innovation performers (universities and the Hungarian Academy of Sciences) to support their commitment towards the national R&I policy goals. This move should be accompanied by the better availability of public funding for R&D for researchers at both universities and the Hungarian Academy of Sciences, who should face equal opportunities to carry out ambitious R&I projects and get rewarded for their scientific excellence and research performance. However, this increased responsibility and accountability should come hand in hand with significantly increased performance-based funding for these institutions. The monitoring, evaluation and publication by the government of the performance of individual institutions against Key Performance Indicators should become a reality. Successful institutions should be allowed to expand or merge and unsuccessful institutions should be allowed to close or be absorbed by other organisations.

- ✓ **Recommendation 13:** Cooperation between universities, and between universities and institutes of the Hungarian Academy of Sciences, should be actively encouraged using grant programmes, joint appointments of researchers and professors, shared administration and "accommodation" of projects and activities, as well as distributed campuses.

- ✓ **Recommendation 14:** Further nurture Hungary's higher education system in order to generate in the long-run an adequate number of graduates with adequate skills for conducting R&I. Science, Technology, Engineering and Mathematics (STEM) studies play a particularly relevant role for the development of Hungary's science and innovation system. Systematic outreach events and education campaigns to encourage Hungarian new generations to study STEM subjects at school and university will pay off. It is also crucial to increase the attractiveness of science and innovation careers by putting in place appropriate incentives that reward researchers' mobility between the business and the public sector and address the wide salary disparities between both sectors.

- ✓ **Recommendation 15:** Hungary should harness the potential of its highly educated R&I human resource base. It must ensure that its universities offer adequate and up-to-date training in entrepreneurship and transferable skills so that Hungarian students get equipped with competences that are fit-for-the-future. Mentoring and exchange programmes between academia and industry, such as "business PhDs" can be most valuable in this respect.

- ✓ **Recommendation 16:** Ensure that the salary levels of researchers are competitive and comparable across the system. Introduce performance-based salary incentives for researchers working in the public sector (universities and the Hungarian Academy of Sciences).

- ✓ **Recommendation 17:** Increase the attractiveness of research careers in Hungarian academia. Universities and institutes of the Hungarian Academy of Sciences should ensure open, transparent and merit-based recruitment as well as performance-based promotion practices. Doctoral students should benefit from improved career conditions and from innovative doctoral training that equips them with transferable skills. Scholarships should be allocated competitively. Doctoral students should be granted sufficient time for research and for interaction with their academic supervisors.

- ✓ **Recommendation 18:** When measuring the scientific performance of researchers, notably in view of appointments and career development, universities and the Hungarian Academy of Sciences should not just give credit to criteria focussed on scientific publications. Exposure to science-business cooperation in the broadest sense should also be addressed, e.g. relevant expertise in the commercialisation of research results and patenting, membership of industry advisory boards, or exposure to cooperation with business or entrepreneurial activities. In addition, scientists should be given due recognition for their work including via prizes, media campaigns and dissemination events, as well as financial and non-financial rewards for outstanding performers.

- ✓ **Recommendation 19:** Talented Hungarian researchers, and notably the young generation, should be supported in carrying out internationally-oriented careers in Hungary as well as in returning to the national R&I system from the diaspora. Programmes should also cater for the attraction of foreign talent. Best international practice in promoting healthy brain circulation should be explored.

- ✓ **Recommendation 20:** Maintain and expand the current Momentum programme. Introduce a new programme to allow existing Momentum awardees, towards the end of their current awards, to compete openly for new funding in BOTH universities and the Hungarian Academy of Sciences – so as to allow productive researchers to build on their successes by joining the national R&I system.

- ✓ **Recommendation 21:** Continue the national scheme funding applicants from Hungarian universities and the Hungarian Academy of Sciences that have been judged fundable by the European Research Council (ERC) but who were not funded by the ERC due to insufficient budget.

- ✓ **Recommendation 22:** Systematic reforms should address the attractiveness of the Hungarian R&I system for researchers operating abroad, including in terms of careers, remuneration and science-business mobility. The Hungarian diaspora should be engaged by building appropriate networks for dialogue and cooperation. This can include awareness raising events with the participation of the diaspora and the local R&I community. Use the expertise of the diaspora researchers for mentoring, placement and collaboration activities with local researchers. Provide incentives for diaspora researchers to act as "ambassadors" of Hungary's R&I potential.

5. FRAMEWORK CONDITIONS FOR INNOVATION IN THE BUSINESS SECTOR

5.1. Introduction

The innovativeness of companies is linked to the **underlying framework conditions for business R&D and innovation**, including supportive legal and institutional environment, governmental policies, incentives offered to the R&D performers, as well as direct and indirect financial support, and access to finance.

This chapter analyses the **key factors shaping these framework conditions**, which are deemed particularly important for the Hungarian R&I system, and were identified by the Peer Review panel through document analysis and interviews.

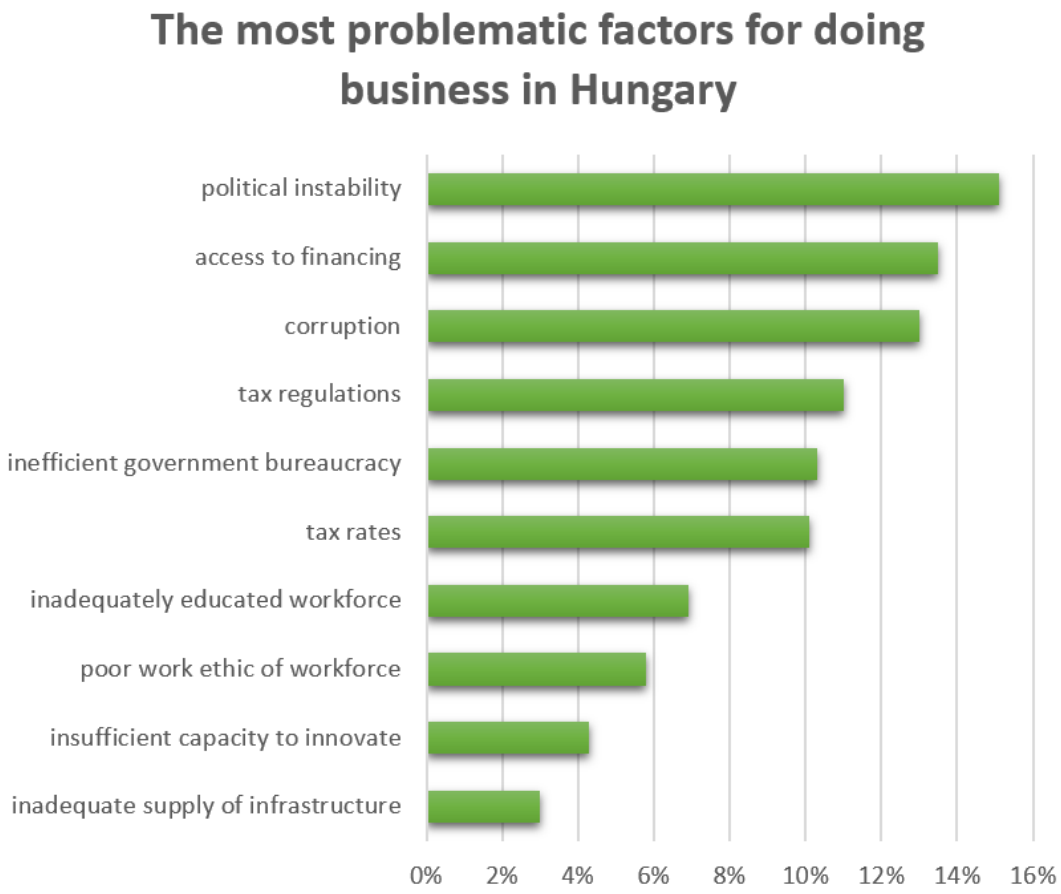
5.2. Institutional environment

The innovativeness of the private sector relies on **the attractiveness, stability and predictability of the legal and institutional environment**. The need to strengthen these framework conditions was identified in the governmental R&I strategy "Investment in the future. National Research and Development and Innovation Strategy (2013-2020)" (Ministry for National Economy, 2013) (see also: section 3.3 of this report), which outlined among others the following **key framework conditions**: a supportive macro-economic environment, institutional stability, co-ordination between related policies, predictability of the legal environment, stability of public funding for R&D, support for competitive internal market (Ministry for National Economy, 2013, p. 17).

In the **World Economic Forum's Global Competitiveness Report** (2014-2015), Hungary is ranked on the 60th place out of 144 countries, with a particularly low rank related to institutions. The identified weaknesses include: **political instability (understood as the lack of stability of institutions and legislations), tax regulations and tax rates, inefficient government bureaucracy, corruption[33] and access to financing** (WEF, 2015, p. 208). Detailed results of the survey administered by the World Economic Forum among business executives operating in Hungary are presented in Figure 10.

Even though the same political party has been in power since 2010, stakeholders interviewed by the Peer-Review panel highlighted the instability of R&I governance and limited predictability of the regulatory environment (for more information about the R&I governance, see also: section 3.2 of the report). The macroeconomic conditions of the recent years contributed to the introduction of new regulations, disapproved by the affected private sector actors, sectoral taxes, as well as temporary suspension or discontinuation of specific R&I support programmes. Representatives of business enterprises operating in Hungary identified shortcomings restricting the market competition and distribution of public services in a recent Eurobarometer survey (Eurobarometer, 2015).

Figure 10. The most problematic factors for doing business in Hungary, according to the survey administered by the World Economic Forum among business executives operating in Hungary, 2014.



Source of data: WEF (2015, p. 208).

The governmental programme "Cutting Red Tape" 2011-2014 resulted in the elimination of multiple regulations, perceived as excessive or unnecessary by private sector organisations, but it did not directly address regulations related to R&I activities. Nevertheless, there were significant improvements and relaxation of regulations between 2007 and 2013, and Hungary's situation seems more favourable for businesses than the EU average, based on the product market regulation data collected by OECD (EC, 2016b, p. 91). At the same time, time-consuming administrative procedures directly affect operations of business enterprises, for example it takes on average 277 hours per year to file the obligatory tax documents in Hungary, compared with only 189.16 hours as the average value for EU-28 (EC, 2015b, p. 8).

An area that suffers from excessive administrative burden is the implementation of R&I support measures, as identified by interviewees representing various stakeholder groups. The problem of excessive administrative burden in the R&I system was neither identified nor addressed by the government R&I strategy (Ministry for National Economy, 2013). Applications for R&I grants and management of the publicly co-funded projects are considered complicated by the beneficiaries, involving various unnecessary activities, excessively detailed contents of project applications (including data not needed by evaluators) and time-consuming reporting duties.

The perceived complexity increased with the new funding calls based on the EU Structural Funds, 2014-2020 (GINOP Operational Programme, *Gazdaságfejlesztési és Innovációs Operatív Program*, designed for regions outside of Central Hungary, and VEKOP Operational Programme, *Versenyképes Közép-Magyarország Operatív Program*, dedicated for Central Hungary with the city of Budapest), as companies could apply for a preliminary, non-binding opinion of the National Research, Development and Innovation Office regarding the eligibility of their projects, but could not benefit from simple rules that would support the preliminary identification of relevant support measures and self-assessment of the appropriateness of project contents for a given support measure. The R&D performing organisations interviewed for the Peer Review project complained also about slow application evaluation procedures and long lead times between the submission of project proposals and co-funding decisions, suggesting that public administration organisations (including NRDIO) should be bound by pre-defined deadlines for announcing the results of a call. The panel was however unable to identify relevant quantitative data or uncover systematic tendencies that would suggest a large scale of these problems.

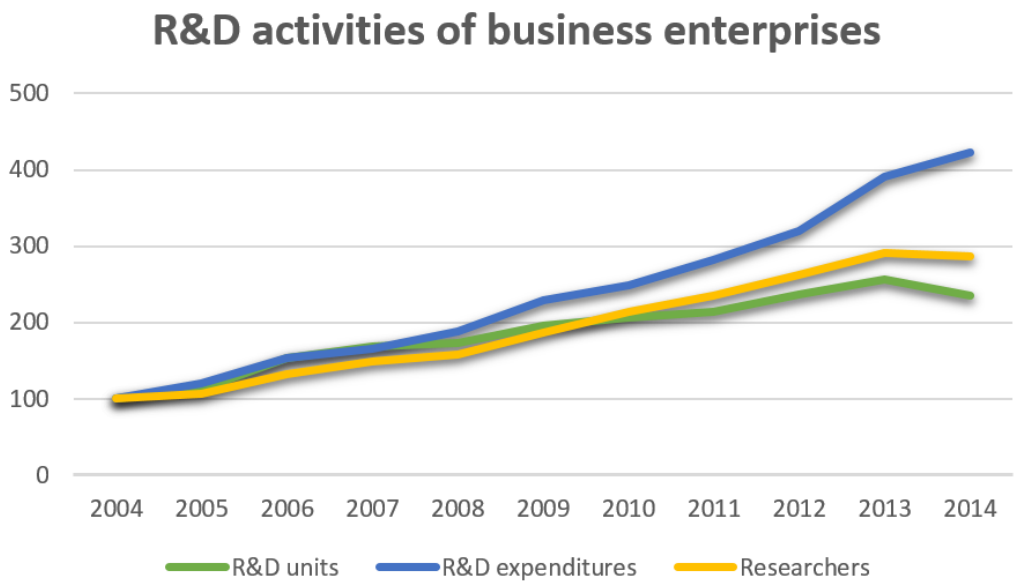
In a similar manner, the interviewed companies-beneficiaries of R&D tax incentives consider the present regulations difficult to implement, lacking the necessary clarity and requiring interpretations regarding individual R&D projects (see also: section 5.5 of the report). The high uncertainty surrounding the eligibility of certain expenditures as R&D costs encourages companies to commission the paid R&D qualification services from the Hungarian Intellectual Property Office in order to reduce their financial risks, as the **relevant legal regulations do not seem to offer sufficient clarity**.

There are indications that **the introduction of new administrative burdens**, which further complicate the R&I support framework, was in part a bureaucratic reaction to the occurrence of non-compliant behaviours or abuses of the support system, but such a reaction leads to unnecessary formalisation and an increase in detailed regulations. For example, the interest of business enterprises in the first funding calls based on GINOP exceeded the initial expectations of the R&I funding agency. Many of the submitted applications were not related to R&D but involved other types of investments, and thus were not eligible for funding, while the costs of their evaluation needed to be incurred by the government agency. Consequently, it induced a reaction of the public administration, tightening the rules to eliminate similar shortcomings in the future, thus launching a vicious circle of bureaucracy.

5.3. R&D activities of business enterprises

The Hungarian private sector has registered notable increases in R&D activities since the country's accession to the EU. The number of business enterprises performing R&D went up from 669 in 2004 to 1,570 units in 2014, and the count of R&D employees in the private sector increased from 8,870 in 2004 to 25,359 in 2014 (KSH, 2015b). **Private sector R&D performers outnumber the public R&D units in terms of absolute counts, employment and R&D expenditures financed from own funds**. Moreover, corporate R&D spending has gradually increased since 2004 (see: Figure 11).

Figure 11. Changes in the numbers of R&D units, size of R&D expenditures and counts of researchers employed by business enterprises in Hungary, 2004-2014 (data normalized with 100 as value from 2004).



Sources of data: Eurostat (2016), KSH (2015b).

The above-described developments would be expected to spur parallel increases in the competitiveness and the innovativeness of the Hungarian private sector, but they remain disjointed from changes in patenting activities or innovative outputs of the private sector. It must be noted that **R&D activities are highly concentrated in a limited number of large companies** (including multinational corporations). Shares of corporate turnover generated by sales of innovative products and services (turnover from innovation) were decreasing in recent years, dropping from 16.4% in 2008 to 13.7% in 2010 and only 9.7% in 2012, and thus gradually approaching the starting level of 7.0%, registered in 2004 (Eurostat, 2016). The Community Innovation Survey revealed that in 2012, only 16.4% of companies in Hungary, representing industries with core innovative activities (identified in accordance with the Commission Implementing Regulation No. 995/2012) introduced product or process innovations (EU-28: 36.0%), while for SMEs with 10 to 249 employees, the ratio was even lower at 14.8% (EU-28: 34.9%) (Eurostat, 2016).

In 2014, out of 619 patent applications filed in Hungary, only 185 originated from institutional applicants (including companies, universities and public research organisations), while 361 applications were submitted by individuals (HIPO, 2015, p. 85). **The small number of innovative Hungarian companies that generate patents mostly do it based on their in-house research, not through collaborations with universities or HAS**. There are indications that at least parts of the observed statistical developments could be attributed to the increased interest in reducing the fiscal burdens by means of R&D tax allowances. This interpretation is further supported by the documented frequency of misclassifications of R&D expenditures by companies in Hungary.

In 2014, as many as 59% of enquiries of the national tax administration to the Hungarian Intellectual Property Office, regarding the qualification of R&D expenditures, yielded negative results, i.e. 539 companies out of 914 verified entities inadequately reported their projects as involving R&D activities to claim R&D tax benefits but the auditing bodies found otherwise (HIPO, 2015, p. 40). The wide occurrence of such irregularities casts a shadow over the accuracy of the previously cited statistics on corporate R&D efforts. The actual Business Expenditures on Research and Development (BERD) are likely to be lower than officially reported due to the incorrect classification of other corporate investments as R&D by the reporting companies. Furthermore, the decomposition of BERD into diverse types of technologies revealed that the compound annual growth in R&D spending of the high-tech manufacturing sector between 2007 and 2012 was very low, far below the EU average (EC, 2016b, p. 102), despite the notable overall increase in this type of spending of business enterprises, so the **R&D efforts are unlikely to be linked to the most advanced technologies**.

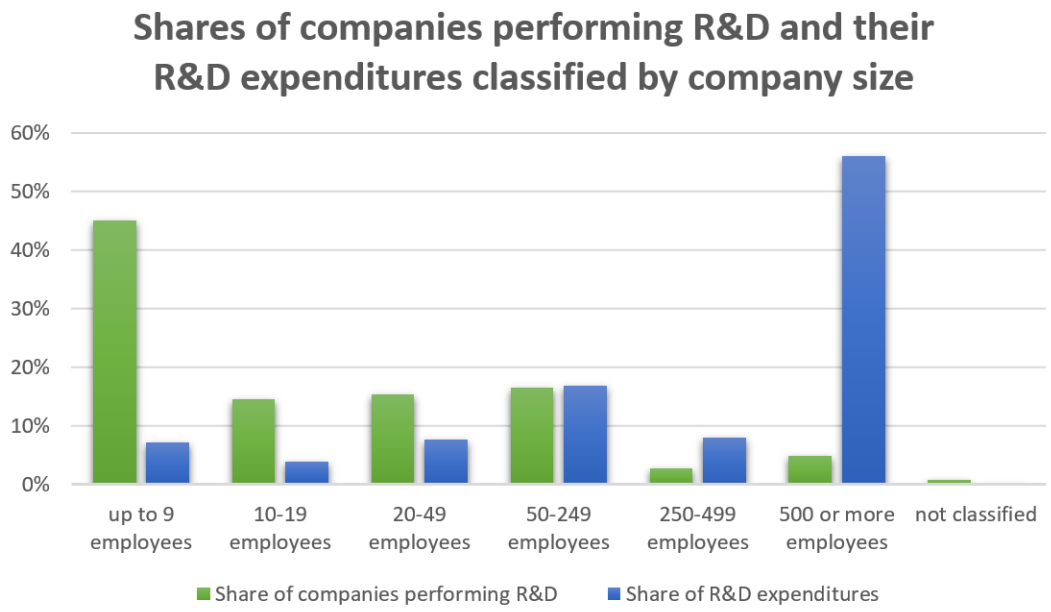
In general, Hungarian innovative companies display healthy and strong collaborative and innovative behaviours, but such activity patterns concern only a small percentage of companies, engaged in R&D and innovations. The overall share of innovative companies in the national economy is very low, and thus the positive results related to R&I are generated by a rather small group of companies. This is also reflected in the use of R&I support measures, as both direct and indirect measures attract the attention of only a small part of the population of Hungarian business enterprises. Representatives of the Hungarian business sector share positive outlooks for the future, and according to an executive survey administered by the consulting company Deloitte, 59.3% of corporate respondents in Hungary declared that their R&D investments in the following 3-5 years will be higher than in 2014, and the further 24.1% planned to maintain the level of R&D investments similar to the year of 2014 (Deloitte, 2015, p. 33).

R&D activities of business enterprises in Hungary are highly concentrated in territories and sectors. **Central Hungary (with Budapest) accounts for the majority of corporate R&D**, R&D-performing companies and patents. **Pharmaceutical, ICT, machinery and automotive companies have the highest contribution to the BERD**, with leading role for the pharmaceutical industry and the largest domestic pharmaceutical firm, Richter Gedeon, that maintains a substantial share in BERD[34]. However, R&D efforts in electrical equipment and manufacturing of transport vehicles are stronger in peripheral regions (Csőke et al., 2013, p. 13-15). Moreover, as in most other countries, the majority of R&D activities and expenditures concern large enterprises, with only a **limited role for the small and medium enterprises**.

Large companies (with 250 or more employees, i.e. 7.58% of the entire population of R&D performing companies in Hungary) accounted for 55.26% of BERD in 2014, and 49.76% of BERD is generated by companies with at least 500 employees (4.84% of all R&D performers in private sector) (KSH, 2015a, p. 67 and p. 70). **SMEs are heavily dependent on external sources of R&D funding, including government and the EU Structural Funds** (46.02% of the R&D expenditures by SMEs were funded from external sources, while the same ratio for companies with less than 50 employees is as high as 53.91%) (KSH, 2015a, p. 67 and p. 70). Detailed comparisons between the different groups of companies are presented in Figure 12, outlining the key role played by a relatively small number of companies with 250 or more employees, which dominate the private sector R&D efforts in Hungary.

[34] Hungarian BERD amounted in 2014 to €1,021.993m (Eurostat, 2016), while the EU Industrial R&D Scoreboard indicates that Richter Gedeon invested the same year in R&D €138.8m (IPTS, 2015), i.e. 13.58% of the country's BERD. Interestingly, national statistics list only 253.9m HUF (€0.823m, exchange rate: 1 € = 308.6585 HUF) in R&D expenditures of the entire pharmaceutical industry in Hungary (KSH, 2015, p. 66), corresponding to only 8.05% of BERD. The discrepancies of data reveal problems with classification of R&D expenditures, but confirm the significant contributions of the key pharmaceutical players to the Hungary R&I system.

Figure 12. Shares of companies performing R&D and their R&D expenditures classified by company size.



Source of data: KSH (2015a).

Another important element of the framework conditions is the **regional diversity of R&I activities**. Central Hungary (notably the city of Budapest and the Pest county) dominates the R&I landscape of Hungary. In 2011, this region accounted for 65.8% of all Hungarian researchers (FTE) and 60.5% of corporate researchers, 62.9% of R&D expenditures, 62.5% of current R&D expenditures and 66.1% of R&D capital expenditures incurred by manufacturing enterprises, as well as 96.6% of international patent applications (NIH, 2013b, pp. 8, 13). **High-tech industries** including pharmaceuticals, electronics, optical products and ICT maintain the majority of their R&D activities, employment and expenditures in Budapest (NIH, 2013b, pp. 13-15), while regions other than Central Hungary focus rather on medium-to-high-tech industries, including the **manufacture of transport vehicles and electronic equipment** (NIH, 2013b, pp. 14-15). Central Hungary was also the leading region in attracting national and international grants and subsidies for R&I in years 2004-2011 (NIH, 2013b, pp. 39-42).

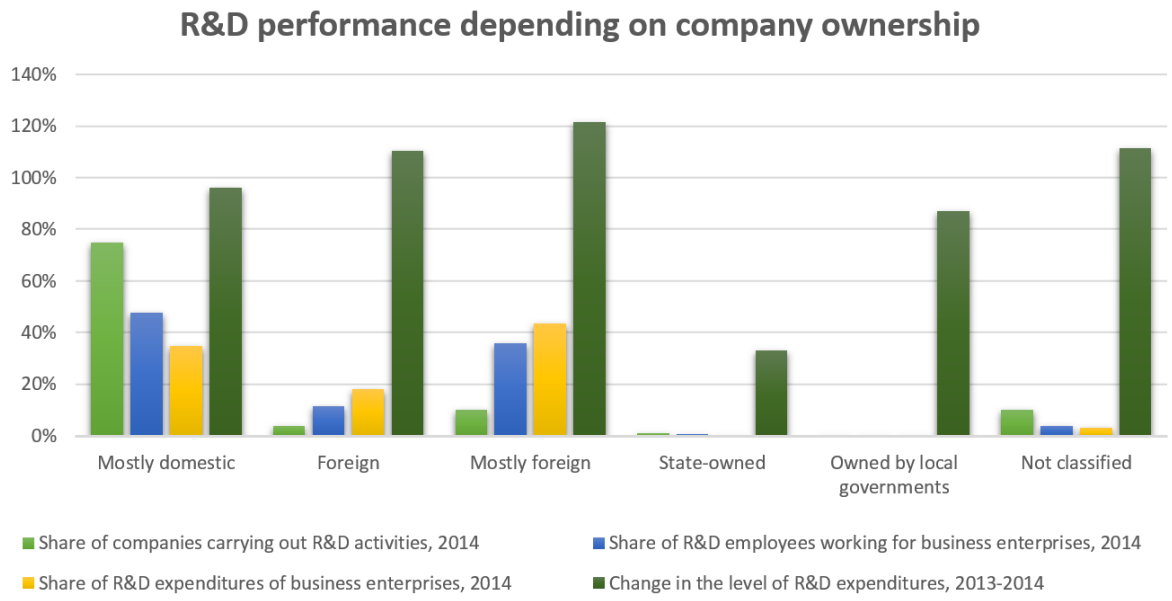
In the period of 2014-2020, disproportionally high public R&I funding is available through the operational programme GINOP to companies located in regions other than Central Hungary, in an attempt to significantly improve the regional innovation performance. R&I performers in Central Hungary are not eligible for support in GINOP, but have their own operational programme VEKOP (albeit with a much smaller budget and more limited list of support measures). They can also apply to NRDIO in calls that mirror the instruments available in GINOP, but are funded from the state budget and the innovation levy. While the measures included in GINOP and VEKOP are planned until 2020, **less certainty surrounds the nationally-funded measures**. This differentiated availability of finance is unlikely to contribute to a substantial increase in R&D activities in these regions in the short term. At the same time, it might stimulate relocations of corporate R&D units or encourage other opportunistic behaviours, negatively affecting the innovation performance of Central Hungary. **Even though the central region stands out in terms of innovativeness, it still suffers from the structural challenges described in this report, including a low share of innovative companies among all business enterprises, and needs to be targeted by R&I policy mix.**

Recommendation 23: *The limited funding available from the EU Structural Funds for Central Hungary is likely to negatively affect the R&I strengths of the region, which accounts for a disproportionate share of high-tech industry and skilled human capital in Hungary. The innovation levy and the state budget can be used to preserve the R&I potential of the region.*

The role of foreign-owned companies appears critical for the present economic development of Hungary. The R&D expenditures incurred by companies that were owned exclusively or controlled by foreign investors, corresponded in 2014 to as much as 61.7% of BERD (KSH, 2015a, p. 74). This group of 216 foreign-controlled entities (13.76% of all corporate R&D units identified in 2014) employed altogether 12.032 R&D employees (47.45% of all R&D

employees working for private sector organisations in Hungary) (KSH, 2015a, p. 71). In 2014, these entities increased their R&D expenditures compared to the previous year (2013), while domestically owned companies and government-controlled enterprises registered a drop in R&D spending for the same period (KSH, 2015a, p. 73). Detailed data are presented in Figure 13.

Figure 13. R&D performance of companies in Hungary, depending on their ownership.



Source of data: KSH (2015a).

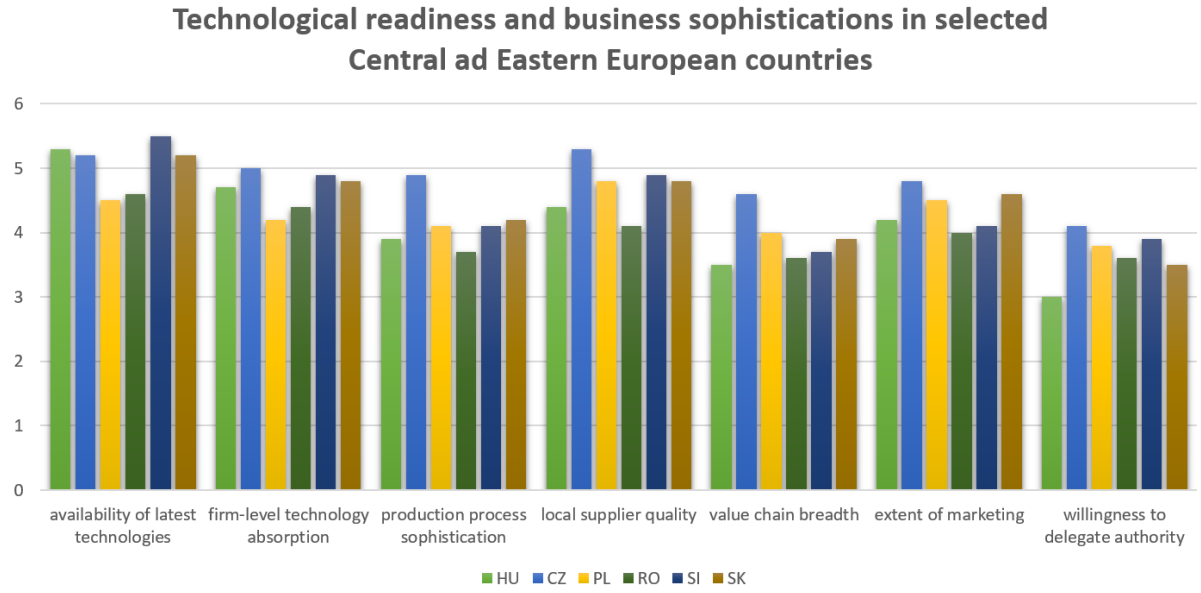
Foreign-owned players do not receive specific attention in official R&I policy documents, but are eligible for support measures available to all companies operating in Hungary. Besides, the government signs strategic contracts with large domestic and multinational companies, offering tax incentives on a case-by-case basis for selected investors, including R&D performers. 77 strategic contracts were signed between the year of 2010 and May 2016 (MK, 2016). The Foreign Direct Investment (FDI) inflows are relatively smaller than in the years directly following Hungary's accession to the European Union, and in 2015, the level of greenfield FDIs remained at historic lows, dropping to about 2% of GDP, while several years earlier these investments amounted to as much as 5-7% of GDP (EC, 2016a, p. 19). Hungary has experienced a drastic decrease in the value of inward FDIs from $7,490m in 2014 to $1,270m in 2015, while the EU-28 benefited from a reverse, increasing tendency in the same period (UNCTAD, 2016, p. 1). In recent years, Hungary was not included among the top 10 FDI locations in Europe by the fDi Report (fDI Intelligence, 2015). Nevertheless, the inward stocks of FDIs still amounted to 82.3% of GDP in 2013, being one of the highest values in the EU, higher only in Belgium, Estonia, Ireland and Luxembourg (EU-28 average: 48.4%) (Kothe, Gestrin and Avery, 2014, p. 9), but the FDI stock in Hungary has been constantly decreasing between 2013 and 2015 (UNCTAD, 2016, p. 1).

The relatively strong position of Hungary in terms of adding value to high-tech manufacturing, and to some extent also services, is a positive development, directly linked to the private sphere of the economy. Still, the share of employment in knowledge-intensive industries and the counts of innovative companies are lagging behind the strong position in manufacturing. **The economy would have the potential to grow faster if it was able to focus more on value-added activities, in particular in the services sector**. This, however, requires an increased availability of highly-skilled employees and intensified innovative efforts of domestic companies. According to a survey among business executives, administered by the World Economic Forum in 2014[35], Hungary lags behind some other Central and Eastern European countries with respect to specific dimensions that affect the performance of domestic business enterprises and their potential to cooperate with partners within multinational value chain (WEF, 2015). Selected results of the survey are summarised in Figure 14, which highlights the limited firm-level absorption of new technologies and sophistication of production processes, alongside restricted breath of the value chains in

[35] The results are based on responses of a relatively small sample of executives from companies operating in Hungary (WEF, 2015, p. 88), and the World Economic Forum does not publish data that would help verify the representativeness of the sample.

Hungary and inefficient managerial approaches, symbolised by the low willingness to delegate authority (WEF, 2015, p. 209).

Figure 14. Technological readiness and business sophistication in selected Central and Eastern European countries, assessed by business executives surveyed by the World Economic Forum, 2014.



Source of data: WEF (2015).

In the R&I Strategy, the government expressed a belief that business enterprises in Hungary invest in R&D because the investments can enhance their competitiveness and support their commercial interests, and the document defined the primary role of government as limited to ensuring "*the most advantageous framework conditions*" (Ministry for National Economy, 2013, p. 12), without an emphasis on more targeted corporate incentives. The data discussed above suggest that **the innovativeness of the Hungarian business sector might also require changes that are not linked to R&D investments but internal improvements related to the use of technologies, upgrading employee skills and increases in business sophistication**. These changes could only be achieved by means of soft measures, including training, mentoring, benchmarking with other companies and transfer of best practices, and such efforts could best be supported by public interventions going beyond the mere supply of funding. It is worth noting that some relevant support measures have been planned in the operational programmes for the 2014-2020 perspective.

Case study 9: Manufacturing Extension Program (MEP), USA

Since 1988, the US have a programme to support manufacturing companies in improving their processes. The idea is to increase the competitiveness of the US manufacturing firms throughout the country, in high and low tech sectors, by providing them with technical and managerial advice and partnerships to learn. The Manufacturing Extension Program (www.nist.gov/mep/about/) focuses on SMEs. The support is provided through a nationwide network of support centres. Those centres do not substitute private consultancies, but supplement their offerings and tackle market failures in the provision of advice that are particularly severe for small and low tech companies. Evaluations have shown that supporting the breadth of companies to buy and use forefront process technologies and employ modern innovation management techniques delivers a high leverage of public funds in terms of turnover growth and additional investment as well as an improvement in the use of resources. Moreover, evaluations found no negative effects on private consultancy firms.

Key messages for Hungary:

- The competitiveness and the ability to innovate is improved across the entire economy though investment in nationwide advisory services.
- Public advisory services fill important gaps even in advanced R&I systems like the US.
- Effects of advisory services extend to suppliers of production and energy efficient technologies as suppliers of products bought as a result of the service.
- There is no crowding out of commercial consulting services, as the network of private consultancies targeting SMEs across the economy is not sufficient.

Recommendation 24: *Not all innovation in Hungary is science-based. The input and the involvement in R&I of engineers, users (customers), entrepreneurs, service-based industries and service providers, e.g. health service, should be further encouraged via dedicated support measures. R&I programmes should also promote multi-disciplinarity.*

5.4. Availability and distribution of R&I grants

In the view of the panel, **the effectiveness of public R&I support measures for business enterprises remains limited** due to risk aversion by potential beneficiaries linked to the modalities for the evaluation and selection of proposals but also due to the eligibility criteria. As explained by interviewees, since the companies that apply for public R&I funding are expected to precisely describe their planned project activities and expected deliverables, even in the case of technology development projects lasting 2 or more years, the submitted proposals tend to concern low-risk projects and smaller-scale, incremental innovations, which could be planned in detail and successfully implemented[36]. In addition, industrial R&D activities usually involve more risky, innovative projects, implemented in multiple stages, with a sequence of managerial decisions leading to increased resource commitments if the initiative is considered promising, or to the termination of activities that do not deliver the expected outcomes. The public support to R&I funding is punctual and does not permit such a life-cycle approach to innovation.

Some of the domestically available R&I support measures could not be easily differentiated, and applicants need to rely on external consultants to navigate through the multiplicity of available support options, eligibility criteria and implementation modalities. **The portfolio of available measures has recently been optimised thanks to the introduction of new operational programmes, 2014-2020**, with funding schemes more precisely targeting different types of organisations or consortia, and differentiated levels of technological readiness. A good approach is also the synchronisation of measures offered based on two different operational programmes, targeting respectively Central Hungary (VEKOP and government funding by NRDIO) and other regions (GINOP), so that applicants and beneficiaries benefit from similar application contents, eligibility and selection criteria. In many of the support measures relevant to R&I performing business enterprises, the range of eligible expenditures is broad, including expenditures on R&D contracted to third parties, consulting, purchase of intangible assets and equipment, as well as marketing costs, making it easy to finance all activities related to the projects.

However, as of April 2016, some of the support measures foreseen by GINOP and VEKOP operational programmes have not yet been fully elaborated. According to some of the interviewed stakeholders, **evaluations of applications** for R&I funding tended to focus in the past on the **quality of written descriptions** and the rhetorical power of argumentation in the applications, often **failing to sufficiently address the innovativeness or commercial impact of proposed projects**. This seems to be improved as in many new GINOP and VEKOP funding calls, evaluation criteria clearly point to innovativeness, commercialisation potential and other business aspects, but it is uncertain whether the evaluators possess the competencies and experiences, and NRDIO does not use international evaluators in these calls.

There is a strong potential for **using the Smart Specialisation Strategy to reorient R&D activities towards key priority themes and thematically focused grants**, but so far, the government has not fully embraced this opportunity. Compliance with the priority areas identified in the Smart Specialisation Strategy became an important eligibility criterion for many funding calls in GINOP and VEKOP, but the priority areas are so broadly defined that applicants would be able to demonstrate this compliance for most of the proposed projects. In addition, corporate R&D projects require quick funding decisions, but the current procedures for evaluating project applications are perceived as prohibitively slow by the interviewed R&D performers (see also: section 5.4 of this report).

Both in the Peer Review project and in an earlier study (Hegyi, 2015), the interviewed business enterprises complained about the **lack of flexibility in publicly co-funded R&D projects**. Beneficiaries are obliged to implement the entirety of their initially planned project activities, and the interviewed stakeholders have reported their unsuccessful attempts at convincing the government agencies to accept amendments to the initial project scope, even when modifications

[36] The short-term orientation is also visible in the design of some support measures offered in the 2014-2020 financial perspective, with certain R&I calls based on GINOP and VEKOP requiring beneficiaries to generate within 2 years revenues that would amount to at least 30% of the awarded grant. This might discourage applicants who were considering breakthrough, high-risk projects and promote in turn applications concerning solutions, which are almost ready for market introduction and do not require major R&D efforts.

were considered necessary for the project deliverables to remain innovative or commercially useful. These limitations could partly be linked to the legal regulations surrounding the distribution of the EU Structural Funds, but problems were also reported for grants funded from the national sources. Some beneficiary companies experienced **problems with cash flow management due to payment delays in publicly co-funded grants**. Another shortcoming of the existing R&I grant system is the fact that not all cost categories typical for R&D projects are fully eligible in budgets of the publicly co-funded project, e.g. a stringent cap was imposed on the project management costs (Hegyi, 2015, p. 14).

Some stages of the innovation cycle are not fully covered by the available support measures, resulting in a "valley of death" or financial crunch even in the case of promising, innovative technologies – in particular, the problem concerns **funding for the scale-up of technology development projects**. Results of many publicly co-funded projects in the past have not been commercially implemented, but the policy measures available in the 2014-2020 period do not seem to address this particular lesson learned. As explained by the NRDIO in interviews conducted for the Peer Review project, R&I funding applications are evaluated by thematic experts, familiar with the given field of research, not necessarily having experiences in commercialisation of innovations.

The R&I policy mix is based on **the underlying assumption that the mere channelling of public funding for a specific intervention area would almost automatically induce the desired changes in the concerned area**. For example, the earmarked funding for entrepreneurship incubators in GINOP is not accompanied by complementary interventions that would stimulate the emergence of the desired institutional structures. However, experiences from the 2007-2013 policy cycle suggest the need for complementary and more targeted policy actions, which would complement the distribution of funding and amplify the results achieved. The programming of support for business enterprises is focused on inputs (allocation of public funding) rather than outputs (expected results such as: innovations, new products, services and technologies, increased competitiveness of companies, growth of exports, etc.). In GINOP and VEKOP, measurable results of the support defined on the level of operational programmes include: numbers of companies receiving grants, amounts of private investment matching the public support provided and numbers of newly employed researchers, but **no output measures are used, such as e.g. generated inventions, filed patent applications, commercialized innovations or sales of new products**. This limits the government's ability to monitor the outcomes of public R&I investments and evaluate their broader impacts on the economy.

Recommendation 25: *Incentivise quality business R&D projects with innovation and commercial impact. In line with the smart specialisation strategy, review the design of support measures to fund business R&D so that these cover priority areas with clear eligibility criteria and selection modalities. Promote openness, impartiality, confidentiality, increased flexibility for project implementation, and shorter times-to-grant. Reduce the bureaucratic burden for applicants and beneficiaries. The systematic use of international peer review for project evaluation of business grants should also be fostered by all agencies and ministries that distribute R&I funding. Funding tools should get redesigned so as to cover the whole innovation cycle, avoiding gaps in funding for innovative businesses, notably fast-growing ones.*

5.5. Design of R&D tax incentives

The most ambitious objective defined by the national R&I Strategy concerns the introduction of "*the most competitive R&D tax incentive system in Europe*" (Ministry for National Economy, 2013, p. 39). The balance between direct and indirect R&I support measures was discussed in section 3.5 of the report. The portfolio of available measures matches the options available to businesses in many other countries. They include among others the preferential tax treatment of incomes derived from R&D projects, and reductions in payroll costs (compulsory social security contributions) for highly skilled R&D employees (PhD holders or doctoral candidates), alongside more traditional measures, reducing tax burdens based on the R&D expenditures (including research contracted to universities or HAS).

The R&D tax allowances are used by a relatively small number of taxpayers (Ministry for National Economy, 2013, p. 4). For example, the above-mentioned payroll incentives were used in May 2015 by 258 firms and 859 employees, 67% of them working for SMEs (data compiled by the Hungarian government). Interestingly, **the Hungarian R&D tax incentives turn out to be very generous compared with other countries, but distributed among a relatively small number of beneficiaries**. The panel was not able to gather the necessary quantitative or qualitative data to explain the reasons for this imbalance, but some interviewees referred to complicated, **not always clear eligibility rules and the heavy administrative burden related to the use of R&D tax incentives**.

In 2013, Hungary distributed as much as 0.13% of its GDP through R&D tax incentives, and only four OECD members among the EU countries had higher shares of indirect R&D incentives in GDP (Belgium, France, Ireland and Netherlands) (OECD, 2015b). **When the indirect support (tax incentives) and direct support for R&I by business enterprises (publicly co-funded grants) are combined, a very high share of GDP spent by the Hungarian government on these forms of support is revealed**: 0.32% of GDP, surpassed only by France and Slovenia (OECD, 2015b) (see also: discussion of the R&I funding mix in section 3.2 of this report). The public R&I funding for the private sector is significantly more generous than the R&I support provided to universities and public research organisations, as described in previous chapters of the report.

Since 2014, taxpayers can use the **services of the Hungarian Intellectual Property Office to verify whether a given project could be considered R&D**, and which expenditures are eligible as R&D costs. In the past, HIPO was offering such services to the national tax administration and courts only. The **complexity of the procedures** is likely to discourage many corporate accountants, and the lack of clear guidelines regarding the classification of R&D expenditures for tax purposes increases the risk of business operations.

All companies with more than 50 employees are obliged to pay the innovation levy, which is a separate tax amounting to 0.3% of the tax base[37]. The innovation levy is reduced if a given company incurs R&D expenditures. Tax revenues collected by the government from the innovation levy are redistributed in the form of a public fund, dedicated to promoting R&I, and are expected to be supplemented by additional contributions from the state budget. The practice of collecting the innovation levy was originally introduced to ensure sustainability of the public funding for R&I, as R&D tax allowances and government grants were financed from contributions of business enterprises, collected on an annual basis. At the same time, it increases the corporate tax burden and is not welcome by taxpayers.

Moreover, **since 2010 only parts of the funds collected from innovation levies were redistributed for purposes related to R&I, and the government was consistently failing to match the amount of collected levies by additional funding**. Therefore, the innovation levy became yet another tax burden, but not necessarily stimulating the development of innovations, with the collected funds remaining at the government's disposal. For example, the available R&D tax credits were in 2013 only about half of the total amount of innovation levy collected from companies in Hungary (Dőry, 2014, p. 14). There were nevertheless positive changes associated with the introduction of Act No. LXXVI on Scientific Research, Development and Innovation from 2014, which reaffirmed the availability of R&D tax allowances and modalities for redistributing the funds collected through innovation levies, even though it did not ensure the allocation of all funds for R&I purposes or topping-up the collected amounts by additional government funding.

Recommendation 26: *Ensure that the funds collected through the innovation levy are redistributed solely for R&I purposes and get appropriately topped-up by government funding. The innovation levy should not become the exclusive source of funding for business R&D activities.*

The attractiveness of the Hungarian tax measures supporting R&I remains limited, and is falling short of being "*the most competitive R&D tax incentive system in Europe*", as envisioned by the government (Ministry for National Economy, 2013, p. 39). The design of R&D tax incentives has not changed in recent years, even though the government discussed some potential improvements, and some of the allowances were phased out from the beginning of 2012. There are no additional tax benefits targeting innovative start-ups (newly founded entities not generating profits), business angels, venture capital firms or capital market participants investing in new ventures. An international comparison of R&D tax incentives positions the Hungarian tax measures on a relatively low, 22nd place in a ranking of 31 benchmarked countries (CPB et al., 2014, p. 121)[38]. At the same time, in the global "Doing Business 2016" ranking by the World Bank, Hungary takes a particularly low, 95th position on paying taxes due to the large fiscal burden, related to numerous taxes and mandatory contributions (World Bank, 2016, p. 207), and thus it shouldn't be surprising that business enterprises look for multiple ways of reducing the tax burden.

[37] See also: footnote 15 in section 3.6 of this report.
[38] The cited report (CPB et al., 2014) offers useful insights into the design of R&D tax incentives in various countries, highlighting good practices and suggesting how to measure the effectiveness of these measures.

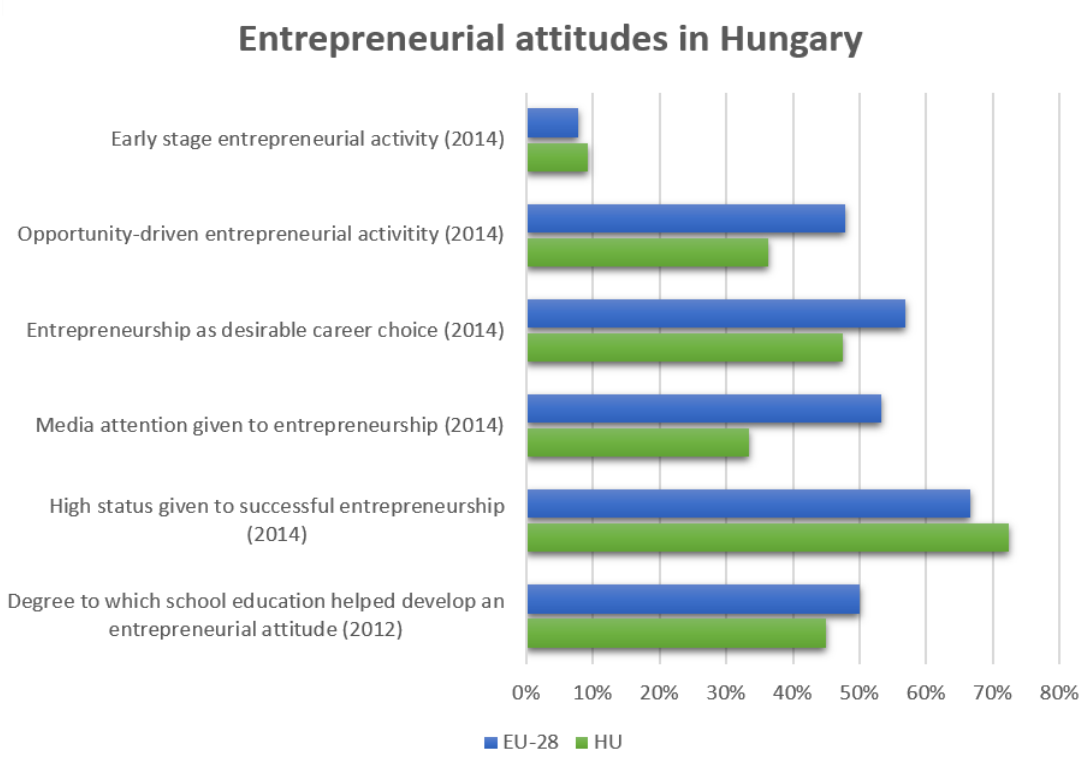
Recommendation 27: *Review and evaluate the existing tax allowances and the generous R&D tax incentives to foster their uptake by fast-growing innovative businesses. Examine the appropriateness of tax incentives for different industries and firms (start-ups, scale-ups, companies with intensive R&I but few sales in Hungary, exporting companies and traditional businesses). Draw conclusions to simplify existing rules and reduce the administrative burden for the users.*

5.6. Institutional and cultural support for entrepreneurship

In the World Bank's "Doing Business 2016" ranking, Hungary is ranked 42nd, with only 7 EU member states holding lower positions (World Bank, 2016, p. 5). **The country has a relatively low position in the global ranking related to starting a new business** (55th rank), with a surge in registration fees for new businesses in 2013 and the increased capital requirements for newly established companies in 2015. It takes 2 days on average to start a new business in Hungary (EU-28 average: 3.53 days), and the cost of starting business is lower than in many other EU member states (HU: €239.5, EU-28: €312.86), but the requirement for the paid-in minimum capital is substantially higher (HU: 54% of income per capita, EU-28: 11.26%) (EC, 2015b, p. 8). Start-ups without earlier business history have difficulties with acquiring external funding, and are not eligible for some of the R&I funding calls[39]. Technological start-ups could not benefit from any dedicated tax incentives, and need to bear the same financial burdens as larger companies (including payroll taxes and mandatory contributions).

It must however be stated that **small businesses can benefit from simplified tax schemes, including options to pay the tax as a lump sum or incur fixed payroll-related payments per each employee.** In addition, corporate bankruptcy is regarded as a stigma in Hungary, and national regulations prevent failed entrepreneurs from embarking on subsequent business ventures. The World Bank's ranking also reveals Hungary's time-consuming and costly insolvency proceedings (lasting 2 years of average, with 41.7% recovery rates), as well as limited protection of minority investors (World Bank, 2016, p. 207). The report on the implementation of the Small Business Act for Europe summarized the empirical data for Hungarian entrepreneurship, comparing it with the EU average (EC, 2015b) (see also: Figure 15).

Figure 15. Survey data concerning entrepreneurial attitudes in Hungary, compared with the EU average.



Source of data: EC (2015d, p. 6).

[39] There are dedicated calls for start-ups, including small grants for young entrepreneurs (GINOP 5.2.3), equity investments in start-ups by publicly co-funded incubators (GINOP 2.1.5), consulting and mentoring services for ICT start-ups (GINOP 3.1.3). In some calls, young technology-based enterprises can only benefit from smaller funding than larger and more experienced companies (e.g. GINOP 2.1.7, VEKOP 2.1.7).

Hungary concentrates more **early-stage entrepreneurial activities** than many other EU countries (HU: 9.33%, EU-28: 7.8%), but only part of it is opportunity-driven (HU: 36.27%, EU-28: 47.9%), and entrepreneurship is a desirable career choice for less than half of the population (HU: 47.30%, EU-28: 56.9%) (EC, 2015b, p. 6). The media attention given to entrepreneurship remains below the EU average (HU: 33.47%, EU-28: 53.3%), but within the society, successful entrepreneurs benefit from a high status (HU: 72.38%, EU-28: 66.6%) (EC, 2015b, p. 6). Education was perceived as influencing the development of entrepreneurial attitudes by 45% of respondents (EU-28: 50%) (EC, 2015b, p. 6). In general, the **EC report on the Small Business Act for Europe implementation in Hungary, suggests that the country remains below the EU average in the implementation of policy measures in six out of nine areas**, even though progress since 2008 could be observed in most of these areas, with the only exception being "second chance"-type of activities, as factors affecting the situation of failed entrepreneurs have actually worsened (EC, 2015b, p. 3).

Case study 10: Change of bankruptcy regulations for entrepreneurs (France)

Before the year of 2013, owners of companies in France that experienced bankruptcy during the three previous years underwent an obligatory registration at the Banque de France under the indicator "040". They could not benefit from bank loans to establish new enterprises due to their previous failure. This indicator was cancelled by a governmental decree in 2013 (https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000027923904&dateTexte=&categorieLien=id) and entrepreneurs are no longer discriminated against based on their business histories. About 140,000 entrepreneurs were affected by this new regulation, which was perceived as a general affirmation of a "right to failure", particularly important for high-risk, innovative companies.

Key messages for Hungary:

- Simple regulatory reform can have a major effect on the risk taking across the entire economy.
- Innovative ventures, including new technology-based firms, need to be assured the right to fail, as otherwise their owners and investors would decide against taking the high business risks.

Recommendation 28: *Revisit Hungarian bankruptcy laws in order to permit a culture of 'good failure' for Hungarian innovative entrepreneurs.*

In a similar manner, in the Global Entrepreneurship and Development Index (GEDI) (Ács, Szerb and Autio, 2016), **Hungary scores particularly low compared to other European countries** on: **perception of entrepreneurial opportunities** (as individuals do not tend to display entrepreneurial traits) and cultural support (as attitudes towards entrepreneurs are unfavourable). According to the interviews with representatives of start-up companies, conducted for the Peer Review project, societal views about entrepreneurs used to be dominated by negative imagery, linking the entrepreneurship to non-transparent or even criminal activities, but these views have improved in recent years. **Successful innovators and entrepreneurs are not promoted by public sector organisations or mass media, and the government does not create good publicity for innovations by means of dedicated media campaigns or presentations of good practice examples.** As has already been discussed in section 4.3 of the report, entrepreneurship education is typically not embedded in graduate and doctoral study programmes in Hungary.

The government participated in a valuable initiative, intended to help **the city of Budapest transform into the start-up hub of the Central and Eastern Europe** (BudapestHUB, 2013), but most of the specific recommendations of the working group listed in the report from 2013 were not implemented afterwards. In an analysis of European countries compiled in 2016, Hungary was found to lag behind in implementing the recommendations of an entrepreneurship roadmap dubbed "*Startup Manifesto*", and the country was ranked on the 24th position out of 28 countries, with only 46% of the recommended, start-up oriented measures implemented so far (Osimo et al., 2016, p. 57). Even though the Hungarian market for technological products is limited in size, not many start-ups pursue the 'born-global' strategy.

So far, **no publicly co-funded programmes have helped better embed the innovative Hungarian companies into global markets**, e.g. by international match-making activities or stays in technology accelerators operating in key international locations. Dedicated consulting services for SMEs will be co-financed from the EU Structural Funds in the following years[40]. The **lack of suitable and easily available office infrastructure for start-ups** in provincial cities must also be mentioned, as the problem was highlighted by some of the stakeholders interviewed for the project, but GINOP includes a dedicated scheme, financing the development of regional infrastructure for business incubators (GINOP 1.1.1).

Case study 11: StartupDelta (Netherlands)

StartupDelta (www.startupdelta.org) is an initiative formed with a multidisciplinary team of government officials from all layers of the Dutch government. Its goal is to position the Netherlands as one of the top three most attractive startups ecosystems in Europe. With help from partners in the government, corporates, educational systems, financial world and many others, StartupDelta strategies are about '**linking up**', '**changing the system**', **and** '**creating impact**':

- '***Linking up***' the ten innovative Dutch startup hubs into One Single Hub. Together they form Europe's largest and best connected startup ecosystem. All hubs have one single point of contact; Startup Delta makes their qualities transparent, shares networks and exchanges ideas and opportunities with the ultimate goal to give startups the best support and environment to grow. Furthermore, Startup Delta links up the Dutch ecosystem to the best hubs in the world.

- '***Changing the system***' to one that is designed for startups, so they have the best environment to establish their business models and flourish. Focused actions are aimed at Capital, Talent and Networks. To accomplish this, Startup Delta works together with government, politics, corporates, academia and many others.

- '***Creating impact***'**:** The approach is based on a limited timeframe to create maximum commitment on all levels of involvement and "push". Startup Delta aims for concrete results which will make the difference, involving others to play a central role in activities and hand over the work, when StartupDelta stops. Startup Delta works together with partners to create a dynamic system which – within one and a half year – should sustain itself.

Key messages for Hungary:
- To make a step change in the conditions for start-ups needs a coordinated effort from the public and private sectors.
- The government can act as a catalyst to high profile the importance of start-ups, create commitment on all levels and facilitate exchange of best practice as well as helpful introductions (including internationally).
- Involve successful entrepreneurs as success breeds success.

Case study 12: Exemption of young companies from social security employer contribution (France)

The French young innovative enterprises (less than 7 years old) are exempt since 2014 from employer's contributions for the employees who are involved in research and innovation projects. SME's have also a specific tax credit for innovation: this tax credit amounts to 20% of the expenses induced by the conception or the achievement of prototypes or technology demonstrators. The expenses basis is limited to €400k per enterprise and per year. Both regulations (which can be added) are examples of public support devoted to start-up's development. More information is available at: http://www.entreprises.gouv.fr/politique-et-enjeux/credit-impot-innovation

Key messages for Hungary:
- Simple tax measures can offer important leverage for startup companies.
- Support can be tailored to the needs of different kinds of firms.

[40] Dedicated support measures are planned to offer consulting services and mentoring to start-ups, including general business mentoring (GINOP 1.1.2), support for capacity building investments (GINOP 1.2.2) and mentoring supporting the international market entry of ICT start-ups (GINOP 3.1.3). Details of these schemes are still being elaborated.

Recommendation 29: *Hungary must develop its innovation eco-system with the support of appropriate physical infrastructure. The creation and development of common laboratories between universities and industry, innovation spaces, incubators, accelerators, and science parks should be promoted. Entrepreneurial education and training should be available both in schools and universities. The provision of "soft service" support (e.g. advice, training, guidance, information) to entrepreneurs and to companies across all industries, types and sizes is an asset. The successes of entrepreneurs should be rewarded through prizes, media campaigns and public exposure.*

5.7. Availability of private capital for innovations

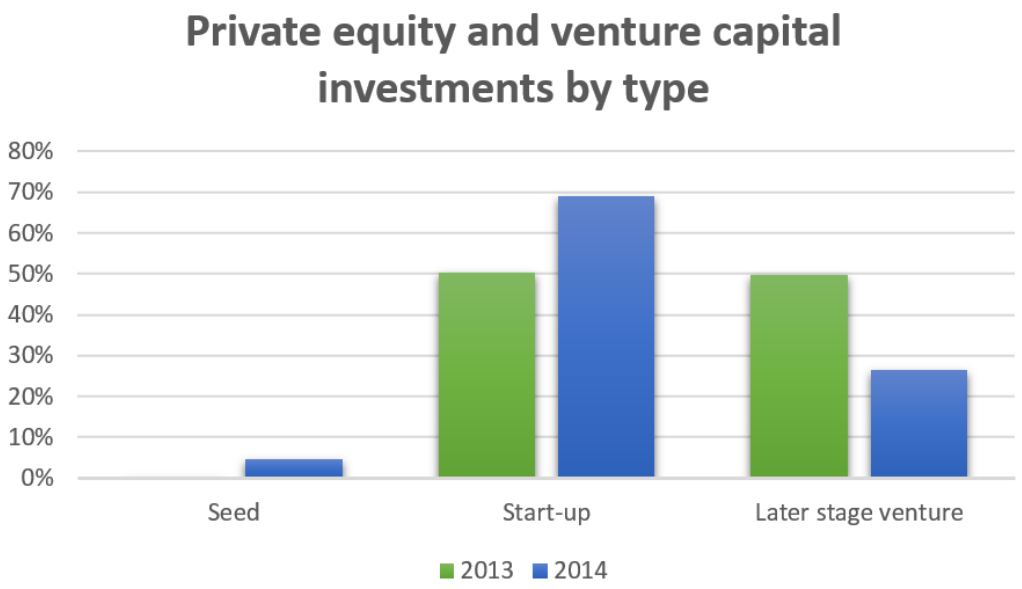
The government's R&I strategy includes objectives related to the creation of a start-up ecosystem (Ministry for National Economy, 2013, p. 34), intending to spur at least 1,000 innovative start-ups by 2020 and promote more than 300 high-tech companies in global markets (Ministry for National Economy, 2013, p. 40). As of 2016, these expectations diverge from the economic reality. According to interviews conducted in the Peer Review project, **new technology-based companies suffer from a lack of seed capital**, which could be used to support start-ups, and due to a lack of further funding, some entrepreneurial processes terminate prematurely.

The existing entrepreneurship incubators focus rather on the provision of office space than professional support services. The situation was not improved by the dedicated government programme "*Start-up_13*", introduced in 2013. Opportunities for entrepreneurship training of students are limited. In 2015, a new call for innovative incubators was launched under the name *"Innovation ecosystem"* (GINOP 2.1.5), intended to support incubators that would select, co-finance, accelerate and promote technological start-ups. The incubators will match the public funding when investing in the shares of the incubated start-ups (20% of funding coming from the incubator, 80% from EU Structural Funds), and can be expected to focus on the most promising investment targets. Another scheme involves co-funding for VC investments (GINOP 8.1.3), but its details are still being elaborated as of April 2016.

The activities of business angels are very limited compared with other European countries, and the Hungarian Business Angel Network has only recently been established. Innovation clusters (including over 20 formally accredited clusters) rely on public co-funding and do not initiate ambitious investment projects based solely on private capital. As the start-ups interviewed for the Peer Review project suggested, many potential investors come from non-technological sectors, such as real estate or finance, and might **not understand the business opportunities related to innovative products or services**. Investors in innovative companies have no additional public incentives other than grants, and the Hungarian tax regime is not supportive of investing in high-risk ventures. Support for technology incubators and mentoring programmes for micro and small enterprises is available based on the EU Structural Funds, but the effectiveness of these newly introduced measures remains to be seen.

In a similar manner, the **availability of private capital for innovative companies is limited** in regional comparison. The total value of VC, private equity and buyout-type investments in years 2009-2014 amounted to €2,270m in Czech Republic (0.193% of GDP), €2,710m in Poland (0,061% of GDP) and €803m in Hungary (0,164% of GDP) (EVCA, 2015, pp. 13, 17). Nearly 30 VC funds were created in Hungary based on the JEREMIE (Joint European Resources for Micro to Medium Enterprises) programme. JEREMIE funding accounted for the majority of Hungarian VC investments between 2010 and 2014 (MNB, 2015), but the investment period of JEREMIE has ended. VC investments in Hungary amounted to €32m in 2014 (EVCA, 2015, p. 13), but when supplemented by other private equity investments, the total value increased to €170m invested in 73 companies (EVCA, 2015, p. 13-14), with only 9 exits in 2014 (EVCA, 2015, p. 25). The majority of the funding was made available to start-ups (69.98% in 2014) with only small shares held by seed financing (4.65%) and later stage ventures, which usually have higher capital requirements (26.37%) (EVCA, 2015, p. 21) (see: Figure 15). In comparison, later stage venture investments accounted for 67.65% of all VC funding in Czech Republic and 47.57% in Poland (EVCA, 2015, p. 21). The high investments in early-stage start-up companies might be explained by commitments of VC funds benefiting from public co-funding for their projects, but the successful new technology-based firms are likely to need more capital for growth also in the later stages of their development, which are typically associated with VC activities.

Figure 16. Private equity and venture capital investments in Hungary, 2013-2014.



Source of data: EVCA (2015, p. 21).

The representatives of business enterprises interviewed by the Peer Review panel described the VC funds operating in Hungary as risk averse and maintaining a restricted scope of activities, maintaining that financial support for commercializing advanced technologies is not readily available. **Limited availability of risk capital was identified as one of Hungary's weaknesses restricting the development of entrepreneurship** (Ács, Szerb and Autio, 2016). Access to financing (in particular, equity finance) hinders the country's competitiveness according to the analysis of the World Economic Forum (WEF, 2015, p. 208).

The World Bank's "Doing Business" report suggests however that Hungary belongs to countries with a **relative ease of getting commercial credit** (World Bank, 2016, p. 207), but this ease is measured by the strength of legal rights, the depth of credit information and the coverage of credit bureaus and credit registries, so the indicator does not represent the features of the actual credit-related procedures, as experienced by business enterprises. SMEs might however have more problems with benefiting from commercial loans, as survey data from 2014 indicated that as many as 25% of SMEs in Hungary had their loan applications rejected, compared with an average of 16.66% in the EU (EC, 2015b, p. 10).

Recommendation 30: *Support measures for innovative start-up companies (direct funding for business R&I activities, tax incentives, strategic advice, training, physical accommodation) should be boosted, addressing both the start-up and scale-up stages in the development of innovative firms.*

In the 2014-2020 financial perspective, Hungary will offer business enterprises financial instruments (including loans, grants combined with loans, counter-guarantees and equity investments). **The relevant support measures are being designed by the Hungarian Development Bank under the guidance of NRDIO, based on a gap analysis exercise, involving discussions with stakeholders**. The Peer Review panel did not identify any attempts to use good practices from other countries in the design of these financial instruments. The schemes have the potential to engage the VC community and stimulate the commercialisation of innovations, but the design of the relevant instruments was uncertain as of April 2016.

Case study 13: R&I programmes with VCs (Poland)

Poland runs a set of programmes for innovative companies, including BRIdge Alfa (seed funding for innovative start-ups) and WITELO (VC funding for science-based companies, previously called "BRIdge VC"). Both programmes were designed based on the experiences of the Israeli VC community and are based on the concept of matching funds: public funding distributed to the beneficiaries is matched by the equal amount of private capital, coming from investment funds that were selected in an open, international competition and subsequent negotiations. Specialists from the financial industry select project-investment targets, taking into account the commercial potential of the beneficiary companies, and public funding is allocated in combination with private capital as an equity-based, financial instrument. In the 2014-2020 perspective, the programmes are using the EU Structural Funds, with a planned budget of €438m and the same amount to be provided by private investors. More information is available at: http://www.ncbir.pl/en/domestic-programmes/bridge-vc/art,1929,bridge-vc-public-private-support-for-rd-commercialization-in-partnership-with-capital-funds.html, www.witelofund.com

Key messages for Hungary:

- Matching funds increase the motivation to select innovative and commercially viable projects.
- International VC community turn out to be interested in a partnership with the R&D funding agency and willing to use the local knowledge to gain access to innovative companies, but the preparations of the programmes and negotiations with investors took altogether 3 years (2012-2015).
- Despite legal challenges, equity-based instruments using matching funds can be designed on the basis of the EU Structural Funds.

Recommendation 31: *Exploit international best practices in the design of new financial instruments and in their evaluation, in order to maximise their potential to match the public funding to the private capital investment, engage the VC community and stimulate the commercialisation of innovations.*

5.8. Summary table

Framework conditions for innovation in the business sector	
STRENGTHS	**WEAKNESSES**
+ improvements in the ease of doing business over time	– limited predictability of the regulatory environment
+ Ministry of Economy recognizing the need to establish advantageous framework conditions for business in the R&I strategy	– many declarations from the R&I strategy from 2013 not implemented
+ existence of Smart Specialisation Strategy outlining priority R&I themes	– limited availability of public R&I funding for companies in Central Hungary
+ strong increases in R&D activities of private sector since 2004	– high territorial concentration of private sector R&I in Central Hungary
+ increasing contributions of foreign-owned business enterprises to BERD	– low growth in R&D spending of high-tech sector since 2007, indicating limited access to the most advanced technologies
	– declining R&D spending of domestically owned companies in 2013-2014
	– low level of greenfield FDIs in 2015 compared to previous years
+ innovation levy as a source of sustainable funding that can be redistributed for R&I purposes	– limited availability of risk capital, including VCs and business angels
+ generous total government spending on R&D tax incentives compared with other OECD countries	– lack of clarity regarding R&D expenditures that are eligible for R&D tax exemptions
	– R&D tax exemptions used by a relatively small number of taxpayers
	– lack of specific tax incentives for start-ups
+ wide availability of R&I funding for business enterprises in the 2014-2020 period	– public R&I support used by companies to fund low-risk projects
	– insufficient support for strengthening manufacturing infrastructure and transferring

	industrial best practices to innovative companies
	– excessive administrative burdens for applicants and beneficiaries of R&I support measures
	– long lead times between the submission of project application and the funding decisions for R&I support measures
	– R&I funding applications evaluated by government experts and scientific peers not experts experienced in commercialisation of innovations
+ Hungarian companies planning increases in their R&I investments	– the stigma of failure and legislation preventing failed entrepreneurs from trying again, with costly insolvency proceedings
	– the government does not create good publicity for innovations by means of campaigns or promotion of success stories

RECOMMENDATIONS

- ✓ **Recommendation 23:** The limited funding available from the EU Structural Funds for Central Hungary is likely to negatively affect the R&I strengths of the region, which accounts for a disproportionate share of high-tech industry and skilled human capital in Hungary. The innovation levy and the state budget can be used to preserve the R&I potential of the region.
- ✓ **Recommendation 24:** Not all innovation in Hungary is science-based. The input and the involvement in R&I of engineers, users (customers), entrepreneurs, service-based industries and service providers, e.g. health service, should be further encouraged via dedicated support measures. R&I programmes should also promote multi-disciplinarity.
- ✓ **Recommendation 25:** Incentivise quality business R&D projects with innovation and commercial impact. In line with the smart specialisation strategy, review the design of support measures to fund business R&D so that these cover priority areas with clear eligibility criteria and selection modalities. Promote openness, impartiality, confidentiality, increased flexibility for project implementation, and shorter times-to-grant. Reduce the bureaucratic burden for applicants and beneficiaries. The systematic use of international peer review for project evaluation of business grants should also be fostered by all agencies and ministries that distribute R&I funding. Funding tools should get redesigned so as to cover the whole innovation cycle, avoiding gaps in funding for innovative businesses, notably fast-growing ones.
- ✓ **Recommendation 26:** Ensure that the funds collected through the innovation levy are redistributed solely for R&I purposes and get appropriately topped-up by government funding. The innovation levy should not become the exclusive source of funding for business R&D activities.

- ✓ **Recommendation 27:** Review and evaluate the existing tax allowances and the generous R&D tax incentives to foster their uptake by fast-growing innovative businesses. Examine the appropriateness of tax incentives for different industries and firms (start-ups, scale-ups, companies with intensive R&I but few sales in Hungary, exporting companies and traditional businesses). Draw conclusions to simplify existing rules and reduce the administrative burden for the users.

- ✓ **Recommendation 28:** Revisit Hungarian bankruptcy laws in order to permit a culture of 'good failure' for Hungarian innovative entrepreneurs.

- ✓ **Recommendation 29**: Hungary must develop its innovation eco-system with the support of appropriate physical infrastructure. The creation and development of common laboratories between universities and industry, innovation spaces, incubators, accelerators, and science parks should be promoted. Entrepreneurial education and training should be available both in schools and universities. The provision of "soft service" support (e.g. advice, training, guidance, information) to entrepreneurs and to companies across all industries, types and sizes is an asset. The successes of entrepreneurs should be rewarded through prizes, media campaigns and public exposure.

- ✓ **Recommendation 30:** Support measures for innovative start-up companies (direct funding for business R&I activities, tax incentives, strategic advice, training, physical accommodation) should be boosted, addressing both the start-up and scale-up stages in the development of innovative firms.

- ✓ **Recommendation 31** Exploit international best practice in the design of new financial instruments and in their evaluation, in order to maximise their potential to match the public funding to the private capital investment, engage the VC community and stimulate the commercialisation of innovations.

6. SCIENCE-INDUSTRY COOPERATION, TECHNOLOGY TRANSFER AND ENTREPRENEURSHIP

6.1. Introduction

Well-organised science-industry dialogue and inter-sectoral interactions are important to improve the cooperation opportunities and the flow of knowledge between the scientific and business communities. **Successful collaboration between these two main actors is key to improve the effectiveness of public R&I investments**, and can be promoted by fostering the mobility of researchers, nurturing the entrepreneurship, intensifying technology transfer and the commercialisation of R&D results as well as by building a solid science and technology governance in a country. The cooperation is also important for the successful development of the Hungarian R&I system, strengthening the industrial base of the country and bringing academic research and education closer to the market.

This chapter analyses the **key factors and challenges that hamper the collaboration and exchange of knowledge between science and industry in Hungary**, which were identified by the Peer Review panel through document analysis and interviews with local stakeholders. Subsequently, it also discusses the possible way forward and offers recommendations that could help unleash the collaborative potential.

6.2. Scope of science-industry cooperation in Hungary

Cooperation between science and industry in Hungary is at an early stage of development. The perception of benefits by both industry and academia is still limited, with key barriers being the restricted availability of funds targeting the cooperation and burdensome, bureaucratic procedures. The private sector plays an increasing role in funding the public R&D, and the situation has improved over time, with intensifying collaboration motivated among others by the R&I policy measures (Havas, 2015, p. 15-16), which is described in the following sections of this chapter. *The quantitative data on science-industry cooperation in Hungary are puzzling, as they seem to present a relatively positive picture, which stands in a stark contrast to the qualitative information collected by the Peer Review panel, including interviews with scientists, university management and companies.* The possible reasons for these discrepancies will be explained below.

In 2014, **business enterprises funded 9.23% of R&D expenditures of the higher education sector in Hungary** (higher than the EU-28 average of 6.38% in the year of 2013) and 8.04% of R&D expenditures of the government sector, including the Hungarian Academy of Sciences (EU-28, 2013: 8.58%) (Eurostat, 2016). Nevertheless, the funding was considered insufficient by the interviewed representatives of scientific organisations, who have to face declining public R&D expenditures expressed as a percentage of GDP. The national statistics on R&D funding are aggregate and do not reveal the number of scientific organisations benefiting from the private sector funding, but it can be assumed that the funding is only received by some of the organisations.

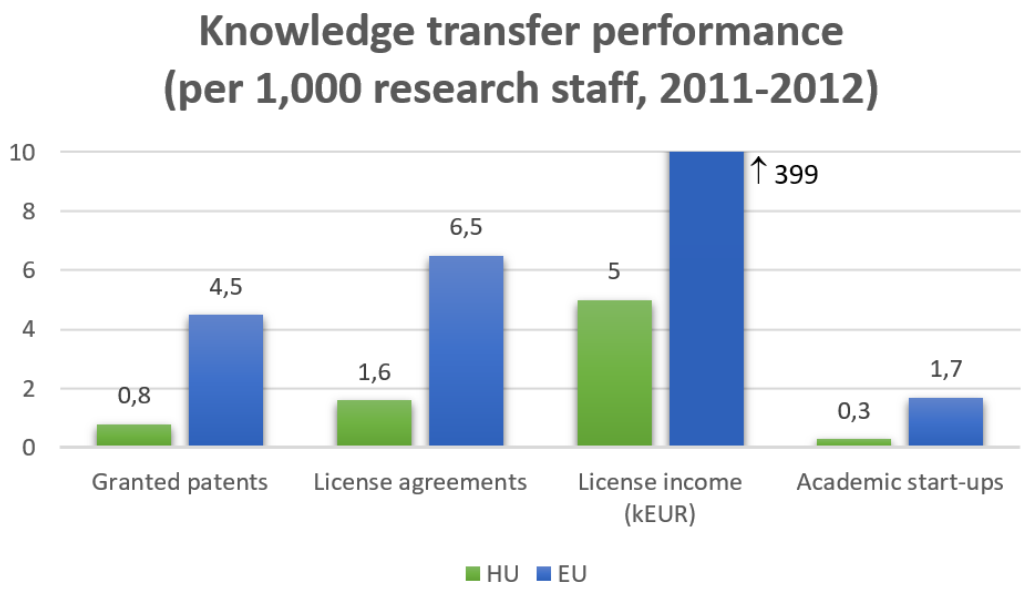
The percentages of **innovative companies collaborating on innovation with higher education or public research organisations (41.1%) are similar to the figures collected e.g. for Germany or Norway and thus relatively high in European comparison** (EU-28: 31.1%) (Eurostat, 2016). Based on the results of the Community Innovation Survey from 2012, 18.1% of innovative companies had cooperation with higher education institutions (EU-28: 13.0%) and 6.8% with government research institutes, including the Hungarian Academy of Sciences (EU-28: 8.9%) (Eurostat, 2016). It must however be noted that these findings concern only innovative companies, i.e. business enterprises that have implemented either product or process innovations. As discussed previously in the report, one of structural challenges for the Hungarian R&I system is the persistently **low share of innovative companies**, so even though these innovative entities might engage in active collaboration with scientific organisations, the **occurrence of such partnerships across the broader business sector is limited**.

Bibliometric analyses of data on scientific publications indexed in Elsevier Scopus database show that between **2003 and 2013, the shares of publications jointly co-authored by representatives of academia and industry in Hungary remained almost unchanged**. In 2008-2013, the share of public-private co-publications in all scientific publications of Hungarian authors was 1.3% against 2.8% for the EU-28 (Scopus-based publication indicators derived from Elsevier's SciVal platform, www.scival.com, December 2014).

Counts of patents filed in Hungary by business enterprises are very limited and no systematic evidence exists for joint patenting efforts of academia and industry. In some specialist technological areas, the interviewed companies described the potential for collaboration with

universities as particularly challenging as researchers and graduates might not have the necessary, state-of-the-art knowledge of these niche fields. **Academic patenting remains in turn very limited** and according to interviews with scientists conducted for the Peer Review project, patents are not considered important in academic careers in Hungary. According to survey data from the Knowledge Transfer Study (Arundel et al., 2013), Hungary produced in 2011-2012 the smallest number of granted patents per 1,000 research personnel among all EU countries (0.8 patent grants per 1,000 researchers) (Arundel et al., 2013, p. 104). The academic licensing activities were also scarce, with an average of 1.6 license agreements and about €5,000 license income per 1,000 research personnel in 2011-2012, and only 0.3 academic start-ups were created in this period per 1,000 research personnel, which are very low values in comparison to most other EU member states (Arundel et al., 2013, p. 105-107). The comparison between Hungry and the EU in knowledge transfer performance is presented in Figure 17.

Figure 17. Knowledge transfer performance indicators for Hungary compared with the average values for the EU, 2011-2012.



Source of data: Arundel et al. (2013, p. 104-107).

Even though there are cases of science-industry collaborations, including contracted R&D, technology transfer and academic spin-offs, they are **not fully integrated into the commercial activities of companies and did not result from systematic policy efforts**. In interviews carried out for the Peer Review project, representatives of business and science sectors recognised the general lack of interactions (despite some positive examples of collaborations), attributing it to different needs and unaligned priorities.

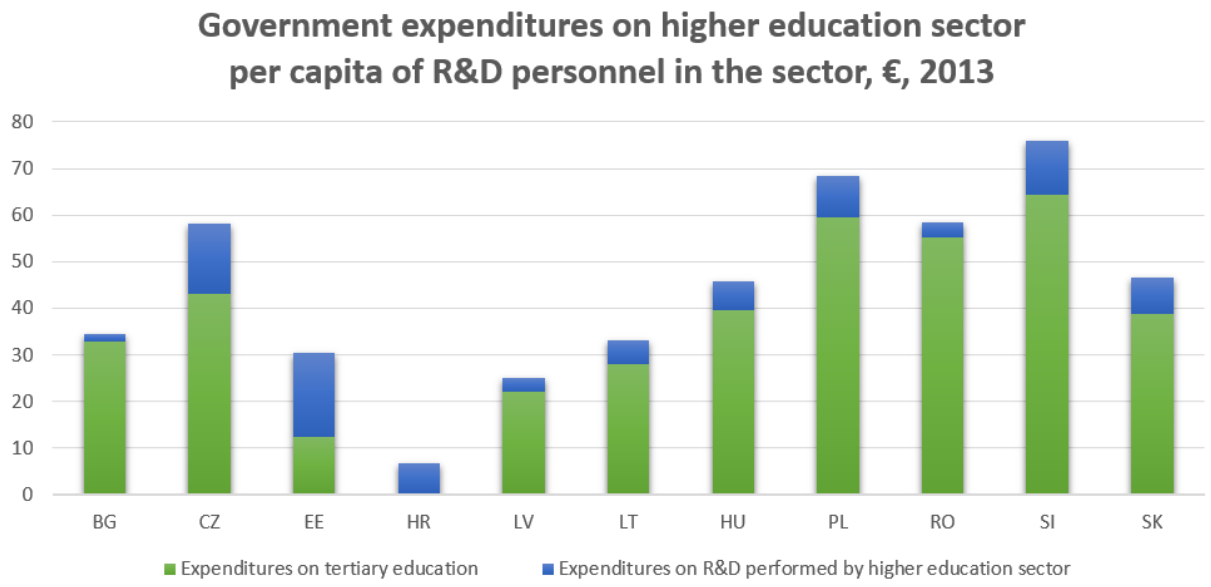
The stakeholders interviewed for the Peer Review project pointed to a **concentration of science-industry cooperation**, with only a relatively small number of scientific organisations actively collaborating with a scarce group of companies. According to the interviewees, the dual character of the business sector in Hungary inhibits progress towards an enhanced science-industry cooperation and technology transfer. On the one hand, large multinational companies embedded in global value chains do not extensively use the outputs of the R&I system in Hungary, with the exception of a small group of international companies that have R&D centres established in the country. On the other hand, **domestic companies, including SMEs, rarely engage in deeper, commercially-driven and mutually beneficial collaboration** with knowledge providers including universities and the Hungarian Academy of Sciences, even though statistics confirm the occurrence of some forms of cooperation.

6.3. Factors affecting the science-industry cooperation

The traditional divide between research, education and innovation in Hungary is not conducive to science-industry collaboration. Universities consider education to be their primary task, and do not prioritise the needs of the society or industry in their strategies. The "third mission" of Hungarian universities – involving broader cultural and social impacts of universities, knowledge transfer and entrepreneurship - is not fully embraced by most higher education institutes. University scientists tend to focus on fundamental research and publishing,

while disregarding opportunities in patenting, industrial research and entrepreneurship. The government decree No. 395/2015, concerning periodic performance assessments of university researchers, does not incentivise industry collaboration or technology transfer, emphasizing rather the traditional scientific achievements, typical for fundamental research[41]. There are **no role models of academic entrepreneurs**, who would be promoted among scientists, particularly belonging to the young generation. Further development of these areas critically depend on building a solid technology transfer infrastructure with embedded capacity for technological intermediation, fostering an entrepreneurship culture, and surpassing cultural legacy challenges.

Figure 18. Government expenditures on higher education sector per capita of R&D personnel in the sector, €, 2013.



Source of data: Eurostat (2016).

The sub-optimal situation is further reinforced by the **composition of funding streams**, supplied by the government to universities – as Figure 18 suggests, the major parts of university budgets not only in Hungary but also in most other Central and Eastern European countries are earmarked for tertiary education not research, with Estonia and Croatia being the only exceptions. At the same time, higher education systems in Western European countries, e.g. in Ireland, the Netherlands and the UK, rely on a more balanced public funding mix, promoting both education and research, and incentivising the universities to also look for external, private funding. As discussed earlier in the report, **the higher education curricula put little focus on innovativeness and creativity, and doctoral programmes encourage scientific research but not necessarily innovation-related activities**. The need for technology transfer and research commercialisation is still not fully recognised by the higher levels of university leadership, and this also leads to the absence of an observable connection between research and innovation at universities.

Entrepreneurship training is not widely available in Hungary and only recently some universities have started such activities for non-business students. Stakeholders representing the private sector as well as some of the academic researchers interviewed for the Peer Review project highlighted the lack of project management education, leaving the university graduates unprepared for collaboration with, or employment in, the private sector. There are few industrially-oriented doctoral programmes where PhDs can be trained within companies.

Even though **Technology Transfer Offices (TTOs)** have been established at major universities following Hungary's accession to the EU, **the commercial exploitation of public research results, including through knowledge transfer and spin-off creation, remains limited**. At the same time, positive developments in some of the convergence regions can be observed, for example in Győr, Miskolc and Debrecen. Many of the above-mentioned TTOs were established based on grants financed from the EU Structural Funds. However, the completion of supported projects puts at risk the sustainability of operations of these offices. Their sizes tend to be small, with only few employees and problems with recruiting and retaining the experienced personnel.

[41] More information about the government decree No. 395/2015 (decree on the implementation of the Act XXXIII of 1992 on the employment status of public sector workers in the higher education and on certain issues of employment in higher education institutions) can be found in section 4.4 of the report.

The national legislations do not prescribe uniform standards for TTO operations, procedures or methodologies of managing contracted R&D projects, technology transfer and spin-off creation. Since 2007, Hungarian laws confirm that inventions generated by university researchers belong to the employing institutions and could be transferred to third parties in a contractual manner. Technology transfer is regarded as a self-financing activity at some universities, but the income it generates cannot fully support the necessary operations. It must also be noted that entrepreneurship incubators tend to operate in isolation from TTOs.

According to the interviewed representatives of business enterprises, **Hungarian universities have slow and complex decision-making processes**, which discourage potential partners from the private sector. In addition, the above-described legal uncertainty also contributes to the delay of procedures. The university reform of 2015 introduced the positions of chancellors, responsible for economic matters, including cooperation with external partners. This change helps to streamline the technology transfer and contract R&D processes of many institutions, but at some of the interviewed universities, it has actually led to an increase in formalization and centralization, with chancellors engaging in micro-management, causing further delays in decision-making processes.

Some companies maintain contacts with individual researchers (as opposed to formal agreements with universities), circumventing the official procedures and eliminating the need to pay the 27 percent VAT on officially registered technology transfer transactions. Moreover, some of the interviewed stakeholders suggested that collaborative R&D projects involving science and industry, which were publicly co-funded, could sometimes be perceived as disguised fundamental research projects, for which scientists needed industry partners to comply with the eligibility criteria, but the companies were not really interested in the project outcomes. This might be explained by the dual character of the Hungarian economy, described earlier in this report: only few large multinational corporations are interested in genuine embeddedness in the Hungarian R&I system and knowledge-based partnerships, while domestic companies do not always have resources or ambitions to pursue R&I-based strategies. In an attempt to approach potential corporate partners, **some universities involve private sector representatives in their governance** (i.e. make them members of the boards of trustees). On the other hand, **domestic business enterprises do not have a tradition of establishing advisory boards that would engage scientists or other stakeholders.**

Case study 14: The Catapult centres (UK) and the Institutes for Technological Research (France)

The Catapult centres scheme in the United Kingdom (www.catapult.org.uk) supports research centres at universities that are co-funded by universities and companies. The centres are organized as not-for-profit, independent technology and innovation centres specialising in specific technological areas. Their main aim is to support the transfer of scientific knowledge into firms and to co-create application and problem oriented knowledge between firms and Universities. The centres are located at the main academic centre of excellence and seek to bring the key experts in a field together. The first centre was opened in 2011, meanwhile 11 centres exist. While in each Catapult, a limited number of firms is at the core, the centres are in principle open to all firms active in the technology of a centre. Catapults are funded through a programme of the innovation agency InnovateUK.

A comparable programme is available in France (http://competitivite.gouv.fr/les-investissements-d-avenir-une-opportunite-pour-les-poles-de-competitivite/les-instituts-de-recherche-technologique-irt-campus-d-innovation-654.html). A French *Institute de Recherche Technologique* (IRT) (Technology Research Institute) is devoted to a specific theme (like nano-electronics, or composite materials) and brings together large and small firms, research laboratories and universities, all working together in a specific place to develop close synergies between actors, with a public-private co-funding. An IRT deals with the entire innovation cycle including research, demonstrators and industrial prototypes. Eight IRTs have been selected by an international peer review panel in 2011, with a total public funding of €2b over 10 years.

Key messages for Hungary:

- The pockets of excellence in the research institutes and universities are systematically linked to key corporate R&D capacity.
- This form of cooperation aiming to excellence is useful also for strengthening the cooperation between SME's and large firms, and private and public actors.
- A central programme can be the catalyst with co-funding.
- Those centres can support a national strategy of focusing on key technological strengths that also attract international corporate R&D.

There are **numerous intermediary organisations** in the Hungarian national innovation system such as regional innovation agencies and foundations for enterprise promotion, but they have not achieved critical mass in size or in the scope of responsibilities.
In Hungary, there are no hotspots of cooperation between the private and public research, which could be compared to applied R&D-oriented organisations such as the German Fraunhofer Institutes, the Finnish VTT or the Dutch TNO. The Hungarian Academy of Sciences operates in ways different from its Western European counterparts. **HAS was traditionally focused on fundamental research and its transformation towards better engagement in private sector partnership networks is gradual and difficult.** Some of the HAS institutes are actively pursuing collaborative strategies, engage in applied research and attract private sector funding for R&D, but the heterogeneity of approaches within the HAS further complicates the picture. HAS institutes do not have their own TTOs, but some of them employ experts supporting legal and financial aspects of technology transfer activities.

Legal and procedural modalities for patenting, knowledge transfer, commercialisation of research results and industry cooperation are diverse, not uniformly regulated for the entire Hungarian Academy of Sciences, and often not even explicitly described. Furthermore, resources in the public science sector are highly fragmented, with a **limited number of initiatives linking universities and HAS in joint research endeavours**. When this couples with the limited public funding for R&D and research infrastructures, it additionally weakens the science base and makes it less attractive for external partners, including companies.

6.4. Public support for the science-industry cooperation

The importance of partnerships between higher education institutions, the Hungarian Academy of Sciences and business enterprises is recognised in the national R&I strategy (Ministry for National Economy, 2013, p. 33). Numerous support measures relevant for the science-industry collaboration were available in the 2007-2013 and were announced in the operational programmes based on the EU Structural Funds 2014-2020.

The **"Start-up 13"** scheme aimed at supporting the development of young technology start-ups with high growth potential. It was financed by the former Research and Technological Innovation Fund (KTIA), based on the innovation levy collected from medium-sized and large business enterprises, and was designed to support the establishment of technology incubators for start-ups, technical and economic feasibility analysis of technological ideas, IP protection, incubation process, market entry and subsequent promotion of technological start-ups. However, the restructuring of the R&I system governance delayed the calls and only a limited number of contracts were concluded. The **"Support to market-oriented R&D activities"** scheme and **"Strengthening Co-operative Research Centres (KKK) and Regional Knowledge Centres at Universities (RET)"** scheme were other support measures from the previous financial perspective. Another relevant scheme is the **National Brain Research Programme** (2014-2017), targeting neuroscientific research groups, whit one of the strategic objectives of fostering the academia-business relations.

For the 2014-2020 perspective, the **GINOP and VEKOP operational programmes** foresee multiple measures supporting science-industry cooperation. In **industrial R&D projects**, academic institutions can be subcontracted by companies and these expenditures belong to eligible costs (GINOP 2.1.1, GINOP 2.1.2, VEKOP 2.1.1). **Innovation vouchers** will be available to SMEs, covering the costs of small-scale contracted R&D projects, performed by academic institutions (GINOP 2.1.4). **Joint R&D projects**, delivered by science-industry consortia, will be supported by a scheme "R&D competitiveness and excellence cooperation" (GINOP 2.2.1, VEKOP 2.2.1), focused on sustainable, long-term initiatives in selected strategic focus areas and leading to the commercialisation of R&D results. It has one of the largest budgets among all R&I support measures, foreseeing support for 12-100 successful collaborative initiatives. Another scheme, called **"Higher Education and Industry Cooperation Centres" (FIEK)** (GINOP 2.3.4), aims to co-fund joint projects addressing the economic needs of the industry.

Apart from FIEK, the **National Smart Specialization Strategy** mentions a specific measure addressing the challenge of fostering science-industry cooperation. **"Open laboratories"** are intended to promote inter-sectoral networking and cooperation by making public laboratories available to SMEs, students and researchers who could use the research infrastructures in a regulated and transparent manner. This could be particularly important for SMEs that previously could not afford to acquire the needed infrastructure and could not benefit from other modalities for accessing them. GINOP 2.3.2 and 2.3.3 measures support **research infrastructures and infrastructure-based projects at scientific organisations**, and could be used for strengthening the collaboration with business enterprises.

Among the public investments in research infrastructures, **ELI-ALPS** should be mentioned – the Hungarian pillar of the Extreme Light Infrastructure (ELI) project in Szeged, funded from the EU

Structural Funds and expected to be completed in 2016. The ELI-ALPS facility will be accompanied by an adjoining science park, built in collaboration with the University of Szeged. Finally, the funding scheme related to IP protection (GINOP 2.1.3) is available both to companies and scientific organisations, helping them cover the costs of international patenting that could further stimulate technology transfer.

Further collaboration is visible in the field of education, as universities started introducing **"dual training"** in 2015 to teach students jointly with companies. Dual training is a specific type of undergraduate degree programme, in which students accept a higher workload compared to traditional programmes. The main benefit is expected to come from the employment by a company, where students gain work experience during their internships. The purpose of dual training is to address the shortage of skilled labour, but it has only limited impact on the population of R&D personnel. In 2015, about 440 students participated in this initiative, through 30 BSc programmes delivered by 19 higher education institutions, with more than half of them being engineering students. The quality of education is overseen by the Dual Training Council, consisting of representatives of government, universities and industry.

Students combine corporate internships with regular studies, and are paid regular wages by companies based on contracts signed upon admission to the programme, and companies can benefit from tax allowances related to the cost of the training. The development of new dual training programmes will also be supported from the EU Structural Funds, 2016-2020. These publicly co-funded programmes have only been up and running for a year, therefore, it is too early to evaluate their impact. The long-term cooperation between universities and companies could also be envisaged by expanding the dual training to graduate and doctoral students. Some universities offer also dedicated courses or master programmes to train future employees for selected partner companies, but the scale of such efforts remains limited. For ICT companies, there will be a separate scheme supporting cooperation with educational institutions (GINOP 3.1.1).

Recommendation 32: *Cooperation between universities, institutes of the Hungarian Academy of Sciences and industry, including at the level of individual entrepreneurs, should be further promoted through targeted means. These can include: dedicated grant programmes to foster the mobility of researchers to industry and vice versa as well as closer-to-market research; the provision of appropriate physical infrastructures (e.g. shared laboratories, incubators, accelerators, science parks, innovation clusters); the introduction of transparent and adequate incentives for inter-sectoral mobility including adequate appointment and promotion criteria in the public sector to recognise the value of business exposure for researchers; the involvement of private sector representatives in the governance of public sector R&I performers; and the promotion of knowledge transfer programmes at institutional and system level.*

Case study 15: Enhancing doctorate holder careers in industry: the SFI Industry Fellowship (Ireland) and PoDoCo program (Finland)

In addition to providing a number of fellowships for researchers wishing to pursue a career in academia, Science Foundation Ireland also provides support for researchers, who wish to develop their careers in industry. Through the SFI Industry Fellowship Programme (http://www.sfi.ie/funding/funding-calls/open-calls/industry-fellowship-programme-2016.html), Science Foundation Ireland will fund researchers in Ireland to spend up to one year working on a collaborative research project in a company anywhere in the world (including in Hungary!). At the end of that project, the researcher is free to return to Ireland, to stay in the overseas country, to continue working in industry or to return to the university, i.e. it is completely open. This scheme provides an opportunity for researchers to experience industrial research and it also offers a chance for the industry to benefit from experiences of various research groups in Irish universities.

PoDoCo (postdocs in companies, www.podoco.fi) is a matchmaking program supporting long-term competitiveness and strategic renewal of companies and employment of young PhD holders in the private sector. The postdoc will get a chance to gain merit by working in the private sector, which is supported by a grant to solve a problem of strategic importance to a company. Finnish companies can approach the program with a problem to be solved. The foundation pool behind the program is the matchmaker and grant funding provider. The company is to fund another matching project period. All fields and all types of companies are eligible to the program. In the Finnish R&I system, PoDoCo is an important measure to broaden the variety of companies hiring PhDs, going beyond the large, R&D intensive companies. It also makes PhDs more interested in working for the private sector.

Key messages for Hungary:

- Academic researchers (especially young postdocs) can benefit from opportunities to engage in industrial research and broaden the scope of career prospects.
- The schemes strengthen mobility and cooperation between public and private research organisations, help researchers transition to a career in industry and expand competences.
- The schemes allow industry to sample the benefits of research collaboration with the public science system and see the real added value in hiring R&D experts, who offer solutions to practical problems, identified by the companies.

One of the latest developments at the national policy level is the governmental announcement of the adoption of the **Industrial Development Strategy for 2016-2020** (the so-called **"Irinyi Plan")** in March 2016. Despite the announcement, the Plan is not yet publicly available (see also: section 3.3 of this report). According to the information provided by government representatives to the Peer Review panel, the Plan is expected to transform Hungary into an innovation-driven economy. While the importance of partnerships between HEIs, PROs and business enterprises at regional, national and international levels is recognised, the references to inter-sectoral R&D and collaborations with university in the Industrial Development Strategy were characterised as limited. Consistent approaches to science-industry cooperation in the key policy documents and across the entire legislative framework are crucial for building a sustainable R&I ecosystem.

Case study 16: Impact programme (Netherlands)

The Dutch Ministry of Economic Affairs launched the Impact Program in 2010 with the aim to improve the ecosystems of universities and research institutes. The program is open to consortia of universities, companies and public parties. The aim is to improve science-business collaboration in order to bring research results to the market and have universities and research institutes take up questions from the public and private sectors. The budget was €63m. The programme is now closed and projects are running until 2018.

Typical activities that take place within the framework of the program are:

- Knowledge transfer **-** universities develop in house screening and scouting activities and business development. The goal is to identify and develop knowledge with commercialization potential. Knowledge Transfer Offices are set up to organize screening and business development, and to support cooperation with public and private partners.

- Startup support - universities are setting up business incubators where researchers and graduates are supported in the development of new businesses. Incubators are essential in the conversion of knowledge into applications with economic potential. Typically, pre-seed funding is available through participation of financial institutions.

- Entrepreneurship education - universities offer entrepreneurship courses and activities. These are regarded an essential condition to provide students with the entrepreneurial skills necessary when aiming at setting up a business, or when working in private companies after graduation.

Key messages for Hungary:

- Individual, isolated measures are not sufficient to exploit the innovation potential of any country. What is needed is to systemize innovation by creating a coherent ecosystem, where interaction within universities and knowledge institutes and between public and private sector is greatly enhanced.
- The government has the ability to act as a moderator, through (limited) co-funding or other incentives as well as mobilizing the necessary support of other institutions such as financial institutions.
- The transfer of knowledge and expertise of universities is fundamental to support innovation. Key is to organize for such transfer to take place in a fluid way. Building the bridge and liaison to support the interaction with businesses. Technology Transfer offices can be one element of this support.

Even though there are more consistent policy efforts since 2013 to support the cooperation between science, higher education and business, the achievement of good results may still be hampered due to the **lack of connection and continuation between different programmes** launched over time. The newly introduced support measures, offered by GINOP and VEKOP, seem to adequately address some of the challenges related to the science-industry cooperation, but many of these calls have not been launched yet. In this particular field of public support, the instability of the national R&I system has been visible over the recent years, leading to the **uncertainty of results and the short-term orientation of strategies and schemes**.

Some of the relevant support measures are subject to **constant redesign and renewal and key players have shown difficulties in adopting them**. There were no *ex post* evaluations of the previously available support measures, so no lessons learned were drawn from the relevant experiences to improve the impact of the measures. Relevant stakeholders of these measures were also not consulted in structured, inclusive and transparent processes, which could involve both beneficiaries of the previous funding as well as organisations that did not benefit from it (either due to their lack of interest or lack of success in funding applications). In addition, recent policies did not have sufficient time to produce visible effects, as some support measures outlined in the R&I strategy from 2013 have only been introduced in 2015, and others are still awaiting their launch in 2016.

Due to the recent changes in the described area, ***the Peer Review panel was not able to comment on the design and expected impacts of the new support measures, especially (and obviously) schemes that were still to be launched. The panel found it difficult to formulate specific conclusions and recommendations without the necessary data that would require a thorough, methodologically sound analysis.***

While there is a broad portfolio of schemes addressing various R&I aspects and involving inter-sectoral cooperation, these **newly introduced schemes and strategic documents do not seem sufficiently co-ordinated and complementary**. Moreover, interviews with stakeholders representing different parts of the Hungarian R&I system revealed the lack of representative, in-depth consultations of the intended support measures and it is unclear whether their design matches the actual needs of the scientific and business community. Failure to conduct independent, methodologically sound *ex post* evaluations of previously available support measures and no thorough *ex ante* evaluations of the specific measures launched in the financial perspective 2014-2020 might contribute to possible mismatches between the government's intent to promote science-industry cooperation and the achieved results. Ideally, the cooperation could result from a natural understanding of the broader, societal contributions of scientists and the "third mission" of scientific organisations, as well as from motivations of companies to benefit from innovations developed by external partners.

These perceptions and value systems cannot easily be transformed by the mere availability of financial incentives, which rather induce short-term inter-sectoral liaisons. Genuine promotion of science-industry cooperation might also require a more time-consuming process of societal changes, which would need to be supported on multiple levels, including by promoting entrepreneurial culture, encouraging research collaboration between multiple partners, educating students and young researchers to appreciate research oriented towards addressing societal or business objectives, and reforming the enabling legal environment to facilitate knowledge transfers between academia and companies.

Recommendation 33: *The design of support measures intended to stimulate science-industry cooperation should take into account the lessons learned from past experiences and from existing policy actions, including the results of the independent evaluations of programmes and the views of stakeholders (beneficiaries and non-users of these support measures). Hungary should equally learn from successful European schemes supporting science-industry cooperation. National support schemes for science-business cooperation should undergo regular impact evaluations in order to promote their further incremental improvement.*

6.5. Summary table

Science-industry cooperation, technology transfer and entrepreneurship	
STRENGTHS	**WEAKNESSES**
+ high shares of innovative business enterprises cooperating with scientific organisations	– R&D activities highly concentrated in large companies, and based on in-house research
+ importance of science-industry cooperation recognized by key R&I policy documents and funding programmes	– limited public funding for universities and Hungarian Academy of Sciences decreases their attractiveness as potential partners for industry
+ private sector's role in funding public science higher than the EU average	– public science focused on fundamental research and academic publishing
	– fragmentation of resources in the public science system, with few collaborative initiatives
+ existence of Technology Transfer Offices at universities	– limited scope of knowledge transfer and spin-off creation at scientific organisations, with limited opportunities and places for science-industry cooperation
	– burdensome, bureaucratic procedures of universities, discouraging partners
	– lack of uniform legal standards or procedures for technology transfer, managing contracted R&D projects or spin-off creation
	– small counts of patents filed by universities and Hungarian Academy of Sciences and limited licensing revenues
	– Technology Transfer Offices of universities under-funded and under-staffed
+ industrially-oriented graduate programmes offered by some universities	– insufficient project management skills of university graduates and researchers
+ dual study programmes bringing universities and industry closer	– education (not research, knowledge transfer or societal contributions) is considered the primary task of universities
+ new support measures targeting	– cultural factors discouraging entrepreneurial

science-industry cooperation offered by NRDIO	attitudes at scientific organisations

RECOMMENDATIONS

- ✓ **Recommendation 32:** Cooperation between universities, institutes of the Hungarian Academy of Sciences and industry, including at the level of individual entrepreneurs, should be further promoted through targeted means. These can include: dedicated grant programmes to foster the mobility of researchers to industry and vice versa as well as closer-to-market research; the provision of appropriate physical infrastructures (e.g. shared laboratories, incubators, accelerators, science parks, innovation clusters); the introduction of transparent and adequate incentives for inter-sectoral mobility including adequate appointment and promotion criteria in the public sector to recognise the value of business exposure for researchers; the involvement of private sector representatives in the governance of public sector R&I performers; and the promotion of knowledge transfer programmes at institutional and system level.

- ✓ **Recommendation 33:** The design of support measures intended to stimulate science-industry cooperation should take into account the lessons learned from past experiences and from existing policy actions, including the results of the independent evaluations of programmes and the views of stakeholders (beneficiaries and non-users of these support measures). Hungary should equally learn from successful European schemes supporting science-industry cooperation. National support schemes for science-business cooperation should undergo regular impact evaluations in order to promote their further incremental improvement.

7. REFERENCES

Ács, Z.J., Szerb, L., Autio, E. (2016) Global Entrepreneurship and Development Index 2016 - GEDI. The Global Entrepreneurship and Development Institute, Washington – Pecs – London. http://thegedi.org/countries/hungary[42]

Arundel, A., Es-Sadki, N., Barjak, F., Perrett, P., Samuel, O., Lilischkis, S. (2013) Knowledge transfer study 2010–2012. Final Report. European Commission, Directorate-General for Research and Innovation, Brussels. http://ec.europa.eu/research/innovation-union/pdf/knowledge_transfer_2010-2012_report.pdf

BudapestHUB (2013) Budapest Runway 2.0.2.0. The start-up credo. BudapestHUB Working Group, Budapest. http://nkfih.gov.hu/the-office/press-room/budapest-2-0-2-0-runway

CPB, CAPP, CASE, CEPII, ETLA, IFO, IFS and HIS (2014) A study on R&D tax incentives. Final report. Taxation Papers, Working Paper No. 52. https://ec.europa.eu/futurium/en/system/files/ged/28-taxud-study_on_rnd_tax_incentives_-_2014.pdf

CRCB (2016) Versenyerősség és korrupciós kockázatok. A magyar közbeszerzések statisztikai elemzése – 2009-2015. Corruption Research Center Budapest. http://www.crcb.eu/wp-content/uploads/2016/03/hpp_2016_crcb_report_2016_hu_160303_.pdf

Csőke, A., Eglesz, G., Imre, O.B., Flamich, T., Kovács, E., Mészáros, Á., Rapkay, B., Szabó, I. (2013) RDI Mirror 3. Regional characteristics of RDI in Hungary. National Innovation Office, Budapest. http://www.kaleidoszkop.nih.gov.hu/documents/15428/38972/RDI%20Mirror%203%20Regional%20FINAL

Deloitte (2014) Researchers' Report 2014. Country Profile: Hungary. http://ec.europa.eu/euraxess/pdf/research_policies/country_files/Hungary_Country_Profile_RR2014_FINAL.pdf

Deloitte (2015) Deloitte Central European Corporate R&D Report 2015. http://www2.deloitte.com/content/dam/Deloitte/hu/Documents/tax/hu-R&D-survey-2015-Central-European-eng.pdf

Dőry, T. (2014) ERAWATCH Country Reports 2013: Hungary. JRC Science and Policy Report. JRC-Institute for Prospective Technological Studies, Seville. https://rio.jrc.ec.europa.eu/en/file/7745/download?token=zZMkjfEU

Dőry, T. (2015) RIO Country Report Hungary 2014. JRC-Institute for Prospective Technological Studies, Seville. https://rio.jrc.ec.europa.eu/en/file/7994/download?token=vvebC0EK

EC (2014) Research and innovation performance in the EU. Innovation Union progress at country level, 2014. European Commission, Directorate-General for Research and Innovation, Brussels. http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2014/iuc_progress_report_2014.pdf

EC (2015a) Erasmus+ statistics 2014. Hungary. European Commission, Brussels. http://ec.europa.eu/education/library/statistics/2014/hungary_en.pdf

EC (2015b) 2015 SBA fact sheet. Hungary. European Commission, Brussels. http://ec.europa.eu/DocsRoom/documents/16344/attachments/15/translations/en/renditions/native

EC (2016a) Country Report Hungary 2016. Including an in-depth review of the prevention and correction of macroeconomic imbalances. Commission staff working document, SWD(2016) 85 final. European Commission, Brussels. http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_hungary_en.pdf

[42] Access date for all Internet sources included in the list of references: 30 June, 2016.

EC (2016b) Science, research and innovation performance of the EU. A contribution to the Open Innovation, Open Science, Open to the World agenda. European Commission, Directorate-General for Research and Innovation, Brussels.
https://rio.jrc.ec.europa.eu/en/file/9083/download?token=LCOIWLRJ

EC (2016c) European economic forecast. Spring 2016. European Economy Institutional Paper, 025. European Commission, Directorate-General for Economic and Financial Affairs, Brussels.
http://ec.europa.eu/economy_finance/publications/eeip/pdf/ip025_en.pdf

EC (2016d) European Innovation Scoreboard 2016. European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs and Directorate-General for Research & Innovation, Brussels.
http://ec.europa.eu/DocsRoom/documents/17822/attachments/1/translations/en/renditions/native

Edler, J. (2007) Internationalisierung der deutschen Forschungs-und Wissenschaftslandschaft. Fraunhofer-IRB-Verlag, Stuttgart.

Edler, J. (2011) Innovation in EU CEE: the role of demand-based policy. In: S. Radosevic, A. Kaderabkova (Eds.), Challenges for European innovation policy. Cohesion and excellence from a Schumpeterian perspective. Edward Elgar, Cheltenham, UK – Northampton, US, pp. 177-208.

Edquist, C. (2014): Efficiency of research and innovation systems for economic growth and employment. Final report from the session I of the 2014 ERAC Mutual Learning Seminar on Research and Innovation policies.
https://era.gv.at/object/document/1348/attach/Item_6_2__2_.pdf

Ernst & Young and GKI (2010) Comprehensive assessment study about the operation of the Research and Technology Fund (KTIA), 01.01.2004 – 31.12.2009. Ernst & Young Advisory Ltd. - GKI Economic Research Co., Budapest. http://nkfih.gov.hu/hivatal/hivatal-kiadvanyai/kutatasi-technologiai

ESF (2014) Organisational evaluation of the Hungarian Scientific Research Fund (OTKA). Evaluation Report. European Science Foundation, Brussels – Budapest.
http://www.esf.org/uploads/media/otka_evaluation_01.pdf

Eurobarometer (2015) Flash Eurobarometer, Businesses and corruption. September – October 2015. European Commission, Brussels.
http://ec.europa.eu/COMMFrontOffice/PublicOpinion/index.cfm/ResultDoc/download/DocumentKy/69802

Eurostat (2016) Eurostat database. Eurostat, Luxembourg. http://ec.europa.eu/eurostat/

Eval-INNO (2014) Developing RTDI evaluation culture in South East Europe. Fostering evaluation competencies in research, technology and innovation – the EVAL-INNO experience. LIT Verlag, Vienna. https://wbc-rti.info/object/document/14453/attach/EVAL-INNO_Final_Publication_WEB.pdf

EVCA (2015) Central and Eastern Europe Statistic 2014. An EVCA Special Paper. August 2015.
http://www.investeurope.eu/media/403969/EVCA-CEE-Statistics-2014.pdf

fDi Intelligence (2015) The fDi report 2015. Global greenfield investment trends. The Financial Times, London. http://forms.fdiintelligence.com/report2015/files/The-fDi-Report-2015.pdf

Havas, A. (2003) Evolving foresight in a small transition economy. The design, use and relevance of foresight methods in Hungary. Journal of Forecasting, 22(2-3), pp. 179-201.

Havas, A. (2015) Types of knowledge and diversity of business-academia collaborations: Implications for measurement and policy. Triple Helix, 2(12), pp. 1-26.

Hegyi, F.B. (2015) Stairway to Excellence country report: Hungary. JRC Science and Policy Report. JRC-Institute for Prospective Technological Studies, Seville.
http://s3platform.jrc.ec.europa.eu/documents/20182/117536/S2E_Report_HU.pdf/d92bd75a-359d-4f1f-83cb-b548d4551a62

Hicks, D. (2012) Performance-based university research funding systems. Research Policy, 41, pp. 251-261.

HIPO (2015) HIPO Annual Report 2014. Hungarian Intellectual Property Office, Budapest. http://www.sztnh.gov.hu/sites/default/files/csatolmanyok/sztnhevesjelentes2014.pdf

IPTS (2015) The 2015 EU Industrial R&D Investment Scoreboard. R&D ranking of EU top 1000 companies. JRC-Institute for Prospective Technological Studies, Seville. http://iri.jrc.ec.europa.eu/documents/10180/649011/SB2015%20EU%201000

Jonkers, K., Zacharewicz, T. (2016) Research performance based funding systems: A comparative assessment. JRC Science and Policy Report, JRC-Institute for Prospective Technological Studies, Brussels. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101043/jrc101043_pbf%20final(1).pdf

Köhler, C., Rammer, C., Laredo, P. (2012) The impact and effectiveness of fiscal incentives for R&D. In: Compendium of Evidence on the Effectiveness of Innovation Policy. Manchester Institute of Innovation Research - NESTA, London - Manchester. http://www.innovation-policy.org.uk/share/01_The%20Impact%20and%20Effectiveness%20of%20Fiscal%20Incentives%20for%20R&D.pdf

Kothe, E., Gestrin, M., Avery, C. (2014) FDI in figures. International investment struggles. OECD, Paris. http://www.oecd.org/investment/FDI-in-Figures-Feb-2014.pdf

KSH (2011) A doktori fokozattal rendelkezők életpályája. Statisztikai Tükör, No. 2011/19. Hungarian Central Statistical Office, Budapest. https://www.ksh.hu/docs/hun/xftp/stattukor/dokteletpalya.pdf

KSH (2015a) Kutatás-fejlesztés, 2014. Táblázatok. Hungarian Central Statistical Office, Budapest. http://www.ksh.hu/docs/hun/xftp/idoszaki/tudkut/tudkut14.xls

KSH (2015b) R&D units and R&D staff number. Hungarian Central Statistical Office, Budapest. http://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_ohk002a.html

KSH (2015c) R&D expenditure (1900-). Hungarian Central Statistical Office, Budapest. http://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_ohk003a.html

KSH (2016) Average gross earnings amounted to HUF 249,400. First Release, Earnings, January 2016. Hungarian Central Statistical Office, Budapest. http://www.ksh.hu/docs/eng/xftp/gyor/ker/eker1601.html

Kuhlmann, S., Rip., A. (2015) New constellations of actors addressing grand challenges: Evolving concertation. KISTEP Inside and Insight, Seoul, September 2015, pp. 8-11.

Ministry for Human Capacities (2014) A change of pace in higher education. Ministry for Human Capacities, Budapest. https://rio.jrc.ec.europa.eu/en/file/7071/download?token=2_ewspGV

Ministry for National Economy (2013) Investment in the future. National research and development and Innovation Strategy (2013-2020). Ministry for National Economy, Budapest. http://nkfih.gov.hu/policy-and-strategy/national-strategies/national-rdi-strategy/2013-2020

Ministry of Rural Development (2012) National environmental technology innovation strategy. Ministry of Rural Development, Budapest. http://kornyezettechnologia.kormany.hu/admin/download/b/4f/50000/NETIS_English.pdf

MK (2016) Stratégiai partnerségi megállapodások. Magyarország Kormánya, Budapest. http://www.kormany.hu/hu/kulgazdasagi-es-kulugyminiszterium/strategiai-partnersegi-megallapodasok

MNB (2015) Elemzés a hazai kockázati tőkealap-kezelők és alapok működéséről. Hungarian National Bank, Budapest. http://www.hvca.hu/wp-content/uploads/2012/03/Elemzes_a_kovkazati_tokealapkezeloi_szektorrol_0202.pdf

NIH (2012) A Kutatási és Technológiai Innovációs Alap által finanszírozott pályázati portfólió hasznosulásának elemzése (2004-2011). Nemzeti Innovációs Hivatal, National Innovation Office, Budapest. http://nkfih.gov.hu/hivatal/hivatal-kiadvanyai/kutatasi-technologiai-150203-10

NIH (2013a) A Nemzeti Innovációs Hivatal kutatás-fejlesztési és innovációs (KFI) értékelési feladatainak módszertani vezérfonala. Nemzeti Innovációs Hivatal - National Innovation Office, Budapest. http://nkfih.gov.hu/szakpolitika-strategia/fogalomtar/nemzeti-innovacios-150203

NIH (2013b) Regional characteristics of RDI in Hungary. RDI Mirror, 3. Nemzeti Innovációs Hivatal - National Innovation Office, Budapest. http://temp.uefiscdi.ro/EDIGIREGION/RDI%20Mirror%203%20Regional%20FINAL.pdf

NIH (2014) Supporting the improvement of international relations through the evaluation of support schemes facilitating Hungary's participation in FP7. Nemzeti Innovációs Hivatal - National Innovation Office, Budapest. http://nkfih.gov.hu/hivatal/hivatal-kiadvanyai/supporting-the

OECD (2008) OECD reviews of innovation policy: Hungary. OECD, Paris. http://www.oecd-ilibrary.org/science-and-technology/oecd-reviews-of-innovation-policy-hungary-2008_9789264054059-en

OECD (2015a) Science, Technology and Innovation Scoreboard 2015. OECD, Paris. http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2015_sti_scoreboard-2015-en

OECD (2015b) Direct government funding of business R&D and tax incentives for R&D, 2013. OECD Science, Technology and Industry Scoreboard 2015. OECD Publishing, Paris. http://dx.doi.org/10.1787/888933274317

OECD (2016a) OECD.Stat. OECD Publishing, Paris. http://stats.oecd.org/Index.aspx

OECD (2016b) OECD Economic Surveys: Hungary 2016. OECD Publishing, Paris. http://dx.doi.org/10.1787/eco_surveys-hun-2016-en

Osimo, D. and the Startup Manifesto Policy Tracker Crowdsourcing Community (2016) The 2016 Startup Nation Scoreboard. How European Union countries are improving policy frameworks and developing powerful ecosystems for entrepreneurs. http://www.europeandigitalforum.eu/index.php/component/attachments/attachments?id=311&task=view

Ranga, M., Ortega-Argiles, R., Bartzokas, A. (2015) Pre-Peer Review of Hungarian Research and Innovation system. Horizon 2020 Policy Support Facility. European Commission, Directorate-General for Research and Innovation, Brussels. https://rio.jrc.ec.europa.eu/sites/default/files/report/HU%20PPR%20FINAL%20for%20PUBLICATION_0.PDF

Rigby, J. (2013) Review of pre-commercial procurement approaches and effects on innovation. In: Compendium of Evidence on the Effectiveness of Innovation Policy. Manchester Institute of Innovation Research - NESTA, London - Manchester. http://www.innovation-policy.org.uk/share/13_Review%20of%20Pre-commercial%20Procurement%20Approaches%20and%20Effects%20on%20Innovation.pdf

Uyarra, E. (2013) Review of measures in support of public procurement of innovation. In: Compendium of Evidence on the Effectiveness of Innovation Policy. Manchester Institute of Innovation Research - NESTA, London - Manchester. http://www.innovation-policy.org.uk/share/16_Review%20of%20Measures%20in%20Support%20of%20Public%20Procurement%20of%20Innovation.pdf

UNCTAD (2016) World Investment Report. Country fact sheet: Hungary. United Nations Conference on Trade and Development, Geneva. http://unctad.org/sections/dite_dir/docs/wir2016/wir16_fs_hu_en.pdf

Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiou, L., Yeow, J. (2014) Barriers to innovation through public procurement: A supplier perspective. Technovation, 34(10), pp. 631-645.

van Steen, J. (2012) Modes of public funding of Research and Development: Towards internationally comparable indicators. OECD Science, Technology and Industry Working Paper 2012/04. OECD Publishing, Paris. http://dx.doi.org/10.1787/5k98ssns1gzs-en

WEF (2015) Global Competitiveness Report. World Economic Forum, Geneva. http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf

World Bank (2016) World Bank's Doing Business 2016. World Bank Group, Washington. http://www.doingbusiness.org/~/media/GIAWB/Doing%20Business/Documents/Annual-Reports/English/DB16-Full-Report.pdf

KI-02-16-982-EN-N

A 'Policy Support Facility' (PSF) has been set up by the Directorate-General for Research & Innovation (DG RTD) of the European Commission under the European Framework Programme for Research & Innovation 'Horizon 2020', in order to support Member States and associated countries in reforming their national science, technology and innovation systems.

On the basis of a preceding pre-Peer Review process, the full Peer Review of the Hungarian Research and Innovation system was carried out between January and July 2016 by a dedicated PSF panel, consisting of eight independent experts and national peers. The Hungarian national authorities expressed a strong political commitment to this exercise.

The PSF panel arrived at seven Policy Messages highlighted upfront in the report. The report explains the rationale supporting each of those policy statements and discusses the 33 specific recommendations, clustered into thematic areas. Case studies from other countries supplement the narrative by presenting good practice examples that could facilitate the implementation of the recommendations.

It is the country's responsibility to ensure the follow-up to the Peer Review as well as the potential implementation of its recommendations through concrete reforms.

Studies and reports

Publications Office

ISBN 978-92-79-61827-7