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Abstract
The 2015 series of RIO Country Reports analyse and assess the policy and the national research and innovation system developments in relation to national policy priorities and the EU policy agenda with special focus on ERA and Innovation Union. The executive summaries of these reports put forward the main challenges of the research and innovation systems.

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Foreword

The report offers an analysis of the R&I system in Czech republic for 2015, including relevant policies and funding, with particular focus on topics critical for EU policies. The report identifies the main challenges of the Czech research and innovation system and assesses the policy response. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The quantitative data is, whenever possible, comparable across all EU Member State reports. Unless specifically referenced all data used in this report are based on Eurostat statistics available in February 2016. The report contents are partly based on the RIO country report, 2014 (Srholec, 2015a).

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Executive summary

Context

In 2014, gross domestic product (GDP) per capita in purchasing power standards reached €23,200, 85% of the EU28 average. After the real GDP dropped in the peak of the crisis, the economy somewhat recovered but plunged to double-dip recession, however, recent figures indicate that GDP growth has gained momentum.

The Czech Republic is one of the most industrialised Member States. Its main manufacturing industries are automotive, mechanical engineering, electrical engineering, and electronics (RIS3 2014).

The Reform of the Research, Development and Innovation (RDI) System was launched in 2008. The main success area lies in the upgrading of research infrastructures, while the progress has been slow in promoting excellence, opening the research labour market, reforming the evaluation framework and getting ideas to market.

Despite the economic crisis and major slowdown of economic growth, R&D intensity of the economy in terms of gross domestic expenditure on R&D (GERD) as % of GDP increased from the bottom 1.24% in 2008 to 2.00% in 2014 (Eurostat, 2015). Since 2011 public funding slightly predominates over the private one but mostly through the intensive use of the Structural Funds. Business and foreign R&D funding, including from the EU Structural Funds, grew rapidly over the recent years, while national public funding of R&D has been stagnating in the recent years.

Key developments in the R&I system in 2015 included:

- The *the Section for Science, Research and Innovations* section started operation at the Office of the Government.
- Technology Agency launched the *EPSILON* programme supporting applied research and experimental development in three priority areas of competitive knowledge-based economy, sustainability of energy and material resources and environment for quality of life, while Ministry of Trade and Industry approved the *TRIO* programme to support business R&I and public-private research collaboration in key enabling technologies
- The new Operational Programmes of the EU Structural Funds were launched
- *Metodika 2013* guidelines for evaluation of public R&I support were extended until the end of 2016, while new guidelines are expected to be put in place in the period 2017 onwards.
- The *IPN Metodika* project proposed a new methodology for evaluation of research organizations and principles for allocation of institutional funding

The Czech R&I system is aligned with many ERA policies but it would benefit from larger extent of internationalisation. There are restrictions on access to and portability of grants as public funding agencies support almost exclusively resident researchers. Open access to both scientific publications and data for research purposes hinges on underdeveloped infrastructure and institutional framework.

In 2008, a comprehensible reform of the RDI system was launched refocusing the policy measures on innovation and private-public research linkages. Business investment in research and innovation is not only supported by direct subsidies anymore, which used to be the dominant policy measure but by much broader portfolio of instruments, including R&D tax credits, support programmers for joint public-private research projects or regional innovation voucher programmes. Nevertheless, RDI policies continue to be focused predominantly on the supply side and are rooted in the linear model of innovation.

The identified challenges for the Czech's R&I system are:

1. Improving the research excellence and internationalisation of Czech science system
2. Finalising the governance reform and introducing an efficient system of allocation of public research funding
3. Strengthening the public-private collaboration
4. Increasing the innovativeness of domestic companies

R&I Challenges

Challenge 1 Improving the research excellence and internationalisation of Czech science system

Description

Czech Republic has increased its public funding to R&D considerably from 0.56% in 2008 to 0.87% in 2014 but mostly due to the increase of the EU Structural funds devoted to R&D. On the output side, however, the Czech Republic is still lagging behind as regards to the scientific excellence. It has close to the EU-28 average number of international co-publications (37.6% with 2013 reference year) and only 5.7% of Czech scientific publications were among the 10 % of publications most cited worldwide (2000-2013, fractional counting). Also in the excellence indicator the Czech Republic has only little improved its scores between 2008 and 2012, virtually no progress has been made towards increasing the number of PCT patents and highly cited publications. Similarly to other countries of the 2004 accession, the Czech Republic FP7 funding share decreased as compared to FP6 and is now at 27.3€/inhabitant higher than the EU13 average of 17.8 €/inhabitant but significantly lower that the EU15 average of 95.2€/inhabitant (StE 2015). The Czech Republic ranks among countries with the greatest share of non-mobile researchers (including transfers inside the country), a share of more than 50% as compared to around 30% in the UK, Sweden or Belgium (Science Europe 2013), whereas mobility is an important factor of increasing research excellence.

Policy response

One of the objectives of the updated national RDI policy from 2013 is to stimulate research excellence and internationalization. Also the Smart Specialisation Strategy from 2014 underlines their importance for the Czech research system. The Czech Republic has designed several instruments supporting the Czech researchers in participation in the EU programmes, EUPRO II being the largest programme, aims at increasing Czech participation in international R&D programs and bilateral activities. The RETURN programme (2009-2019) with €17M of the total budget supports the leading Czech scientists willing to come back the Czech research organisations after a period spent abroad. The new Operational Programmes foresee instruments supporting Czech teams applying for Horizon 2020 funds and other EU-level funding measures.

Still, the main funding instrument of the Grant Agency of the CR (basic science funding agency) is a standard grant project, to which are allocated nearly three-quarters of the budget thus about €97m in 2014. Projects aimed at excellence in basic research started only in 2011 and received 17% of the budget, junior grants (started in 2014 and replaced postdoctoral grants) got 11% of the funding and international bilateral grants amount to 1% of the total funding. The interim methodology of institutional funding allocation is already taking into account the excellence by awarding additional points for the awardees of the ERC grants. The Czech Republic has also significantly invested in research infrastructures (cf. National Roadmap of the Czech Republic of Large Infrastructures for Research, Experimental Development and Innovation for the years 2016-2022) also with the aim to attract foreign researchers.

Policy Assessment

The current public funding allocation system tends to spread thinly the resources with limited incentives for research excellence and therefore fails to achieve critical mass. There are limited financial incentives (RETURN programme) and no regulatory policy measures that encourage brain circulation and opening up of the Czech research system. The attractiveness of the new research infrastructures might need to be coupled with other soft measures in order stimulate foreign and local researchers to seek employment in the regions where those infrastructures are located.

Challenge 2 Finalising the governance reform and introducing an efficient system of allocation of public research funding

Description

The reform of the structure of the public RDI system commenced in 2008. The Council for R&D and Innovation (CRDI) has gradually become the central policy actor with increasing competencies and the Technology Agency of the Czech Republic (TA CR) was created to allocate funding for applied research, experimental development and innovation on competitive basis whereas the competitive funding for basic science is channelled through the Grant Agency of the CR. Nevertheless, the Ministry of Education, Youth and Sports (MEYS) and the Ministry of Industry and Trade still manage, through different intermediaries, the Operational Programmes (OP) of the EU Structural Funds. It results in overlapping roles of the Ministries (e.g. similar knowledge transfer programmes managed by the Ministry of Industry and Trade and by the Technology Agency of the Czech Republic – see challenge 3), coordination problems as well as fragmentation of funding. The Czech Republic was also subject of the Council recommendation for stalling its civil service reform. The lack of legislation (implemented only in mid-2015) resulted in high turnover of employees of public administration and problems with building capacity necessary for implementation and evaluation of R&I strategies. Moreover, the reform of the system for allocation of institutional funding is long overdue. The changes in the evaluation system were subject to the Council Recommendations in 2011- 2014.

Policy response

Pavel Bělobrádek, the Deputy Prime Minister for the Science, Research and Innovation announced the plans to form a new Ministry for Research and Innovation in August 2015. A new law on Support for Research, Development and Innovation is under preparation that should clarify the status of the Ministry and improve the coordination in the system. The Czech Agencies for Basic Research and Applied Research will have a joint budget to streamline the funding efforts. The government recently approved a creation of a new funding Agency for Entrepreneurship and Innovation replacing the CzechInvest agency in disbursing the EU funds that are under the responsibility of the Industry and Trade Ministry. The adoption of the Civil Service Law is aimed inter alia to decrease the high turnover of civil servants and enhance the analytical capacities of the public administration.

The Government is preparing a new system of evaluation of the results of research organizations and their institutional public funding. For the transition period 2013-2015 the Government on 19th June 2013 approved the interim methodological guidelines based on a combination of peer review and quantitative evaluation based on research outputs including commercialisation of public research results. The IPN METODIKA project designed a new system of evaluation of research organisations and allocation of institutional funding. Pilot testing of the new methodology has been conducted in 2015. Based on those experiences, a new methodology of evaluation of research organizations will be proposed in 2016 and implemented not earlier than 2017.

Assessment

The concentration of the RDI policy under the new Ministry is a way to increase the coordination between the RDI policy and its implementation in various agencies. However, the exact role of the Ministry is still not clear, e.g. if the higher education and innovation will be under the competences of the new body. The new addition to the system, the Agency for Entrepreneurship and Innovation operational in 2016 will even increase the number of actors. The first results of the long awaited reform in evaluation of public funding will be seen only in 2017 but the intermediate methodology with the independent peer-review already introduces more balance to the system based previously solely on quantitative indicators.

Challenge 3 Strengthening the public-private collaboration

Description

The level of privately-funded public R&D expenditure in Czech Republic is very low (€38m in 2014 (one of the lowest in the EU-28). In 2014 it was only 1.23% of the total GERD. What is even more worrying this indicator displays a declining trend since 2000. Also the share of public-private co-publications is low (just about 1% compared to the EU-28 average of 2.2%, RIO calculations based on Scopus, 2015). The patenting activity of public research organisations has grown in the recent years (from 47 patents granted or receiving validation from the Czech Industrial Property Office in 2008, to 144 in 2011 and 190 in 2012)[1] but the general international patenting activity is increasing much slower (EPO registered 167 patent applications in 2014 (10.6% growth compared to 2013) and granted only 66 patents in the same year while PCT patents numbers are even decreasing. The RIS3 strategy recognizes also the low application relevance of public research which is evidenced by a mismatch between fields with high-impact publications and patenting activity (RIS3 2014).

Policy measures

In April 2013, the national research, development and innovation (RDI) policy for 2009-15 was updated and its stress on knowledge transfer and the innovative capacity of the business sector was reinforced.

The Technology Agency of the Czech Republic (TA CR), created in 2009 to support applied research and science-business cooperation designed programmes to support knowledge transfer. ALFA, Competence Centres, DELTA and EPSILON programmes emphasise as one of their main goal promote collaboration of enterprises with public research organisations. GAMA programme of TA CR (€69m 2014 -2019) was specifically designed to support the verification of R&D results in terms of their practical application and their subsequent commercial use.

At the same time, the Ministry of Industry and Trade continued the TIP programme, similar to ALFA in 2009-12, and Innovation programme targeted at knowledge transfer. In 2015 it introduced a new programme supporting applied research and cooperation, TRIO targeting also public-private collaboration.

CzechInvest (the MIT executive agency) Innovation programme supports knowledge transfer and PROSPERITY programme the creation of science and technological parks, TTOs and business angels networks. Many regional governments have implemented innovation voucher programmes

Since 2014 the tax credits that enable enterprises to deduct R&D expenditures from their tax base have been extended to the purchase of external R&D services from research organisations, a policy measure aimed directly at stimulating industry-academia collaborations. Seed fund programmes for researchers are foreseen in the new Operational Programme: Enterprise and Innovations for Competitiveness.

Assessment

The current weak Czech Republic performance may be attributed to still low incentives for researchers to commercialise its results (see challenge 2) as well as low innovativeness of the business sector (challenge 4). The first results of the evaluation reform may be expected in 2015-2016 as the interim methodology already takes into account patents while evaluating the performance of public research institutions. The new tax credit may increase the volume of privately financed public performed R&D and the effects should be monitored in the next years.

[1] http://www.vyzkum.cz/FrontClanek.aspx?idsekce=8304

The existing numerous support measures need to be evaluated and streamlined in the next funding period. Policy measures supporting horizontal mobility such as traineeships or integration in the organization of industry-oriented PhD programmes are however not yet in place. Equity financial instruments for projects of commercialization of know-how in the research organizations (Proof-of-concept programme) is foreseen in the new Operational Programme Enterprise and Innovation for Competitiveness (OP EIC) under the National innovation fund (NIF).

Challenge 4 Increasing the innovativeness of domestic companies

Description

The Czech Republic is characterized by the high employment in medium-high manufacturing although without major changes since 2008 (11.2% in 2014 compared to 5.7% in EU-28 and similar to Slovakia and Germany). About one quarter of Czech value added comes from manufacturing industry and this sector accounts for two-thirds of Business Expenditure on R&D (BERD).

Still, the majority of BERD concentrates downstream with a predominance of experimental development rather than research and is dominated by a few large foreign affiliates. Foreign affiliates accounted for 55% of all business expenditure on R&D in 2013. This results in a dual economy with R&D intensive multinational companies utilizing imported intermediate outputs and non-innovative and not integrated into the global value chains domestic companies (OECD 2014). This is evidenced by the very low share of SMEs introducing marketing/organisational innovations and process/product innovation (25^{th} and 19^{th} in the IUS ranking). Although the Czech Republic fares poorly in the use of venture capital in the IUS, its position should improve given the increased activity of risk investment in the country (EVCA 2014).

Policy response

TA CR has been established in 2009 as the dominant supporter of applied research and innovation and launched a portfolio of new programmes (most prominently ALFA, Competence Centres and the forthcoming EPSILON) but none of its programmes are specifically devoted to supporting innovation in SMEs. At the same time, the OP EI (2007-2013) funded programmes run directly by the Ministry of Trade and Industry supported knowledge transfer in SMEs (Innovation and Development programmes), while the Cooperation programme financed the establishment of technology platforms and clusters.

In 2014, the Czech government has extended the existing tax credits to external R&D services, i.e. contractual research purchased from research organizations. This change was aimed at stimulating industry-academia collaborations but can also stimulate innovativeness of SMEs which lack human resources and infrastructure in-house. The SMEs are also the major beneficiaries of the existing tax incentives for R&D.

New strategy of the Investment and Business Development Agency Czech Invest from 2011 encourages the internationalization of Czech firms by facilitating global links through its Foreign Cooperation Programme and Gesher/Most programme (designed to support the participation of Czech companies of all sizes involved in R&D in cooperation with their partner companies in Israel). The internationalisation of SMEs is also one of the objectives of the new RIS3 strategy.

CzechInvest provides specialized services to entrepreneurs via the projects: CzechAccelarator targeted on internationalization of Czech innovative companies and CzechEkoSystem focusing on couching young entrepreneurs.

Assessment

CzechInvest has managed successfully to integrate management of the EU Structural Funds with FDI and innovation programmes but the creation of the new Agency for Entrepreneurship and Innovation (that will be created by splitting of the roles of CzechInvest) may have an impact on the coordination of those policies. Most of the TA CR funding programmes have been launched only recently and could not yet yield results. Still, the current policy mix is dominated by grant funding with limited efforts devoted to support venture capital or business angels and revolving funds. However, the new programming period foresees a larger portfolio of funding measures that will have to be designed with the lessons learned from the failure of the take up of revolving measures in the 2007-2013 programme.

1. Overview of the R&I system

The Czech Republic is a medium size Central European country with an area of 78.9 thousands square kilometres and population of 10.5 million people, accounting for, respectively, 1.8% and 2.1% of the EU28 total. In 2014, gross domestic product (GDP) per capita in purchasing power standards reached €23,200, 85% of the EU28 average. In 2012 and 2013, the economy plunged into a recession with GDP declining by 0.9% and 0.5%, respectively, however, in 2014 the GDP grew by 2.0% and in 2015 the recovery is gaining further momentum with annual GDP growth rate well above the EU28 average (Eurostat, 2015).

The macroeconomic situation is relatively favourable. Unemployment rate is well below the EU28 average and slightly decreasing from 7.0% in 2012 to 6.1% in 2014. Budget deficit as % of GDP halved from 3.9% in 2012 to 2.0% in 2014 and remained safely below the 3% threshold for two consecutive years, which is expected to last in the near future. Government debt as % of GDP oscillated in the narrow range of 42% to 45% over 2012-2014, thus not representing a major concern for macroeconomic stability.

Despite the recession, gross domestic expenditure on R&D (GERD) significantly increased both in nominal terms and as % of GDP from 1.79% in 2012, to 1.91% in 2013 and to 2.00% in 2014, hence closing the gap vis-à-vis the EU28 average. The share of manufacturing in value added was 37.9% in 2014, which indicates that the economy is one of the most industrialized in the EU28. A relatively large share of employment is concentrated in the high and medium-high manufacturing sectors, particularly automotive, mechanical and electrical engineering, while employment in knowledge intensive services is on the rise. However, indigenous innovation capabilities remain modest and there is a lingering technology gap between domestically and foreign owned firms.

The Innovation Union Scoreboard 2015 (European Commission, 2015a) classified the Czech Republic among the "moderate innovators", which maintain the overall innovative performance slightly below the EU28 average. Nevertheless, the Czech Republic moved up to the 2nd place in the moderate innovators category just short of Estonia but already ahead of Italy, Spain, Portugal and Greece. The main strengths are in upper secondary education, R&D expenditure in the public sector, international scientific co-publications and exports of medium and high-tech products. The weak areas are concentrated in top scientific publications, internationalization of public research sector, public-private scientific co-publications, access to venture capital and the output of applied research with regards to the usage of intellectual asset protection and licensing revenues.

The mid-term update of the RDI policy 2009-2015 (CRDI, 2013a) and the new National Policy of RDI of the Czech Republic 2016 – 2020 (CRDI, 2016) reconfirmed the commitment to meet the 2020 national target of 1% of public spending on R&D per GDP. In 2014, public sector R&D funding, if combined from national and foreign sources, reached 0.97% of GDP, hence the national 2020 goal has been already met (Eurostat, 2015). However, this is to a large extent due to the construction of several major EU-funded projects of research infrastructure. It remains to be seen whether this level of public R&D funding will be sustained after these investments are finished.

After a period of political instability and early parliamentary elections, a centre-left majority government has been formed at the beginning 2014. Pavel Bělobrádek, leader of the junior coalition partner the Christian Democratic Union – Czechoslovak People's Party, has been appointed the Deputy Prime Minister for the Science, Research and Innovation, a newly created position in the RDI governance system, and the Chairman of the CRDI. A new Section for Science, Research and Innovations has been formed at the Office of the Government, which provides administrative support to the CRDI. A new RDI law is under preparation, which considers forming a separate Ministry for Research and Development, thus fundamentally reforming governance of the national RDI system.

Table 1 Main R&I indicators 2012-2014

Indicator	**2012**	**2013**	**2014**	**EU -28**
GDP per capita	15,300	14,900	14,700	27,400
GDP growth rate	-0.9	-0.5	2.0	1.4
Budget deficit as % of GDP	-4.0	-1.3	-1.9	-3.0
Government debt as % of GDP	44.7	45.2	42.7	86.8
Unemployment rate as % of the labour force	7.0	7.0	6.1	10.2
GERD in €m	2,877	2,997	3,091	283,009
GERD as % of the GDP	1.79	1.91	2.00	2.03
GERD (EUR per capita)	273.9	285.0	294.0	558.4
Employment in high- and medium-high-technology manufacturing sectors as % of total employment	10.5	10.8	10.9	5.7
Employment in knowledge-intensive services as % of total employment	32.0	32.8	32.2	39.8
Turnover from innovation as % of total turnover	18.7	15.3	13.4	11.9
Value added of manufacturing as % of total value added	36.6	37.4	37.9	26.2
Value added of high tech manufacturing as % of total value added	1.4	2.0	2.2	2.5

Source: Eurostat (2015)

1.1 Structure of the national research and innovation system and its governance

1.1.1 Main features of the R&I system

RDI policy making is fairly centralized. Regional authorities, the self-governing regions at the NUTS3 level, do not have any legally binding responsibilities in this respect. At the regional level, the role of RDI policy is limited to the implementation of national programmes and the implementation of regional development policies. Nonetheless, the law does not prevent the regional authorities from launching their own RDI policy initiatives, though only a very few have done so, for example, by launching innovation voucher programmes. Nevertheless, this is changing, at least in some regions, in the context of the RIS3 strategies implementation.

The private part of R&D system is characterized by openness that is one of the highest in the EU28. In 2014, the business sector financed 56.0% of R&D, of which roughly two-thirds were funded from domestic sources and one third was obtained from abroad. Foreign public sources, predominantly the EU Structural Funds, accounted for as much as 32.1% of public R&D funding and recorded a major increase during the previous programming period. Since 2007 more than half of BERD is performed by foreign affiliates, a bulk of which is concentrated in R&D facilities of major multinational corporations. Both the HEIs and PROs play a major role in the public R&D sector. In 2014, HEIs performed 25.5% and the PROs 18.0% of R&D.

1.1.2 Governance

In 2008, the Reform of the Research, Development and Innovation (RDI) system was launched. The reform profoundly changed the governance of RDI policy. Competences of particular governmental bodies are given by the Act No. 130/2002 Coll. on the Support of Research and Development from Public Funds and by the Reform amendment Act. no 211/2009 Coll. The main players in RDI policy making are as follows:

Deputy Prime Minister for the Science, Research and Innovation is a member of the government responsible for RDI policy supported by the Section for Science, Research and Innovations (SRI) at the Office of the Government.

Council for Research, Development and Innovation (CRDI) is an advisory government body for RDI policy with 17 members chaired by the Deputy Prime Minister for the Science, Research and Innovation. At the political level, the CRDI plays the main strategic and coordinating role.

Ministry of Education, Youth and Sports (MEYS) is the central administrative authority for R&D programmes in the public sector, particularly institutional funding for public universities, and for promoting international research collaboration.

Ministry of Industry and Trade (MIT) administers policies in the domain of business RDI.

Technology Agency of the Czech Republic (TA CR) provides competitive funding for applied research, experimental development and innovation.

Czech Science Foundation (GA CR) provides funding for competitive grants in basic research.

Czech Academy of Sciences (CAS) is a major funding provider and as the whole the single most important research performer.

Council of Higher Education Institutions (CHEI) and Czech Rectors Conference (CRC) coordinate and represent higher education institutions.

Association of Research Organizations (AVO) represents about 80 private research institutes specialized in applied research.

Association of Innovative Entrepreneurship (AIE) consists of 30 organizations representing about 84,000 self-employed persons and 1,100 corporations.

CRDI proposes to the government multi-annual RDI budget plan, which consists of a proposal for national public RDI expenditure in the following year and an outlook over two additional years. Nevertheless, the outlook is frequently subject to changes in the next budgetary cycle, hence the multi-annual budgeting framework does not ensure predictable policy. So far a macroeconomic model has not been used to assess the RDI impact on economic growth and there are no plans to create one.

Methodology of Evaluation of Research Organizations and Evaluation of Finished Programmes (valid for years 2013 - 2015), so-called Metodika 2013 (CRDI, 2013b), outlines the official guidelines for evaluation of public R&D support. Monitoring system is fairly advanced and effective. Research and Development and Innovation Information System of the Czech Republic (IS VaVaI) provides open access to regular, detailed and complete data about publicly funded support measures, projects and their outputs. Yet the data is underutilized for evaluation purposes. The evaluation methodology is reduced to descriptive tabulations of data on R&I inputs and outputs that does not provide strategic intelligence for programme development and policy making. Ex-ante, ongoing, ex-post evaluations and impact analyses that provide accurate and comparable information on the programmes according to international standards are not regularly conducted. International benchmarking of research institutions is lacking.

1.1.3 Research performers

At the heart of the public research sector is (i) the Czech Academy of Sciences (CAS), consisting of 54 formally independent public research institutes, and (ii) 26 public, 2 state and 44 private HEIs. Unlike in Western Europe, a large part of research activities are under the umbrella of the CAS, the primary mission of which is to conduct basic research, while the higher education sector has been traditionally less research-oriented and more focused on teaching. Nevertheless, this has been changing in recent years, as the CAS tends to get more involved in applied research and the higher education sector significantly expands its research activities.

The private research sector consists of about 2,300 actors that perform R&D activities, of which about 25% are foreign affiliates and 80% are small and medium size enterprises. The main R&D performing sectors are the automotive, machinery, electronics and information and communication industries with about 50% share in both R&D employment and expenditure, respectively (CZSO, 2015a). The largest single private R&D performer is well-known to be the carmaker Škoda Auto, a part of the Volkswagen Group, which maintains a large research facility and its own private university. Other major business R&D performers include, for example, ABB, ČEZ, Bosh, FEI, Honeywell, Škoda Transportation, Visteon-Autopal and Zentiva, most of which are also foreign affiliates (Kejhová 2015).

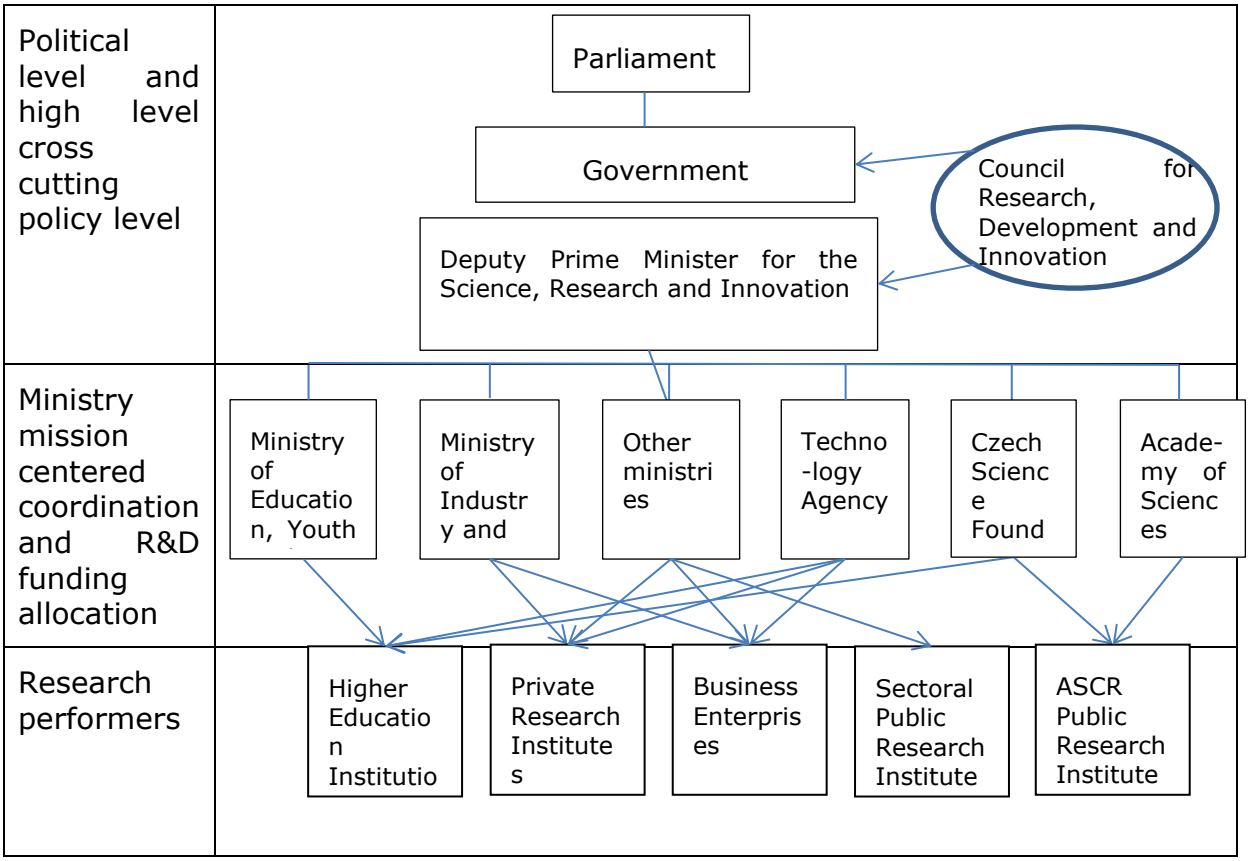

Figure 1 Structure of the R&I system

2. Recent Developments in Research and Innovation Policy and systems

2.1 National R&I strategy

The National RDI Policy of the Czech Republic 2009–2015 (CRDI, 2009) is the central policy document, which has been developed to facilitate the implementation of the Reform of the RDI system in the Czech Republic (CRDI, 2008a). More recently, the Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 (CRDI, 2013a) assessed the progress achieved so far in implementing the RDI reform. The main aim of the update is to provide impetus for improving conditions for innovation, knowledge transfer, diffusion of frontier technologies and development of human resources as well as to re-align the reform agenda with the revised government medium-term budgetary plans in public R&D spending.

New R&D programmes are supposed to follow the updated National Priorities of Oriented Research, Experimental Development and Innovation (CRDI, 2012) that have been summarized under six long-term thematic focus areas: i) Competitive knowledge-based economy; ii) Sustainable energy and material resources; iii) Environment for quality life; iv) Social and cultural challenges, v) Healthy population and vi) Safe society. The priorities are designed to reflect major societal challenges, including those outlined at the EU level, and needs of the society as concrete goals solvable through RDI in available capacities and are set for the time horizon until 2030. The new priorities should be taken into account in the multi-annual R&D budget plans and respected in designing public RDI support, including prospectively in allocation of institutional funding. The updated National Priorities will be extended by priorities of applied research, work on which will start in 2016 and are supposed to be finalized during 2017.

The National RIS Strategy identifies eight key enabling technologies: i) Advanced materials; ii) Nanotechnology; iii) Micro- and nano-electronics; iv) Advanced production technologies; v) Photonics; vi) Industrial biotechnology; vii) Knowledge for digital economy, cultural and creative industries; viii) Social science knowledge base for non-technical innovation, which are broadly in line with the long-term thematic priorities, and there are four national S3 platforms: i) Engineering; ii) Information and telecommunication services and software; iii) Transport equipment; and iv) Pharmaceuticals and life technologies (MEYS, 2014).

The Government adopted a comprehensive long-term Strategy of International Competitiveness in 2011 (MIT, 2011a), which addressed framework conditions affecting innovation performance in a broad sense. The core of the competitiveness strategy called "3i" deals with institutions, infrastructure and innovation; the three pillars that are indicated as the main weaknesses of the current system. In parallel, the National Innovation Strategy (MIT, 2011b) that was produced jointly by the MEYS and the MIT develops in more comprehensive way the innovation pillar. The strategy outlines a long list of concrete goals for innovation policy summarized under four main priority axes: i) Improving conditions for excellent research; ii) Developing cooperation for transfer of knowledge between business and academia; iii) Promoting innovative entrepreneurship; iv) Skilled human resources for innovation.

2.2 R&I policy initiatives

During 2015, Pavel Bělobrádek, the Deputy Prime Minister for the Science, Research and Innovation, has formed the Section for Science, Research and Innovations (SRI) within the Office of the Government, which may form the basis of a separate office and ultimately even a full-fledged ministry. The purpose of the SRI is to coordinate the R&I system and integrate R&I policies, including the preparation of the national R&D budget, setting up of funding rules, supporting of research excellence, deepening of international cooperation and management of RIS3 Strategy.

In November 2015, The CRDI approved a proposal of National RDI Policy of the Czech Republic 2016–2020 (later approved by the government in Feburary 2016). The main priorities are to i) streamline governance of the R&I system, including clearer division of competences, using participatory governance in policy design and improving cooperation between the actors; ii) implement a new evaluation framework of research organizations, which provides strategic intelligence for governing of the system, and increase stability, predictability and effectiveness of the system of institutional funding; iii) develop a state-of-the-art base for applied research, stimulate transformation of the public research sector to more applied orientation and focus the support framework on addressing strategic challenges and user needs; and iv) boost R&I capabilities in the business sector, including streghtening technology transfer from the public sector and public-private cooperation and particularly promoting the sector of domestic innovative SMEs. The proposal has been distributed for consultations to the ministries and stakeholders.

The SRI is working on a new law on the support of research, development and innovation, which should replace the Act No. 130/2002 Coll. on the Support of Research and Development from Public Funds, and may fundamentally reform governance of the R&I system. According to a Communication on this new act, approved at the 307th meeting of the CRDI in September 2015, the preferred solution recommends the inception of a new Ministry for Research and Development, which takes over executive responsibilities from the CRDI and MEYS in the R&D domain, under the umbrella of which will be moved GA CR and TA CR, and which thus assumes the role of the central R&D policy actor. Nevertheless the MIT is supposed to retain responsibilities for policies with regards to business R&D and innovation. Hence, the recommended solution involves the separation of competences for R&D and innovation policies in two ministries. It should be mentioned that these changes are still a matter of political debates. If the new law is submitted to the government and approved by the parliament in line with the schedule, it may become effective at the earliest from January 2017.

A new advisory body, the Council for Competitiveness and Economic Growth (CCEG), has been formed under the Office of the Government. The CCEG is chaired by Pavel Bělobrádek, Deputy Prime Minister of Science, Research and Innovations, the deputy chairmen are Jan Mládek, the head of MIT, and Kateřina Valachová, the head of MEYS. The Council provides advice on in decision-making on conceptual issues concerning competitiveness and economic growth including new sectors of cultural and creative industries and digital economy, and contributes to achieving effective interrelation and coordination of government departments and strategies. The new advisory body was formed from the original Council for Competitiveness and Information Society that divided into the CCEG and the Government Council for Information Society with the aim of their more efficient management.

Government resolution No. 351 from May 13th 2015 assigns Pavel Bělobrádek, the Deputy Prime Minister for the Science, Research and Innovation, jointly with the providers of project funding the task to produce and submit to the Government a document that delineates generally binding rules for the preparation and evaluation of R&I support programmes until the end of 2016. The new rules should follow basic principles outlined in an attachment to this resolution which stipulates that ex-ante, ongoing, ex-post and impact evaluations should be conducted according to the international evaluation standards. A number of strategic documents, e.i. CRDI (2009), CRDI (2013a), MIT (2011b) and Arnold (2011), emphasized the need for a major overhaul of the methodology of programmes evaluation, however, with a little effect on the evaluation practice so far. Hence, this resolution provides yet another imperative. Much depends on whether appropriate resources are devoted to production and implementation of the new rules.

Since 2012, TA CR has started to fund a portfolio of new programmes: i) ALFA supports applied research and experimental development and stimulates public-private R&D cooperation with a budget of about €290m over 2011-2016; ii) BETA is a programme of public procurement in research, experimental development and innovation for the needs of public administration bodies with a budget of €25m over 2012-2016; iii) OMEGA supports applied social science research and experimental development with a budget of €12m over 2012-2017; iv) Competence Centres supports projects of RDI centres in progressive fields that involve long-term public-private collaboration with a budget of about €240m over 2012-2019; v) GAMA funds the verification of R&D results in terms of their practical application and their commercial use with a budget of €69m over 2014-2019; vi) DELTA provides grants for joint international projects with third countries with a budget of €30m over 2014-2019; and vii) EPSILON, a follow-up on ALFA, is aimed at supporting applied research and experimental development with a high potential for rapid application in innovations in three priority areas of competitive knowledge-based economy, sustainability of energy and material resources and environment for quality of life with a budget allocation of €373m over 2015-2025.

As the result of the implementation of the Reform of the RDI System, the number of R&D budget providers has been halved to 11 in the budget period 2013-2015. The responsibility for administrating national public support for competitive funding of applied research, experimental development and innovation was supposed to move from ministries and other state institutions under the umbrella of the TA CR. However, this has been done only partly, as in 2015 the MIT got approved programme TRIO for support of business R&I and public-private research collaboration in key enabling technologies with a budget of €134m over 2016-2021, which partly overlaps with the purpose of the TA CR's program EPSILON. Hence, national support for business R&I becomes fragmented into two programmes providing direct subsidies but under different funding providers. In addition, the MEYS and MIT continue to administer large Operational Programmes (OP) of the EU Structural Funds dealing with R&D and innovation, which require national public co-financing.

In 2014, the government approved new OP dealing with RDI that are going to be funded from the European Structural and Investment Funds (ESIF) during the programming period 2014-2020. The OP Enterprise and Innovation for Competitiveness (OP EIC) under the MIT with the EU contribution of €4.32b (a total budget allocation of €7.91b) is designed to support the development of a competitive and sustainable knowledge and innovation—based economy. The OP Research, Development and Education (OP RDE) administered by the MEYS with the EU contribution of €2.78b (a total budget allocation of €3.4b) is aimed to support the transition to economy based on education, motivated and creative labour force, high-quality research results and their implementation in practice. The Operational Programme Prague – Growth Pole of the Czech Republic (OP PGP) administered by the Prague City Hall with the EU contribution of €0.2b (a total budget allocation of €0.4b) includes one priority axis directly relevant to RDI on "Strengthening research, technological development and innovation" that is aimed at promoting public-private cooperation and the establishment and development of knowledge-intensive companies. In 2015, these ESIFs were approved by the European Commission.

New research centres and infrastructure projects financed by the OP RDI, through the Priority Axes 1 and 2 that are going to have a profound impact of the whole R&D system are under construction and gradually opening (MEYS, 2013). Six large projects with a total amount of subsidy of €835m (85% funded by the ERDF) were approved for funding in regions outside of the capital city of Prague in 2010: i) ELI - Extreme Light Infrastructure (€271m); ii) BIOCEV - Biotechnology and Biomedicine Research Centre (€92m); iii) CEITEC - Central European Institute of Technology (€209m); iv) Centrum excellence IT4Innovations (€72m); v) ICRC - International Clinical Research Center (€94m); and vi) SUSEN - Udrzitelna energetika (€97m). National programs sustainability I and II have been established to fund launching of the new facilities until 2020.

In addition, CIIRC - Czech Institute of Informatics, Robotics and Cybernetics (€54m) located in Prague was approved for funding (although not through the OP RDI) in 2013.

MIT has established a new Agency for Entrepreneurship and Innovation (API). The API is a spinn-off from the CzechInvest investment and business development agency, from which around 130 employees has been transferred to the new organisation. The primary responsibility of API is to administer the drawdown of money from the OP EIC. The CzechInvest agency has previously been responsible for the drawdown of money from the European funds under the MIT umbrella. The main reason for this move is the requirement of the European Commission that all intermediary bodies servicing operational programmes are subject to the Civil Service Act or similar legislation. The rest of Czechinvest continues to operate as previously.

Overall, these policy measures follow the National RDI Policy 2009-2015 and its mid-term update from 2013; hence in a broad sense they jointly form a coherent and integrated framework for reforming the RDI system that is in line with the EU priorities and increasingly aimed at promoting excellence in research and fostering innovation. However, the degree of implementation of the reform agenda is highly uneven and often falls short of expectations. Stakeholders are fragmented into adversary interest groups, along the dividing lines of industry, university and government sectors, rather than working in concert. Opportunities for joint programming are seldom exploited, cross-border cooperation remains rare and the leverage effect of EU funding largely depends on how the challenge of integrating the new research centres and infrastructures is tackled. New long-term priorities of oriented RDI announced in 2012 that are largely in line with the grand challenges of Horizon 2020 and the National RIS Strategy released at the end of 2014 are increasingly accommodated in the design of new programmes of targeted support.

2.2.1 Evaluations, consultations, foresight exercises

Metodika 2013 provides the official guidelines for evaluation of public R&I support for both research organizations and programmes (CRDI, 2013b). However, the evaluation methodology is essentially limited to monitoring and accounting of data collected in the IS VaVaI, predominantly on research outputs, but does not provide strategic intelligence in terms of assessing the quality of research organizations, policy interventions, counterfactual analysis, impact evaluation and international benchmarking that can be taken on board in policy, management of the research organizations and programme development. Methodology for evaluation of R&I programmes is outlined in a mere two pages and largely reduced to ex-post reporting of inputs and immediate outputs; ex-ante, ongoing, and ex-post impact evaluations are not conducted according to international standards. The evaluation system is lacking financial, data and human resources for delivering evidence-based recommendations for policy making. For a lack of better solution in hand, the validity of Metodika 2013 has been extended by one year until the end of 2016.

The results of an individual national project, funded from the OP EC, on "Effective System of Research Financing, Development and Innovation" (IPN Metodika) aimed at proposing a new system of research financing, development and innovation, were presented at a final conference in October 2015. The main outcomes are a proposal for methodology of evaluation of research organizations based on informed peer review, including a pilot implementation thereof, and performance-based principles for the allocation of institutional funding (Arnold and Mahieu, 2015).

Other outputs include proposals for upgrading of the IS VaVaI, evaluation methodology for research infrastructures (IPN Metodika, 2014) and general guidelines for evaluation of R&I support programmes (Srholec, 2015)[2].

The Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014, an annual overview of the R&I system, has been presented to the government in September 2015 (Office of the Government of the Czech Republic, 2015a). After the establishment of the SRI, which is responsible for its production, the analysis has been fundamentally revised and can be considered as an early attempt for developing system-level evaluation. The analysis highlights the improving quality of science infrastructure, international science cooperation and human resources in research but points to lagging behind in applied research, public-private collaboration and technology transfer as well as to the fragmentation of the R&I governance system. The recommendations include strengthening the focus of R&I policy on priority areas, deepening support of public-private linkages that stimulate R&I efforts in the business sector and a reform of the R&I governance.

Innovation capacity 2014+ (INKA) project, administered by TA CR and implemented by a consortium of Berman Group, South Moravia Innovation Centre and Technopolis, maps the national innovation landscape. The aim of the project is to develop a methodology for regular screening of the national innovation potential in order for TA CR to identify areas in which the economy is more innovative and competitive. The project should help TA CR to determine the extent to which there is demand for research results in the business sector, what kind of research leading to innovation should be performed and which instrument for state support of research are suitable. The project includes primary data collection through in-depth interviews of about three hundred innovative enterprises. Results of the pilot implementation of the proposed methodology should be released in the first half of 2016.

During 2014 and 2015, TA CR organised a project on "Increasing the effectiveness of TA CR in RDI intervention and improving RDI public administration capacities" funded from the OP Human Resources and Employment (OP HRE) under the Ministry of Labour and Social Affairs (MoLSA). The main objective of which is to improve the provision of project funding for applied research and innovation and strengthen professional capacity in this field; partial objectives include i) setting of an analytical framework to grasp the results and impacts of RDI; ii) deepen the involvement of experts within the RDI support system; iii) streamlining of the available advisory services; iv) the development of methods for innovative public procurement; and v) raising awareness and educating the state bureaucracy in these matters. Pilot testing of the proposed measures, which involved among others the cooperation of TA CR, EGAP,the CzechTrade and CzechInvest agencies, were also conducted in the project.

MEYS conducted an evaluation of the sustainability of research centres supported from the OP RDI (MEYS 2015), which includes detailed consideration of their financing requirements, analysis of their funding prospects and risk assessment. The evaluation methodology involved desk research as well as site visits. The main conclusion is that there is an urgent need to put in place a complex national strategy for safeguarding the sustainability of the new research centres, because a number of them is already in operation and their sustainability is being under pressure It has been recommended that the national strategy cuts across ministries and should clearly address the funding requirements.

[2] The author was commissioned by the IPN Metodika project to prepare this document over the period from November 2014 to Novermber 2015.

Using a methodology for evaluating large RDI infrastructures prepared in the IPN Metodika project (IPN Metodika, 2014), a comprehensive two-stage assessment of all existing and planned projects of large R&D infrastructures was carried out by the MEYS in the second half of 2014. The evaluation was based on information submitted by research organisations, which registered their projects on a voluntary basis. In total, 119 projects have been assessed and out of that 58 successfully passed the evaluation. The outcome of the evaluation was used in the update of National Roadmap for Large Research, Experimental Development and Innovation Infrastructures (MEYS, 2015a).

The Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 has been approved by the government resolution No. 294 on 24th April 2013 (CRDI, 2013a). The update provides a comprehensive evaluation of the progress in implementing the RDI policy. The update revolves around four priority areas: i) Supply of high-quality human resources; ii) Enhancing the framework for transfer and utilization of knowledge; iii) Boosting the innovative capacity in the business sectors and iv) Improving strategic management of the system. The update emphasized the need to improve conditions for innovation, knowledge transfer and diffusion of frontier technologies. Another purpose of the update is to re-align the reform agenda with the government medium-term budgetary plans in public R&D spending, which have been significantly downsized in the aftermath of the economic crisis.

In August 2015, Office of the Government commissioned a mid-term assessment of the National Policy 2009-2015. This mid-term assessment conducted by study team led by the Technology Centre of the ASCR involved indicator-based evaluation of the strategic goals set by the National Policy as well as qualitative assessment of individual policy measures. Results of the mid-term assessment were used in the preparation of the new National Policy 2016-2020 (CRDI, 2016).

2.3 European Semester 2014 and 2015

The national 2020 target is to reach 1% of public R&D expenditure per GDP. Already in 2012 government sector R&D funding obtained from national sources reached 0.66% of GDP, whereas public R&D funding from abroad, primarily from the EU Structural Funds, amounted to 0.29% of GDP, which in total is 0.95% of GDP. In 2013 and 2014 the total figure of publicly funded R&D spending further edged up to 0.97% of GDP; primarily due to a small increase of the foreign component to 0.31% of GDP (Eurostat, 2015). Hence, the national 2020 goal has been almost met, if the foreign public sources are included. However, this is to a large extent due to a spike of EU funding for the construction of several major projects of research infrastructure. It remains to be seen whether the increased level of public R&D funding will be sustained after the investment phase of these large-scale investment projects fizzles out.

Country-specific recommendations for the Czech Republic in 2014 (European Commission 2014b) emphasize that deeper changes need to be introduced in the funding of research institutions that provide right incentives to strive for excellence, address societal challenges and promote public-private cooperation and thus that there is a need to accelerate work on the new methodology for the evaluation of research organizations and performance-based allocation of institutional funding. The 2015 European Semester Country Report (European Commission, 2015c) concluded that there has been only limited progress in addressing the 2014 country-specific recommendation on a new methodology for evaluating research and allocating research funding.

The National Reform Programmes 2014 and 2015 – in line with European Commission (2014b and 2015c) - stipulate that a new system of evaluation of research organisations and allocation of institutional funding is put in place (Office of the Government of the Czech Republic 2014a and 2015b). The IPN Metodika project aimed to produce the new methodology and funding rules by mid-2015. After several rounds of consultations with the stakeholders, the final results were published in May 2015 (Arnold and Mahieu, 2015).

Pilot testing of the new methodology has been conducted and an implementation plan has been produced. Hence, after several years of a stalemate there has been a new important development, which has a potential to bring international best practices of informed peer review into the core of the evaluation methodology. The proposed changes in the evaluation framework are taken into account in preparation of the new law on the support of research, development and innovation. Nevertheless, no clear roadmap for implementation of the new methodology has been approved by the government so far and it is expected that funding decisions could be based on results of the new methodology at the earliest in 2018.

Moreover, the National Reform Programme 2014 (Office of the Government of the Czech Republic, 2014a) recommends designing a new methodology of evaluation of targeted RDI support programmes, which includes ex-ante, interim and ex-post stages, and which involves the assessment of the intervention logic and evaluation of their effectiveness, results and impacts. In 2014, a working group consisting of the main providers of targeted funding started to work out the solution under the auspice of the CRDI, the results of which is a memorandum drafted by the SRI and approved by the leadership of CRDI in spring 2015 on "Basic principles of the preparation and evaluation of programmes and groups of grant projects for research, development and innovation (Office of the Government of the Czech Republic, 2015c). Government Resolution No. 351 from 13 May 2015 calls for the main stakeholders to produce on the base of these principles and submit to the government until the end of 2016 generally binding rules for preparation and evaluation of RDI programmes. In the meantime, the IPN Metodika project proposed general guidelines for evaluation of RDI programmes and systemic changes needed for their implementation (Srholec, 2015), which further elaborate on the basic principles. Hence, this recommendation has not been fulfilled so far, but there are two general documents that address this issues and a clear imperative by the government to achieve significant progress along these lines in a near future.

Finally, as required by the National Reform Programmes 2014 and 2015 (Office of the Government of the Czech Republic, 2014a and 2015b), the government prepared with the help of IPN Metodika a project of a methodology for evaluating large RDI infrastructures that is built on the principles of an informed international peer-review (IPN Metodika, 2014).In fact, the methodology has been already implemented in a comprehensive evaluation of research infrastructures that has been conducted by MEYS in the second half of 2014.

2.4 National and Regional Research and Innovation Strategies on Smart Specialisation

Czech regional authorities, consisting of 14 self-governing regions at the NUTS3 level, do not have any legally binding responsibilities in RDI policy. Yet the law does not prevent them from launching own RDI initiatives, which is, however, difficult given their restricted budgets. So far their main role has been in catalysing the EU Structural Funds projects, primarily those funded from the OP RDI. The South Moravian region is the main exception representing the national role-model of regional innovation policy with dedicated authorities, a well-functioning innovation agency and a dialogue with the business community; for more information see (RISJMK, 2013). Several other regions are attempting to emulate this model with various degrees of success, most prominently Prague, Moravia-Silesia, Liberec, Zlín and Hradec Králové regions, while other regions have either only paid a lip service or ignored the need to developing regional innovation policy altogether.

MEYS accepted the responsibility for designing the RIS3 strategy and appointed the so-called RIS3 Coordination Board in November 2012 (MEYS, 2014). Regional RIS managers were selected in April 2013 and the national RIS3 facilitator was assigned in September 2013. The regional managers were appointed and funded by the MEYS. Only South Moravia and the Capital City of Prague have started to work on their RIS3 strategies in a bottom-up manner, independently of the centralized initiative.

It remains to be seen to which extent the top-down approach to crafting of the regional RIS3 strategies makes a tangible difference on the ground, especially in the regions where indigenous initiative and innovation policy capabilities have been very limited so far.

The National RIS3 Strategy has been approved by the government and submitted to the European Commission in December 2014. The key enabling technologies have been specified as: i) Advanced materials; ii) Nanotechnology; iii) Micro- and nano-electronics; iv) Advanced production technologies; v) Photonics; vi) Industrial biotechnology; vii) Knowledge for digital economy, cultural and creative industries; and viii) Social science knowledge base for non-technical innovation. Four national S3 platforms have been formed: i) Engineering; ii) Information and telecommunication services and software; iii) Transport equipment; and iv) Pharmaceuticals and life technologies; more are expected to be added through the entrepreneurial discovery over time. The strategy provided detailed consideration of financial requirements from the ESIF, particularly the OP RDE, the OP EIC and the OP PGP; however, there were no details on the use of national funds beyond the ESIF co-financing; this was left to be specified by the government annually. Monitoring reports are also to be published annually and evaluation is scheduled to be conducted every two years in line with the update of the strategy.

In 2015, the management and implementation of the RIS3 strategy has been transferred under the auspice of the Deputy Prime Minister for the Science, Research and Innovation, hence the SRI has become responsible for its implementation. However, the European Commission did not approve the submitted version of the RIS 3 strategy and demanded a revision, in particular the improvement of the alignment with national funding. As the result, an action plan on how to fulfil the ex-ante conditionality that includes the intermediate plan of activities of the SRI and quantification of relevant financial allocations in public budgets have been agreed and is being implemented. The RIS 3 strategy has been updated accordingly and sent for verification to the European Comission in the fourth quarter of 2015. After successful verification by the European Comission, the updated RIS3 strategy will be submitted to the government.

So far RDI policy making has been fairly centralized. Co-ordination between the national and regional level innovation strategies has been very weak, if not missing altogether. National innovation strategy has addressed the regional aspects of innovation vaguely only. Drafting of the national RIS3 strategy and most importantly its implementation involved, at least formally, a coordinated action of the national and regional authorities on the topic of innovation policy; hence representing a much needed opportunity for establishing a nation-wide debate on this topic. Needless to say, it is pertinent that this dialogue is sustained beyond this particular purpose and elements of multilevel governance of the RDI system become gradually implemented.

2.5 Main policy changes in the last five years

Main Changes in 2011
Strategy of International Competitiveness addressed framework conditions affecting innovation performance. *National Innovation Strategy outlined goals for innovation policy.* *TA CR starts funding projects in the first programme ALFA.*
Main changes in 2012
National Priorities of Oriented Research, Experimental Development and Innovation started to guide the design of new support programmes. *The number of R&D budget providers was halved to 11 in the multi-annual budget plan.* *TA CR started funding BETA, OMEGA and Competence Centres programmes.* *TIP programme of the MIT was defunded in medium-term.* *Regional governments started to implement innovation voucher programmes.*
Main changes in 2013
Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 re-confirmed the reform track. *Metodika 2013 provided a medium-term modification of the formulae-base evaluation of research organisations and allocation of institutional funding.* *Higher education reform ended up in doldrums.* *The centre-right coalition government collapsed, early elections were held, and a new centre-left government was formed.* *National programs sustainability I. and the prospective National program sustainability II. were put in place to sustain financing of the new research centres and infrastructures.*
Main Changes in 2014
National RIS Strategy was released. *Nine out of sixteen members of the CRDI council were replaced.* *Pavel Bělobrádek was appointed the Deputy Prime Minister for the Science, Research and Innovation and the Chairman of the CRDI.* *MEYS signed under the IPN Mmetodika project a contract with Technopolis Group to design a new system of evaluation of research organisations and allocation of institutional funding.* *TA CR started funding the GAMA and DELTA programmes.*

MIT shut down the project Seed Fund to launch a public-private venture capital fund.

GA CR did not issue a new call for postdoc projects but started a new programme of junior projects.

R&D tax credits were extended to purchase of external R&D services from research organisations.

Main Changes in 2015

The SRI section started operation at the Office of the Government.

TA CR started funding the EPSILON programme, while MIT got approved the TRIO programme.

The OP EIC, OP RDE and OP PGP started to be implemented in the new programming period.

Metodika 2013 guidelines for evaluation of public R&I support were extended until the end of 2016, while new guidelines are expected to be put in place in the period 2017 onwards.

The IPN Metodika project proposed a new methodology for evaluation of research organizations and principles for allocation of institutional funding as well as a methodology for evaluation of research infrastructures and guidelines for evaluation of RDI programmes.

3. Public and private funding of R&I and expenditure

3.1 Introduction

In 2014, gross domestic expenditure on R&D (GERD) amounted to €3.1b (CZK 85b) and increased by about 9% as compared to the previous year, driven mainly by the expansion of foreign business funding. GERD jumped by 71% over the period 2008-2014, which marks a remarkable recovery. As a consequence, R&D intensity of the economy in terms of GERD as % of GDP increased to 2.00% in 2014, as compared to the lowest point of 1.24 % at the dawn of the crisis in 2008, hence noticeably approaching the EU28 average of 2.03% (Eurostat, 2015).

Business enterprise expenditure on R&D (BERD) accounted for 56% (€1.73b) of the total, the higher education sector came second with 25% (€0.79b) closely followed by the public research institutions with 18% (€0.56b), while the private non-profit sector remained negligible accounting for less than 1% (€0.01b) in 2013. BERD as % of GDP reached 1.12% in 2014, which represents a significant increase compared to 0.86% in 2011, the crisis bottom of 0.73% in 2008, and about 0.70% ten years ago, hence noticeably catching-up with the EU28 average of 1.30%. The national 2020 target of 1% public R&D intensity of GDP has been reached already, if foreign public sources are factored in, however, national public sources tend to grow slowly, which casts doubts about sustainability of the recent R&D investments growth (Eurostat, 2015).

In 2014, the indigenous business enterprise sector financed 36% (€1.11b) of GERD,. The government sector funded 33% of GERD (€1.02b), most of which is split between higher education (48%) and public research institutions (35%). Foreign sources in total contributed by 30% (€0.94b) of GERD funding in 2014, more than tripling from only 9% in 2008, which makes the latter by far the most dynamic source. About half of the foreign funds came from public sources in; predominantly the EU funds, and the other half from private sources, thus funding of R&D in foreign affiliates through multinational corporations. (Eurostat, 2015 and CZSO, 2015a).

Government budgetary appropriations or outlays for R&D (GBAORD) amounted to €0,97b (CZK 26.64b) and 0.63% of GDP in 2014, which represents a noticeable increase from €0.82b (CZK 20.49b) and 0.51% of GDP in 2008, respectively; however, the rise is largely due to the need to co-finance the EU Structural Funds. As the result, GBAORD as % of GDP nearly eliminated the gap as compared to the EU28 average of 0.67%, despite major cuts in other parts of the government budget during the prolonged recession. GBAORD stagnated in the narrow range between 0.64% and 0.66% of GDP over 2011-2014 and even somewhat dropped from 2013 to 2014, hence did not keep up with the economic recovery (Eurostat, 2015). Nevertheless, GBAORD is earmarked to slightly increase to CZK 26.91bin 2015 (CRDI, 2015) and further increase to CZK 28.59b in 2016, CZK 29.00b in 2017 and CZK 29.17b in 2018 according to the multi-annual R&D budget plans approved by the government (Office of the Government of the Czech Republic, 2015d).

Table 2 Basic indicators for R&D investments

Indicator	2011	2012	2013	2014	2015	EU 28
GERD (as % of GDP)	1.56	1.79	1.91	2.00	..	2.03
GERD (Euro per capita)	243.4	273.9	285.0	294.0	..	558.4
GBAORD (€m)	1,050.6	1,039.8	1,027.9	967.3	967.3	92,828
R&D funded by BES (% of GDP)	0.59	0.65	0.72	0.72	..	1.12
R&D funded by GOV (% of GDP)	0.65	0.66	0.66	0.66	..	0.66
R&D funded by HES (% of GDP)	0.01	0.02	0.01	0.01	..	0.02
R&D funded by PNP (% of GDP)	0.00.	0.00	0.00	0.00	..	0.03
R&D funded from abroad (% of GDP)	0.31	0.46	0.52	0.61	..	0.20
R&D performed by HEIs (% of GDP)	0.38	0.49	0.52	0.51	..	0.47
R&D performed by government sector (% of GDP)	0.31	0.33	0.35	0.36	..	0.25
R&D performed by business sector (% of GDP)	0.86	0.96	1.03	1.12	..	1.30

Source: Eurostat, 2016

3.2 Smart fiscal consolidation

3.2.1 Economic growth, fiscal context and public R&D[3]

The Czech Republic weathered the 2008-09 economic crisis with a relatively moderate real GDP loss of 4.8% and only once in 2009. However, the post-crisis recovery was slow throughout 2010-2013. After a somewhat more solid growth in 2014 (2%) driven by domestic demand with particularly strongly growing investment the Czech economy has grown by 4.8% in 2015 driven not only by robust domestic demand (both consumption and investment) but also by solid public investments on the back of EU funding. The Commission projects real GDP growth to be around 2.3-2.7% in 2016-17 due to fading out of the effect of EU funding on the investments.

[3] http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_czech_en.pdf

Before the crisis the Czech Republic had sound public finances characterized by low level public debt level (28% of GDP) and government deficit on a decreasing path (0.7% of GDP in 2007) due to fiscal discipline and strong economic growth. During 2008-09 the deficit reached 5.5% of GDP and public debt increased rapidly by about 10% of GDP. Fiscal adjustments through increases in indirect taxation and important cuts in public investment in the following years brought down the headline deficit to 1.3% of GDP by 2013 and balanced the government budget in structural terms. This has worsened slightly to 1.9% and 0.7% of GDP deficits in headline and structural terms, respectively. European Commission estimates a slight improvement of the deficit to 1.6% of GDPdue to better than expected corporate tax collection. The headline deficit is expected to fall to 1.1% of GDP in 2016 and 1% of GDP in 2017 due to sharp decline in public investments. The debt ratio is moderate (41% of GDP) and due to fiscal discipline it is expected to remain so (40% of GDP) throughout 2016-2017. However, long-term sustainability of public finances remains an issue due to population ageing triggering increases in pension- and healthcare spending.

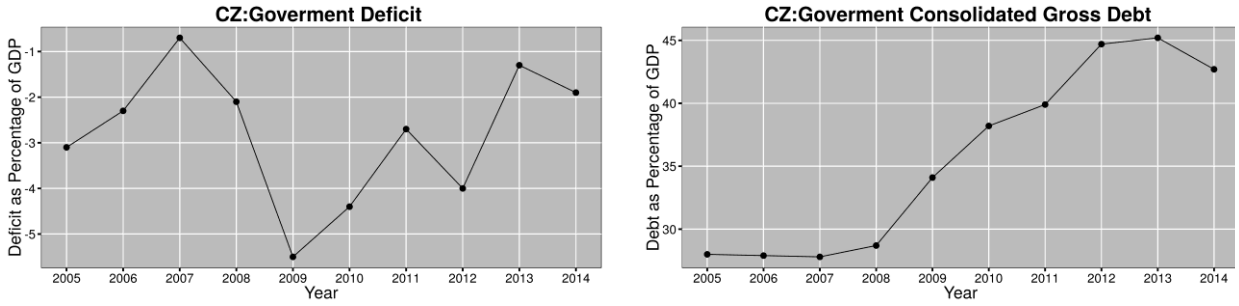

Figure 2 Government deficit and public debt.
Data Source: Eurostat

Total GERD in the Czech Republic was €2,997m in 2013. There are three main sources of R&D funding: the business sector (€1,127m), the government (€1,041m), and foreign funding (€814m). Direct funding from the government goes to R&D in business enterprises (€188m), the government (€364m) and the higher education sector (€485m).

Table 3 Key Czech Public R&D Indicators Source: Eurostat

	2007	2009	2013	2014
GBAORD, % of gov. exp.	1.29	1.32	1.56	1.5
GERD, % of GDP	1.31	1.30	1.91	2 (p)
out of which GERD to public, % of GDP	0.54	0.56	0.87	0.87 (p)
Funding from GOV to, % of GDP				
Business	0.12	0.13	0.12	0.11 (p)
Public (GOV+HES)	0.46	0.49	0.54	0.55 (p)
Total	0.58	0.62	0.66	0.66 (p)
EU funding, % of GDP	0.02	0.03	0.30	n.a.

Source: Eurostat 2015, p - provisional

3.2.2 Direct funding of R&D activities

The sources of R&D funding according to the Frascati manual are: Government sector (GOV), Higher education sector (HES), Private non-profit sector (PNP) and Abroad (including EC). In this analysis the public sector as source of funds is given by the GOV part of the total intramural R&D expenditure (GERD), whereas the public sector as a sector of performance is the aggregation of GOV and HES. Figure 3, below shows the historical evolution of GERD financing in current prices in Czech Republic.

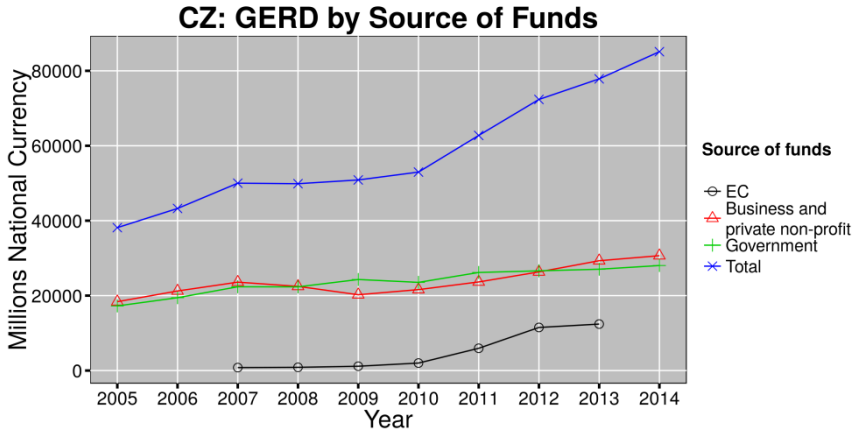

Figure 3 Development of government funding of the total GERD Data source: Eurostat

The total R&D expenditure (GERD) in nominal terms was slightly affected by the crisis and only for a short period of time 2008-09 after which it started increasing again, slowly at the beginning and more substantially in 2011 onwards. The reasons for this spectacular progress after 2011 are two: the increase in the R&D funding received from the European Commission via Structural Funds for R&D and the increase of the business R&D investments which had been affected during the crisis period. The private and public sectors contribute almost equally to the funding of R&D throughout the period of this study, and sometimes even complementing each other. For example, while R&D investments of the private sector dropped during the crisis in 2009, public R&D expenditure slightly increased resulting to an almost stable total GERD. GERD in 2014 increased due to abroad funding, both from business and the European Commission.

3.2.2.1 Direct public funding from the government

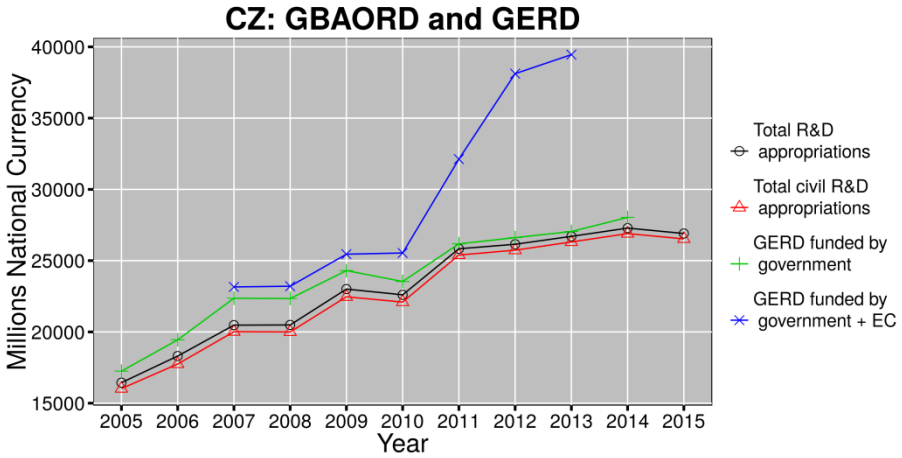

Figure 4 R&D appropriations and government funded GERD in millions of national currency Data source: Eurostat

Figure 4 shows that although the total R&D appropriations (GBAORD) are lower than the actual public expenditures on R&D, they both follow the same trend, especially when expressed in nominal values. This pattern is common for the Member States that joined the EU after 2004 and it could be due to the Structural Funds, although it remains uncertain how these quantities are related. When analysed as % of GDP, the GERD funded by government is lower than GBOARD as from 2010. In addition, the gap between the total civil R&D appropriations and total GBOARD is very small, which means that the military R&D plays a minor role in the Czech public expenditure.

In 2011, GBAORD and GERD funded by the government increased significantly, especially when expressed as % of GDP. Since then, the fluctuations were small and the overall trend was positive. In 2014 the GBAORD when measured in national currency, stagnated roughly at the same level and was subject to a slight increase in 2015. Further increases are foreseen for 2016-2018 period according to the multi-annual R&D budget plans approved by the government[4]. However, before the financial crisis in the reform agenda of 2008 the government declared plans to keep increasing public R&I funding by as much as 8% annually, which indicates that in reality there has been a major reduction of the growth of public R&I spending.

[4] Návrh výdajů státního rozpočtu České republiky na výzkum, experimentální vývoj a inovace na rok 2016 s výhledem na léta 2017 a 2018, http://vyzkum.cz/FrontClanek.aspx?idsekce=736349 .

One notices that the growth of the GERD funded by government and EC together is much sharper than the GERD funded by the Czech government alone, which demonstrates clearly the importance of the structural funds for R&D. When the same quantity is expressed as percentage of GDP, the increase is even sharper, due to a decrease in Czech GDP in 2012 (by 1%).

3.2.2.2 Direct public funding from abroad

Table 4 Public Funding from Abroad to the Czech R&D (in millions of national currency)

Source from abroad	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total	2057.27	2061.64	3632.41	4431.13	5736.32	7376.40	12335.61	18758.24	21138.70	25939.09
BES	1391.62	1340.71	2707.24	3467.05	4431.13	5160.40	6242.42	7136.22	8563.01	NA
EC			794.61	863.07	1152.55	1998.81	5943.04	11502.58	12407.31	NA
GOV					67.81	77.72	56.78	10.50	0.00	NA
HES					14.38	34.61	1.03	2.81	3.04	NA
International Organizations			15.12	21.43	68.40	97.21	71.28	80.45	61.11	NA
Total as % GERD	5.39	4.76	7.26	8.89	11.28	13.92	19.66	25.92	27.15	30.48
EC as % GOVERD			3.55	3.86	4.74	8.49	22.70	43.22	45.88	NA

Table 4 confirms the increasingly important role of the structural funds in the funding of R&D activities in the Czech Republic. EC contribution increased from 3.5% of the publically funded GERD in 2007 to almost 46% in 2013. In general, external funding (category abroad) has become very important as it represented 13.9% of the total GERD in 2010 and over 30% in 2014. It is important to note that this is not only due to the increase in the structural funds but also due to the less dramatic but significant increase in the funding from foreign businesses. Indeed, until 2011 foreign R&D investments from the business sector where the major source of external funding.

Based on data from DG REGIO, the total Structural Funds for the period 2007-2013 for Czech Republic amounted to 26.5 billion Euros of which 2.9 billion (i.e. 11%) is dedicated to 'Core' R&D activities**.** Unlike other Member States from Eastern Europe, Czech Republic's share of SF allocated to R&D is higher than the equivalent share at EU28 level (9.4%), which shows the importance of the R&I policy. The role of the Structural Funds for R&D is clearly visible and it has rapidly increased in 2011-2012.

Distribution of public funding

Figure 5 shows how the government expenditure for R&D is distributed between the public and the private sectors.

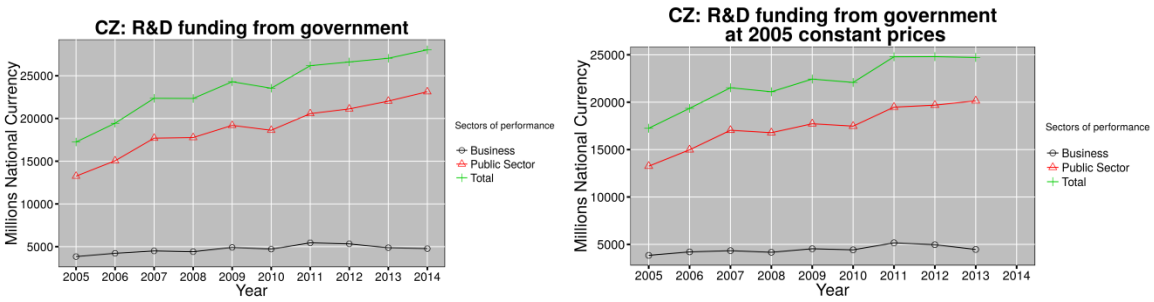

Figure 5 Government intramural expenditure by sectors of performance
Data source: Eurostat

The public sector is the main recipient of government funded GERD and was the one affected the most by the cuts in 2010 due to the financial crisis. Direct support from the government to business decreased during the 2011-14 period. However, at the same period the indirect support to business sector through tax incentives increased, compensating for this loss (see section 3.3.3 below).

3.2.3 Indirect funding – tax incentives and foregone tax revenues

The Czech R&D tax credit scheme was introduced in 2005 with the aim of stimulating private R&D expenditure. It was introduced as a deduction from the income tax in the amount of 100 % of expenditure on R&D in the taxable period[5].

In 2014 the tax credits were extended to external R&D services, i.e. contractual research, purchased from research organizations. This change was aimed at stimulating industry-academia collaboration.

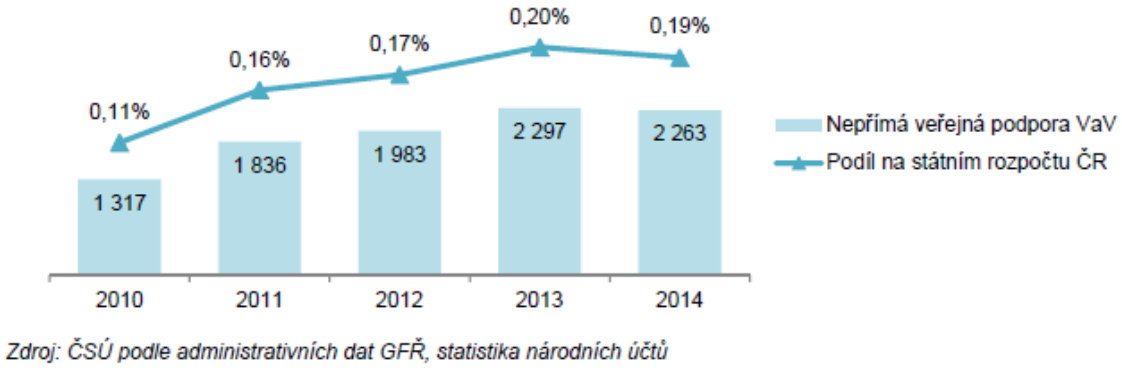

Figure 6 Indirect support for R&D (2005-2013) in CZKm and as % of state budget[6].
Source: Czech Statistical Office February 2016

[5] http://www.czechlegislation.com/en/586-1992-sb ,
http://portal.gov.cz/app/zakony/zakon.jsp?page=0&nr=586~2F1992&rpp=15#seznam

[6] https://www.czso.cz/csu/czso/neprima-verejna-podpora-vyzkumu-a-vyvoje-v-ceske-republice-2014

Both the amount of R&D tax credits and the number of enterprises that are applying for the indirect support were growing till 2013. In the first year (2005) 434 of enterprises used the tax relief, in 2010 the number almost doubled (716), and in 2014 reached 1 264 enterprises. The amount of the tax relief decreased slightly in 2014 (from CZ 2 297m to CZK 263m) even though in the 2014 the tax relief allowed also for the deduction of the highest share of the tax credits are allocated to the automotive sector and more generally to the manufacturing sector. For the first time in 2013 it was used by the financial and insurance sector.

Eighty six percent of firms that use the indirect R&D support have less than 250 employees, however they receive only 30% of the total indirect funding as their expenditure on R&D is much lower than in large companies. For the SMEs the direct funding remains the major source of funding, whereas for the large companies the indirect funding is slightly over 60% of the total (indirect and direct) public funding for R&D [7].

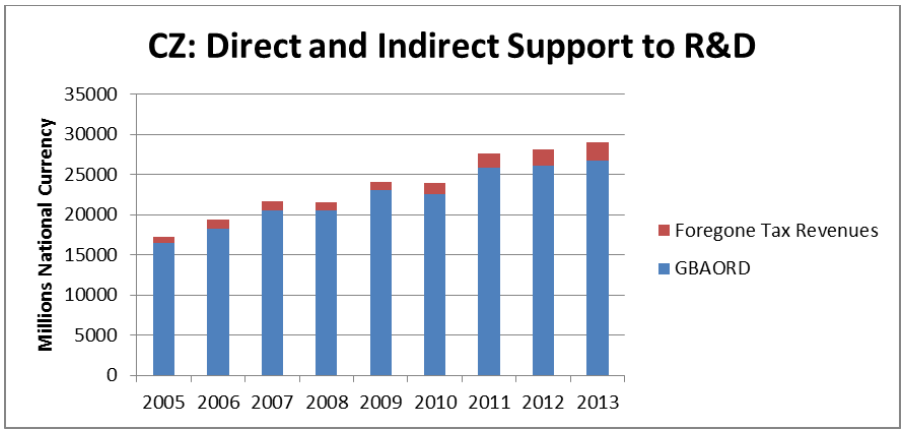

Figure 7 Direct and Indirect R&D support

Figure 7 is based on national data (for the foregone tax revenues) and Eurostat (for the GBAORD) and it gives an idea of the evolution of the relative size of the direct and indirect R&D support.

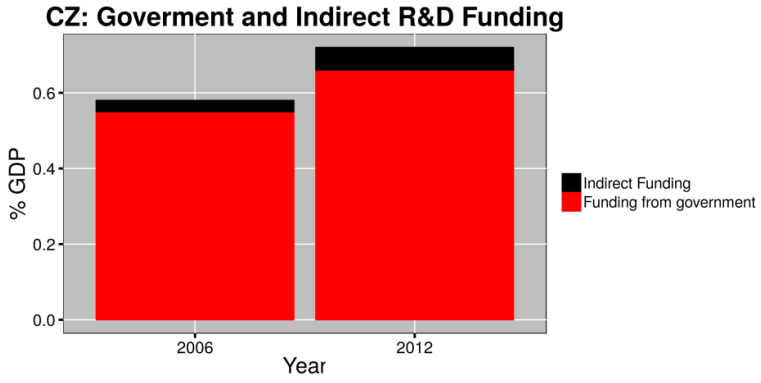

Figure 8 Direct and Indirect funding of R&D (source: OECD)

[7] Ibidem

The increase in the indirect public support to R&D can also be seen in relative terms, as % of GDP, in Figure 8 which is based on data from OECD.

3.2.4 Fiscal consolidation and R&D

The post-crisis fiscal consolidation in the Czech Republic took place practically between 2010 and 2013 both nominally and in structural terms. Figure 10, below shows the scatterplot of the structural balance and GBAORD as % GDP, first panel as well as GERD as % GDP, second panel[8]:

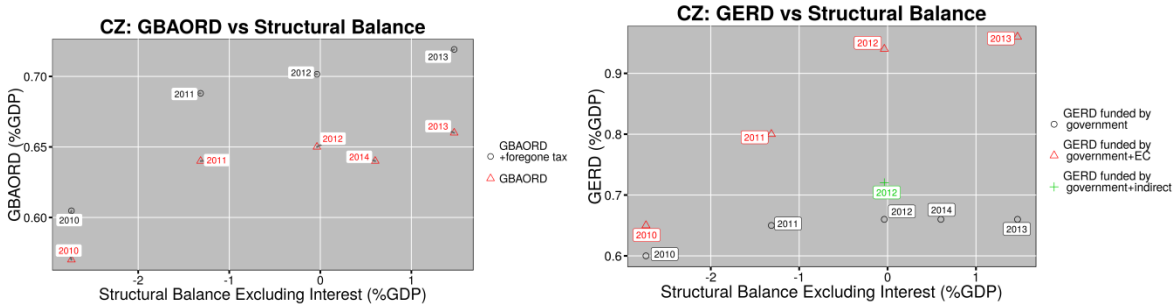

Figure 9 Fiscal consolidation and R&D Data source: AMECO, Eurostat, OECD, National sources

While the structural deficit shrank and turned into a surplus during 2010-2013, both GBAORD and government financed GERD increased or at least stayed at the same levels. The slight decrease of GBAORD in 2014 is rather minor. Therefore, we can argue that post-crisis fiscal consolidation did not have a negative impact on direct public support to R&D. Adding indirect funding through R&D tax incentives further improves the picture. Also as show previously the EU funding was very important for the public funding of the Czech R&I system during the fiscal consolidation period.

The post-crisis fiscal adjustment process has not come at the expense of public support to the Czech R&D. However it has significantly retarded the increase in the R&D budget foreseen in the pre-crisis period. The slower growth of direct funding was compensated by the use of the EU Structural Funds for R&D and the increase in the indirect support for R&D.

3.3 Funding flows

3.3.1 Research funders

MEYS and CAS are the main providers of funding distributed within the public research sector. MEYS primarily provides research funding to the HEIs sector with a budget of €383m (CZK 10.53b) in 2014 that is earmarked to increase to €409m (CZK 11.26b) in 2015 and to €449m (CZK 12.35b) in 2016. Institutional funding, which accounts for about two-thirds, is divided between the individual HEIs strictly on the base of the points obtained in the annual performance-based evaluation exercise following Metodika 2013 (for more details see Section 3.4.2). Project funding is organized in a variety of programs, which widely differ in the underlying allocation mechanisms, however, most of which involve elements of peer review; again predominant recipients are the HEIs. CAS has its own line in the national R&I budget that consists solely of institutional funding with a budget of €162m (CZK 4.45b) in 2014 that is earmarked to growth to €164m (CZK 4.52b) in 2015 and to €175m (CZK 4.83b) in 2016.

[8] Structural balance data comes from the AMECO database the other indicators were taken from Eurostat and OECD.

The funding is distributed among 54 PROs that are members of the academy on the base of its own evaluation methodology based on international peer review, which is conducted every five years (CRDI, 2015b).

GA CR and TA CR are formally independent agencies that provide competitive project funding. GA CR administers project-based funding of basic research with a budget of €126m (CZK 3.46b) in 2014 that is earmarked to growth steadily to €134m (CZK 3.68b) in 2015 and to €139m (CZK 3.83b) in 2016, the primary recipients of which are the HEIs and PROs; the funding is allocated using international peer review. TA CR that has been established in 2009 provides project-based funding for applied research, development and innovation through a wide portfolio of new programs with an overall budget of roughly €100m (nearly CZK 3.00b) over 2014-2016; the funding is allocated on the base of external domestic peer review and distributed to both private and public recipients, including their joint projects (CRDI, 2015b).

MIT used to be the main provider of national project-based support to business RDI before TA CR started to take over this role and its line in the national R&I budget has been declining ever since from €139m (CZK 3.82b) in 2010 to the bottom of €31m (CZK 0.85b) in 2015. Nevertheless, MIT is re-emerging as the provider of direct R&D subsidies to business enterprises, hence its budget is earmarked to start increasing to €41m (CZK 1.12) in 2016 again; the funding is predominantly allocated on the base of peer review panels and flows predominantly to the business sector. Less significant amounts are channelled through five other ministries, namely the Ministry of Agriculture, Ministry of Culture, Ministry of Defence, Ministry of Health and Ministry of Interior with individual national budget lines of roughly €50m (CZK 1.3b) and less in 2014 (CRDI, 2015ab).

In addition, MEYS and MIT coordinate the EU Structural Funds with sizeable resources devoted to RDI funding. In the previous programming period 2007-2013, MEYS administered the OP RDI and OP EC with a combined budget of about €3.8b and MIT administered OP EI with a total budget of of €3.0 for RDI relevant activities and the Prague City Hall administered the OP PC and OP PA with which innovation activities with only a small fraction of possible R&D financing were also supported; these OPs expired in 2015. In the current programming period 2014-2020, MEYS coordinates the OP RDE with a total budget allocation of €3.4b, MIT coordinates the OP EIC with a total budget allocation of €7.91b and the Prague City Hall coordinates the OP PGP with a total budget allocation of €0.4b. The main recipients of the OP research funding from MEYS are the HEIs and PROs, while most of the funds channelled through MIT are directed to the business sector.

Private non-for-profit funding of public research performers plays a very marginal role. The only source of philanthropic funding that deserves to be mentioned is the Neuron foundation, established in 2013 by merging with the Czech billionaire Karel Janeček Benevolent Fund for Support of Science and Research that was in operation since 2010, which supports scientific research through personal grants, awards and popularization events and which has allocated a total of €1m (CZK 29.5m) over its life-time so far.

3.3.2 Funding sources and funding flows

The role of the EU Structural Funds in the public funding of R&D has grown enormously in the programming period 2007-2013 (Mana and Štampach, 2015). Public national sources edged up by only about 19% from €854m (CZK 23.5b) in 2010 to €1,017m (CZK 28.0b) in 2010, the increase of which is in fact primarily due to co-financing of the EU Structural Funds that is included in these figures and the most of which is concentrated in the central government; the regional and local funding remains miniscule. The EU funding sources, predominantly the EU Structural Funds (ERDF and ESF) channelled through the OPs at the MEYS and MIT, recorded a six-fold increase from a €80m (CZK 2.2b) in 2010 to €483m (CZK 13.3b) in 2014 and amounted to the total of about €1,663m (CZK 45.8b) over 2010-2014.

From this follows that the share of the EU funds in the total public R&D funding nearly quadrupled from 8.6% in 2010 to 32.2% in 2014, which makes it by far the most dynamic funding source over this period. The EU Structural Funds became instrumental mainly for upgrading of the research infrastructure. Other sources of public transnational funding are negligible.

Czech participants active in projects funded under the 7th Framework Programme (FP7) acquired from the EU support of €290m in 1,153 projects with 123 coordinators, which represents a sizeable increase as compared to the 6th Framework Programme with the EU support of €139m in 890 projects with 38 coordinators only. H2020 participation, which is at an early stage, seems judging by the funding of contracts already signed relatively to the EU28 total to be generally in par with the FP7 participation. At the system level, the EU FP funding has been of rather minor importance, especially if compared to the large amount of funding channelled through the EU Structural Funds. Nevertheless, the EU FP sources were relevant for particular research performers, such as top research workplaces in the HEIs and PROs located in Prague that did not have access to the EU Structural Funds due to GDP per capita well above the EU28 average in the capital city region.

In 2014, the domestic business sources financed 36% of GERD and the foreign business sources financed 15% of GERD. As much as 97% of the domestic business R&D funding was spent by the firms themselves, hence only 3% flew elsewhere, which testifies to the very weak link between the business sector and other parts of the system; this proportion remained remarkably stable over the last ten years. Somewhat surprisingly foreign business R&D funding tends to be more open with 11% being spent outside of the business sector, almost all of which goes to the PROs and only a negligible amount ends up in the HEIs (CZSO, 2015a).

R&D performed by foreign affiliates amounted to €974m (CZK 26.8b) in 2014 and grew by 10% to 20% annually since 2010. BERD is characterised by a level of domination by foreign-owned companies that is one of the highest in the EU, as about 56% was performed by foreign affiliates in 2014 up from 51% in 2011 but slightly down from 57% in 2008. Likewise, BERD funding from foreign business sources increased rapidly, in fact nearly tripled, from €148m (CZK 4.1b) in 2010 to €410m (CZK 11.3b) in 2014, thus financed nearly a fifth of BERD already (CZSO, 2015a). Even though individual data are not available for confidentiality reasons, it is well known that most of the largest business R&D spenders, probably all of the top five, are foreign affiliates, including Škoda Auto, Honeywell, Škoda Transportation, Zentiva and Bosch.

3.4 Public funding for public R&I

3.4.1 Project vs. institutional allocation of public funding9

Public R&D funding has been traditionally dominated by institutional support. However, this has changed in the context of the Reform of the RDI System that has been launched in 2008. As a result, according to the official classification used by the CRDI the share of project funds increased markedly in the last few years, namely from 44% in 2009 to 51% in 2014 (CRDI, 2015a). However, in fact the true share of project funding was higher, probably in the range between 55% and 60% in 2014, because several items officially recorded under the heading of institutional funding, such as co-financing of the EU Structural Funds administered by the MEYS and MIT or support to projects of international cooperation under the MEYS, do not necessarily meet the definition.

Despite the Reform of the RDI system, the balance between thematic and generic funding has remained remarkably stable; oscillating in a narrow range between 58% and 61% share of generic funds in GBAORD over the period 2008-2012 (Eurostat, 2014). Until very recently the allocation of thematic funding has only loosely reflected the national priorities and grand challenges. Yet this is changing with implementation of the updated priorities of oriented R&D for the period until 2030 (CRDI, 2012), which are designed to reflect major societal challenges in line with in the Horizon 2020, and which start to be respected in the thematic focus of new support programmes, such as in the recent calls of the ALFA and OMEGA programmes of TACR and the new TRIO programme of MIT that explicitly require the proposals to address the national priorites, and prospectively also in allocation of institutional funding. None of the existing policy documents, however, sets binding targets in this respect.

3.4.2 Institutional funding

In 2009, early in the reform a new fully performance-based methodology for evaluation of R&D results and distribution of institutional funding was introduced. The methodology was based exclusively on quantitative indicators. It has been decided that each provider receives institutional funds based on historical research results achieved over the past five years, as reported to the IS VaVaI. However, the new system has been heavily criticized by the academic community among other things for being too mechanistic, for not taking into account differences in publication behaviour between fields of science and for creating unstable funding conditions. The International Audit of Czech RDI concluded that the evaluation methodology is not fit for its purpose and recommended a fundamental revision (Arnold, 2011).

A medium term modification of the evaluation methodology of research outputs has been introduced for the period 2013-2015, the so-called Metodika 2013 (CRDI, 2013b), on the base of which institutional funding is going to be allocated at least until 2017. Pillar I remains the same as before using formulae-based procedure of assigning points to publications. Newly introduced Pillar II involves international peer review by expert panelsof a list of top outputs submitted by the evaluated organisations.

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[9] "Institutional funding is defined as the total of national budgets in a given country, attributed to an institution, with no direct selection of R&D project or programmes and for which money the organisation has more or less freedom to define the research activities to be performed." Institutional funding can be in the form of non-competitively allocated Block funding. Institutional funding may also be allocated in a variable/competitive manner tied to institutional assessments. "project funding is defined as the total of national budgets in a given country, attributed to a group or an individual to perform an R&D activity limited in scope, budget and time, normally on the basis of the submission of a project proposal describing the research activities to be done". Steen, J. v. (2012), "Modes of Public Funding of Research and Development: Towards Internationally Comparable Indicators", *OECD Science, Technology and Industry Working Papers*, 2012/04, OECD Publishing. http://dx.doi.org/10.1787/5k98ssns1gzs-en.

Moreover, extra bonuses are awarded to research organisations, which obtained project funding from the European Research Council (ERC). Pillar III considers outputs of applied research, predominantly patents, and takes into account external funding acquired for applied research and contractual research.. The revised methodology at least partly removes the highly criticized shortcomings of the previous evaluation system, though; the evaluation continues to heavily rely on the formulae-based allocation of points for outputs. In 2014, for instance, the distribution of awarded evalution points was 74%, 11% and 15% between pillars I. II. and III., respectively.

In 2015, the government decided to prolong the validity of Metodika 2013 until the end of 2016 and to merge the evaluation for the years 2014 and 2015, which henceforth will be conducted jointly during 2016. For this purpose Metodika 2013 undergone a revision process in 2015, which however was aimed at rather minor parametric changes, predominantly related to its implementation that do not require a formal approval of the government. After 2016 a new system of RDI evaluation and distribution of institutional funding that has been prepared within the IPN Metodika project is expected to be gradually implemented. The proposed evaluation methodology is based on an informed peer-review, comprises of five main components: i) Research environment; ii) Membership of research community; iii) Scientific research excellence; iv) Overall research performance; and v) Societal relevance, and takes into account different roles of research organizations in the national system. The proposed funding principles divide institutional funding into segments devoted for the different types of research organizations, which is for each recipient sub-divided into a block grant, a performance agreement and a performance-based research funding system using the evaluation scores; the latter two performance-based parts account for 20% and the block grant that refers to an average of what the organization received in the previous 3-5 years for 80% of the funding. Nevertheless, a roadmap for the implementation has not been announced yet.

According to the initial reform plans, almost the full amount of institutional funding was supposed to be allocated using the performance-based formulae. However, in order to stabilize the funding flows, a consensus has been reached that only 20% of the money is allocated using the evaluation results, hence competitively, while 80% of the money is divided in the same proportion as in the previous year, hence representing block funding. Metodika 2013 does not include explicit rules for allocating the institutional support anymore, which is a major departure from the previous funding mechanism in the sense that institutional funding is not supposed to be automatically allocated based on the evaluation results Hence, the evaluation system is performance based but the evaluation results only provide background information for budget decisions and institutional funding is in fact distributed according to budget negotiations among actors.

In 2014, the single largest recipient of institutional funds was the CAS with €163m (CZK4.5b), which constituted 34% of the national total; however, the CAS increasingly acquires funding from other sources than its own public budget line (CAS 2015). It is important to note that the institutional funds that are allocated to the CAS in its own public R&D budget line become re-distributed between the member research institutes using results of its own internal evaluation methodology that involves international peer review, which is conducted every five years and the most recent round of which has been performed in 2015. Overall, however, the largest share of the national institutional funding, about 44% and €203m (CZK5.6b) in 2014, is channelled to the sector of higher education by the MEYS, which distributes the funds among the individual higher education research organisations using results of the formulae-based evaluation of Metodika 2013. Much smaller amounts are channelled through other ministries which predominantly use the institutional funds to support field-specific research centres under their own umbrella (the Ministry of Agriculture, the Ministry of Health, the Ministry of Culture, and others).

National public co-financing of the EU Structural Funds dealing with R&D and innovation that is administered by the MEYS and MIT and that amounted to €51m (CZK1.4b) in 2014 is also classified under the category of institutional funding in the public R&D budget

3.4.3 Project funding

GA CR allocates grants for basic research with an annual budget of €127m (CZK 3.5b) in 2014, which more than doubled from €55m (CZK 1.5b) in 2008. GA CR uses international peer review to guide the allocation of funds. The main funding instrument is a standard grant project, to which are allocated nearly three-quarters of the budget thus nearly €100m in 2015, the call for which is announced annually and can have duration of 1-3 years. Other funding instruments with much smaller budget allocations include projects for excellence in basic research, postdoctoral grants, junior grants and international bilateral grants. Applications are assessed by an expert panel (39 panels in 5 disciplinary areas) on the base of two-step review procedure; first, the applications are evaluated by two internal reviewers and then only those that satisfy minimal quality requirements (about half of the applications) are evaluated by at least two foreign reviewers (Slovaks are not perceived as foreigners). The main evaluation criteria are research novelty, quality of the proposal, management of the project and track-record of the coordinator. The success rate ranges between 15 to 30%, depending on the program and year.

The MEYS also has a significant budget devoted to project-based funding, which is directed primarily towards the higher education sector, including the competitively allocated funding for research conducted by master and doctoral students – the so-called "specifický výzkum" – with a budget of €44m (CZK 1.2b) in 2014, each university divides the funding for "specific research" within using its own selection criteria mostly based on internal and/or domestic peer review, there are no plans to transfer this funding under the GA CR.

Five other ministries also provide project funding to research in the public sector through their individual research programmes, namely the Ministry of Agriculture, the Ministry of Culture, Ministry of Defence, Ministry of Health and Ministry of Interior; however, the amounts are much smaller and past experience has shown, that these programmes, while nominally project funds, are often used as a source of institutional funding for research institutes controlled by the given ministries and also as means of research funding for the needs of these ministries.

Most programmes of project funding in the public sector, for example the GA CR and MEYS grants, provide funding to bottom-up projects broadly across most fields of science, hence there is little priority setting and the funding does not explicitly respond to societal challenges, at least as far as the project selection criteria are concerned. Evaluations of these programmes according to international standards have never been performed, thus little in known about their impact on the target groups, effectiveness and efficiency. All project funding is formally allocated to the organization of the project coordinator; there are no person bound grants that the individual recipient could transfer to a different organization.

3.4.4 Other allocation mechanisms

Other mechanisms that provide public funding to public R&I but cannot be classified as project or institutional funding are rare. BETA programme of TA CR assigns competitively public procurement in RDI for the needs of public administration bodies, the recipients of which may (or not) be research performers in the public sector, hence this is a tool for governmental organizations to obtain contract research.

3.5 Public funding for private R&I

3.5.1 Direct funding for private R&I

The dominant providers of direct national funding to stimulate private R&I are the TA CR and MIT, the combined amount of subsidies channelled by which amounted to about €150-200m (CZK 4-5b) annually over the period 2010-2014. Five other ministries, namely the Ministry of Agriculture, the Ministry of Culture, Ministry of Defence, Ministry of Health and Ministry of Interior, provide direct R&I subsidies available to recipients from the private sector but with noticeably smaller budget allocations of a combined value of €94m (CZK 2.6b); most of which in fact does not end up being distributed to private entities. Several regions have implemented innovation voucher programmes since 2012; however, their funding has been limited to a combined value of less than €1m (CZK 26m) annually, hence very small so far.

In recent years, the focus of innovation policy started to shift from supporting internal R&D in firms to stimulating public-private research cooperation and commercialization of research results. At the forefront of this transformation is the wave of new programmes implemented by TA CR, which was established in 2009. The programme ALFA that supports business R&I projects and stimulates public-private research cooperation started to fund first projects in 2011. Competence Centres programme that funds joint public-private RDI centres in progressive fields with strong application potential was launched in 2012. Two additional programmes started in 2014, namely GAMA supporting the practical application and commercialization of R&D results and DELTA for joint international projects in applied research with third countries. EPSILON that replaces ALFA started in 2015. As a result, the budget of TA CR has grown significantly from €33m (CZK 0.9b) in 2011, to €109m (CZK 3.0b) in 2014. TA CR evaluates project proposals using peer-review but only with the help of domestic experts. TA CR programmes increasingly pay attention to the national R&I priorities that respond to societal challenges.

The major part of funding for private R&I used to be administered by the MIT, primarily through the TIP research programme the budget of which, however, has been significantly reduced with expenditures of €109m (CZK 3.0b) in 2012, €73m (CZK 2.0b) in 2013 and €40m (CZK 1.1b) in 2014, and is earmarked to continue shrinking in the medium-term budget outlook. From 2017 onwards the MIT was supposed to cease to administer competitive funding from the national public R&D budget and completely pass this role to the TA CR. Nevertheless, this has been reversed in 2015, when the government approved TRIO programme at MIT for support of business R&I and public-private research collaboration in key enabling technologies with a budget of €134m over 2016-2021. Hence, MIT is taking back its original role of the major provider of direct subsidies to business R&I. Attention to support of RDI in industrial enterprises from start-ups to mature enterprises and fostering public-private linkages has been also paid in the sub-programmes Innovation, Potential, Cooperation and ICT and Strategic Services of the OP EI administered by the MIT.

Arnold (2011) heavily criticized the poor quality of national R&I programme evaluation. Yet there has been little progress since then. Metodika 2013 devoted only two pages to evaluation of R&I support programmes, which in any case is limited to ex-post descriptive overviews of their inputs and outputs derived from program monitoring, hence the existing evaluation framework does not provide much need strategic intelligence for programme development; next to nothing is known about their impacts. In fact, there has never been evaluation of national R&I programme that meets minimum international evaluation standards, not mentioning counterfactual impact evaluation and/or econometric analysis of additionality effects.

Public Procurement of Innovative solutions

In 2014 the total market of public procurement in Czech Republic was equal to Kč577b (€21b) or approx. 13% of the GDP with 78% of the volume registered in the Public Procurement and Concession Portal ISVZ. The total value of R&D public procurement contracts in the Czech Republic was about Kč1.1b (€40.5m) for products and services in 2014[10].

Legal context

The Directives 2004/17/EC and 2004/18/EC were transposed into Act no. 137/2006 Coll. on Public Contracts and Act no. 139/2006 Coll. in Concession Contracts and Concession Procedures (Concession Act), and include a comprehensive framework for electronic public procurement.

In pursuance of the SEC (2004) 1639 Communication the Czech Republic adopted resolution no. 500 on 10 May 2006 and adopted the National Plan for the Introduction of Electronic Public Procurement over the Period 2006-2010. Decrees no. 326/2006 Coll and 329/2006 Coll. lay down the requirements on Attestation Procedure for Electronic Tools and Electronic Means, Electronic Tools and Electronic Acts in Public Procurement[11].

Furthermore, if the public procurement act allows the exception, the Act No. 130/2002 Sb on support of research, experimental development and innovation with public funds, and amending certain related laws can be directly applied.

A new act on Public Procurement is now discussed in the lower chamber of the parliament and its adoption is foreseen by April 2016[12].

The PCP/PPI landscape in the Czech Republic

Public tenders in the Czech Republic, except of those for R&D, are very rarely recognised as the opportunity to promote innovation. A national target on public procurement of innovative goods and services has not been announced. The national procurement policy does not mention innovation support as its objective.

Public procurement in R&D for the needs of public administration bodies is centralised under the BETA programme of the Technological Agency of the Czech Republic.

For the years 2011 and 2012 TACR selected 101 themes for which the agency either announced public tenders or prepared tender proceedings. Due to the large number of announced public tenders, the complexity of the tender proceedings and the associated rigid administrative duties TACR proposed to simplify the process both in terms of the themes (research needs) and the tender procedure. These and other proposals for amendments were contained in a draft amendment to the BETA programme, which was submitted to the Government for approval in early 2013.

The research needs must contribute to the fulfilment of at least one of the specific objectives of the programme or specific objectives set by the relevant governmental body.

A national target on public procurement of innovative goods and services has not been announced. The national procurement policy does not consider the objective of supporting innovation.

[10] http://www.portal-vz.cz/getmedia/e404b766-77d0-488b-8809-6951c53c0eb9/Vyrocni-zprava-o-stavu-verejnych-zakazek-v-Ceske-republice-za-rok-2014_final.pdf

[11] http://www.portal-vz.cz/en/Jak-na-zadavani-verejnych-zakazek/Elektronicke-zadavani-verejnych-zakazek/National-Documents

[12] Petr Kadlec, Workshop on the legal framework of Innovation Procurement in Europe, Brussels 2015.

The standard procedure pursuant to Act on Public Procurement is used to select the bids for the public tenders for the research needs approved from 2013. The length of projects (fulfilment of the public tenders) in the BETA programme from 2013 is between 6 and 36 months. The cost of the project is limited by the programme resources, and the resources allocated to the relevant government bodies. The support for projects in the BETA programme is 100 % of the total eligible costs. The total budget for the whole duration of the programme amounts Kč640m.

Czech procurers participate also in the networking project COMPLETE that prepares the ground for PPI on novel optical networking solutions (Czech education and scientific network CESNET).

3.5.2 Indirect financial support for private R&I

Since 2005 the Ministry of Finance (MF) operates a system of tax incentives that allows firms to deduct expenditures on R&D carried out in-house from their tax base. In 2005, 33% of R&D performing businesses used the tax relief and the indirect support of R&D, i.e. the tax revenue foregone by the state, amounted to €27m (CZK 0.82b). In 2013, 51% of business R&D performers draw on indirect support to R&D and the indirect support of R&D reached €84m (CZK 2.30b). Nearly 80% of firms that use the indirect R&D support have less than 250 employees and about 70% of them are domestic-owned; hence this instrument proves to be particularly suitable for promoting R&D in domestic SMEs (CZSO, 2015b).

The primary objective of the R&D tax credit scheme is to stimulate private expenditure on intramural R&D. It has been recognized, however, that this form of tax deduction is going against the need to intensify collaboration between the business sector and academia. Hence, starting from 2014 the indirect fiscal support through R&D tax credits was extended to the purchase of external R&D services from research organizations with the aim to stimulate public-private linkages. The expansion of scale and scope of R&D tax credits has not lead to a reduction of direct public funding for private R&I, at least this has been seldom raised in the debates about public support to business R&D. So far there has not been any evaluation of this support scheme.

3.6 Business R&D

3.6.1 The development in business R&D intensity

The Czech BERD has been following a growing trend since 2005 with a small decrease in 2009 and in 2014 reached over 1% of the GDP (1.12%) (see Figure 10).

In 2013 the service and manufacture sectors amounted together to more than 90% of the Czech BERD (38% and 57% respectively). The manufacture is strongly correlated to the total BERD..

The business sector (Figure 11) is by far the main funder of the Czech BERD (0.69% of the GDP in 2014). The contributions from abroad gained on importance increasing from 0.04 in 2005 to 0.32% in 2014, i.e. currently funding about one fourth of the total BERD. The government funding remains fairly stable, oscillating between 0.11-0.14 in 2005-2014 and was at 0.11% in 2014, i.e. an intensity much lower than of the business sector and abroad funding.

The R&D performed by foreign affiliates amounted to €974m (CZK 26.8b) in 2014 and grew by 10% to 20% annually since 2010. The Czech BERD is characterised by a level of domination by foreign-owned companies that is one of the highest in the EU, as about 56% of the total BERD was performed by foreign affiliates in 2014 up from 51% in 2011 but slightly down from 57% in 2008.

What is more, the R&D investments of the foreign-owned companies are highly concentrated in small number of sectors and small number of firms, the R&D of domestic companies is more equally distributed (the average annual expenditure for performed R&D per company in the foreign-controlled enterprises totalled CZK 37m, in the domestic private enterprises it was nearly 4 times less, i.e. CZK 9.7m (CDRI 2015).

Another factor of distinction is the fact that foreign-owned companies financed more than 95% of their R&D expenditures in 2012 from private sources (domestic and foreign) whereas domestic firms use more often the public funds to finance their R&D activities (almost one third of the total expenditure).

As much as 97% of the domestic business R&D funding was spent by the firms themselves, hence only 3% were contracted out, which testifies to the very weak link between the business sector and other parts of the system; this proportion remained remarkably stable over the last ten years.

Even though individual data are not available for confidentiality reasons, the largest business R&D spenders are foreign affiliates such as: Škoda Auto, Honeywell (engineering), Škoda Transportation, Zentiva (pharmaceutical) and Bosch (engineering and electronics and three Czech companies: České dráhy (Czech Railways), the ČEZ Group (industrial transportation) - both with the state as major shareholder) and Aero Vodochody (airospace manufacture). The latter are listed in the EU Industrial R&D Investment Scoreboard 2015.

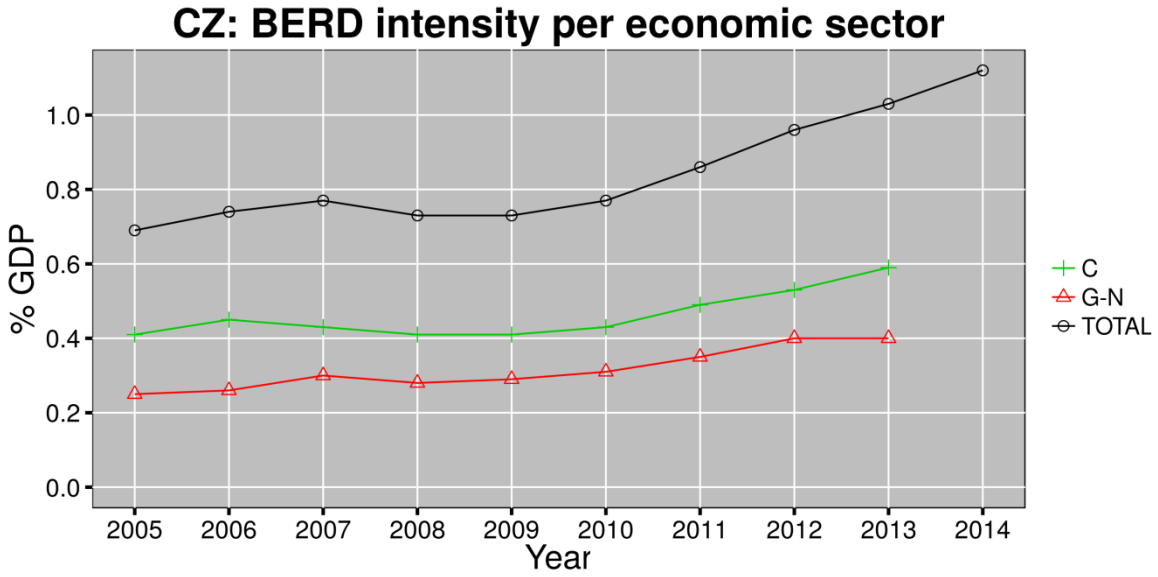


Figure 10 BERD intensity broken down by most important macro sectors (C= manufacture, G_N=services)

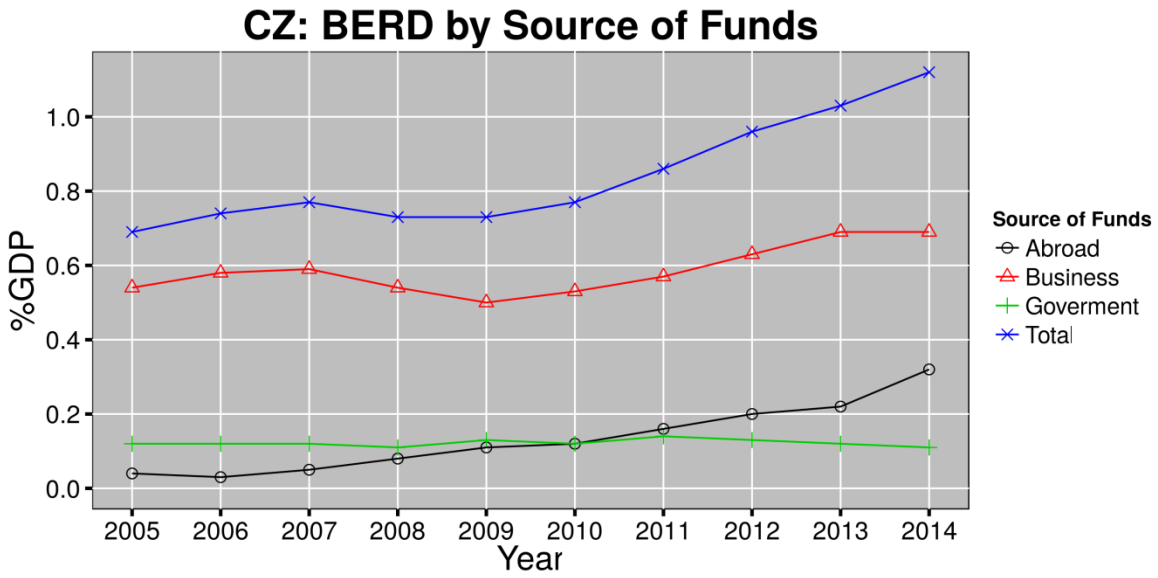


Figure 11 BERD by source of funds

3.6.2 The development in business R&D intensity by sector

The automotive sector is the leading sector of the Czech manufacture (Figure 12), followed by engineering sectors, i.e. the manufacture of machinery and equipment and the repair and installation of machinery and equipment.

For the three sectors mentioned above we observe an increasing trend since 2011 but with the sharpest growth for the automotive sector. In the period of 2009-2010 both automotive and manufacture of machinery and equipment experienced a slight decrease possibly linked due to the global financial and economic crisis, which had also an impact on business investment in R&D.

In the automotive industry the main player is Škoda Auto that is responsible for around 80% of the total investment in the automotive sector (CDRI 2015).

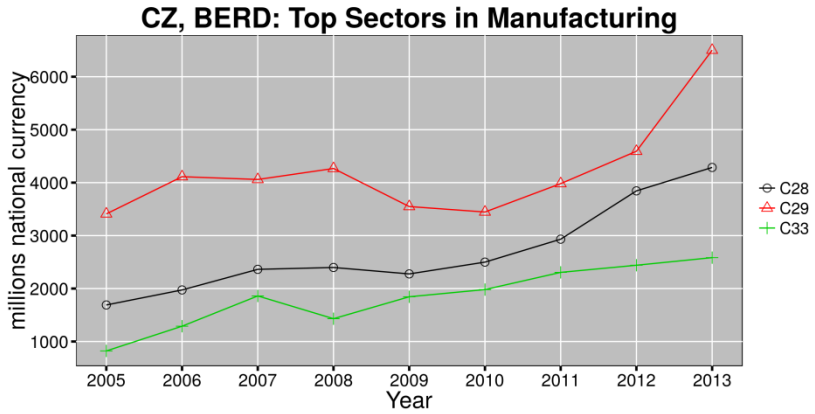


Figure 12 Top sectors in manufacturing (C28=manufacture of machinery and equipment n.e.c.; C29=manufacture of motor vehicles, trailers and semi-trailers C33 Repair and installation of machinery and equipment)

As far as the services are concerned, we notice the importance of the professional, scientific and technical activities and the ICT with similar growth till 2012. In 2013 we observe a decrease only for professional, scientific and technical activities. It has to be noted that this sector is rather peculiar given the fact that many of these R&D companies were created from the former departmental research institutes that were privatised after 1989 and therefore account for a significant amount of the Czech R&D service sector. In all three sectors smaller private domestic businesses dominate.

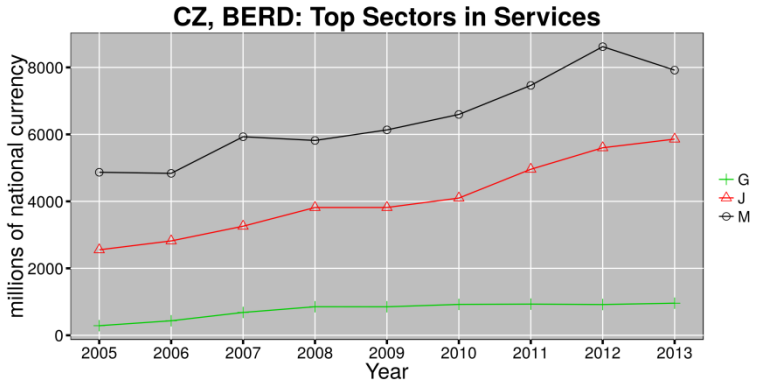


Figure 13 Top service sectors (J=information and communication, G=wholesale and retail trade; repair of motor vehicles and motorcycles, M=professional, scientific and technical activities).

3.6.3 The development in business R&D intensity and value added

Unsurprisingly, due to its importance in the Czech BERD, manufacturing is the biggest contributor to Gross Value Added (GVA) in the Czech Republic in 2012 (Figure 14). The wholesale and retail trade, repair of motor vehicles and motorcycles is the top service sector in terms of GVA. It is however only third sector in terms of BERD with much lower intensity and not growing dynamically as the ICT and professional, scientific and technical activities.

Finally, we notice the importance of some services (like the real estate activities, construction and the activities related to human health) in terms of their GVA, whereas they play a modest role in the BERD.

Consistently with the aforementioned importance of the automotive industry in the Czech economy, the manufacture of machinery and motor vehicles is the leading sector also in terms of GVA for the Czech manufacture. Other important sectors in terms of GVA but not in terms of BERD intensity are manufacture of fabricated metal products, except machinery and equipment, manufacture of food products; beverages and tobacco products. The third and fifth manufacturing sector in terms of GVA - manufacture of machinery and equipment n.e.c. and manufacture of electrical equipment is also important in terms of BERD.

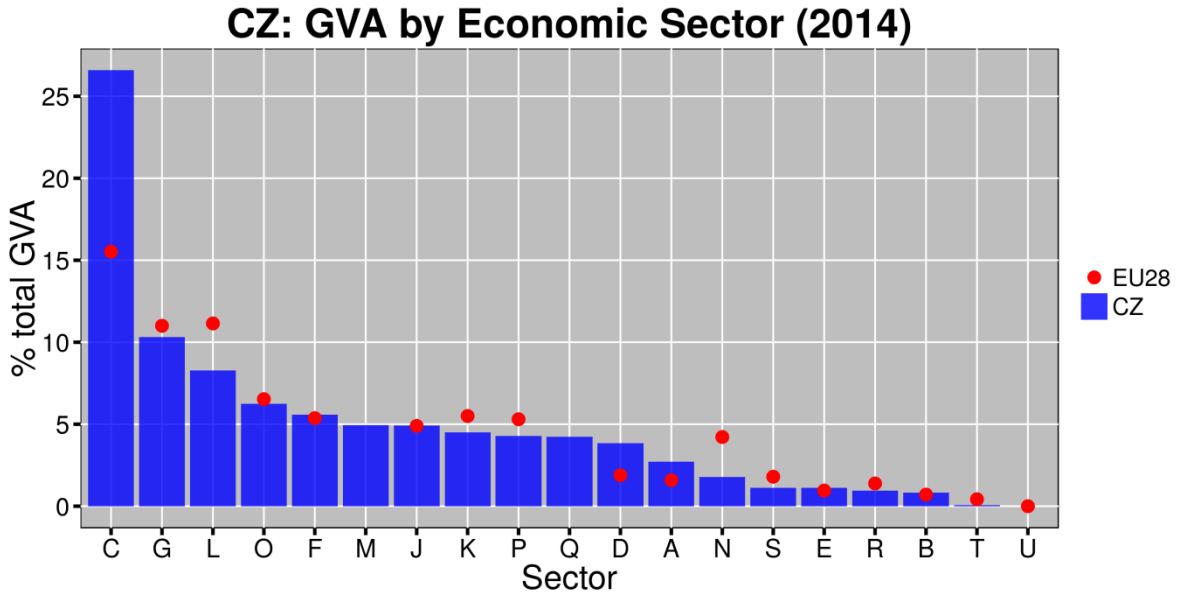


Figure 14 Economic sectors as percentage of the total GVA. Top 6 sectors in decreasing order: 1) manufacture, 2) wholesale and retail trade (repair of vehicles and motorcycles), 3) real estate activities, 4) public administration and defence, 5) construction, 6) professional, scientific and technical activities

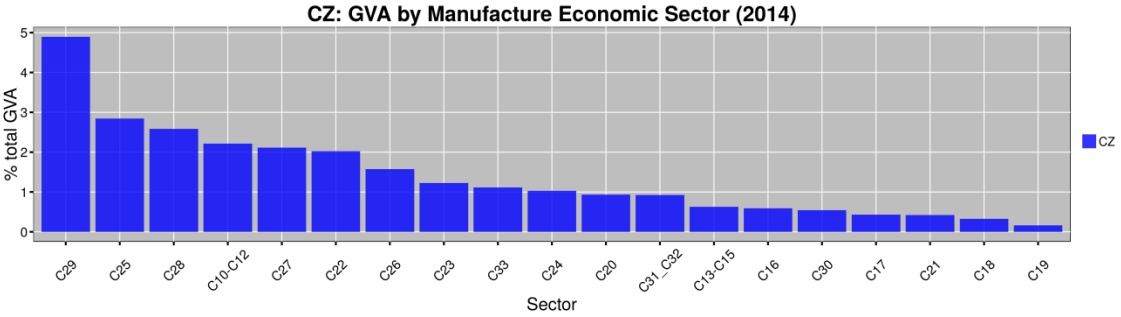


Figure 15 GVA in manufacturing. Top 6 manufacturing sectors: 1) manufacture of motor vehicles, trailers and semi-trailers 2) Manufacture of fabricated metal products, except machinery and equipment, 3), Manufacture of machinery and equipment n.e.c., 4) Manufacture of food products; beverages and tobacco products 5) Manufacture of electrical equipment, 6) Manufacture of rubber and plastic products.

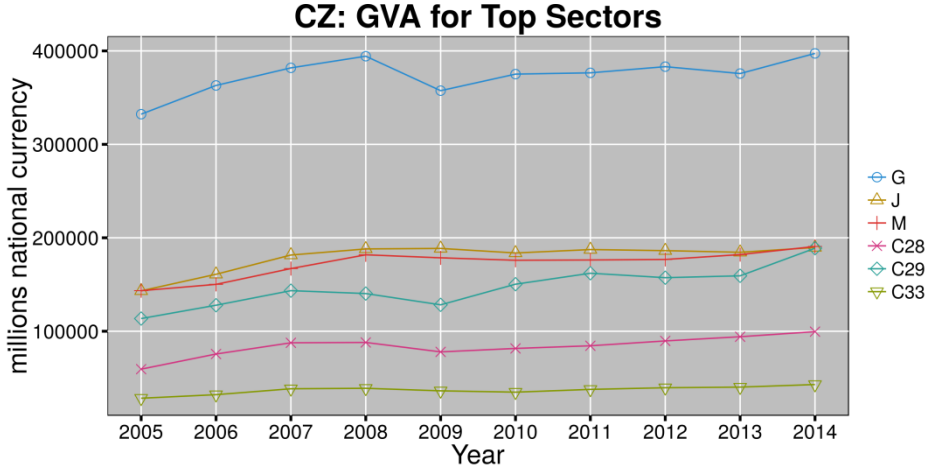


Figure 16 Value added at factor cost for the leading manufacture and service sectors in Figures 3 and 4

Figure 16 shows the value added for the top manufacture and service sectors. We notice the dominance of the services of the automotive sector, which are clearly set apart from the other services and manufacture sectors.

The number of researchers employed in business is growing in all major sectors, most dynamically in the ICT sector. It is however worth noting that business employs a very low rate of women researchers. In 2012 women accounted for only 19% of the R&D staff in the business sector, among the lowest results in the European countries (CDRI 2015).

3.7 Assessment

The R&D activity of Czech enterprises reached for the first time over 1% of the GDP in 2014. It was growing steadily since 2010 and the recent increases were gained mostly thanks to the inflows of funding from abroad. The Czech business R&D is largely performed by foreign-owned companies and concentrated in the high and medium-tech sectors (automotive and engineering). On the contrary, the R&D in services (information and communication services, services related to automotive services and professional and scientific activities) is more often performed by domestic companies.

According to the International Audit of Czech RDI (Arnold, 2011, pg. 56), the share of project funding allocated competitively was too high, exceeding proportions that many countries deem as dangerous, and one of the key recommendation was that in order to assure stability and opportunities for long-term planning institutional funding should comprise at least 50% of the public R&D budget. Despite initial reform plans to reach 60% to 40% ratio between project (or targeted) and institutional funding by 2015, the policy has been updated in this respect and the ratio has stabilized around 50% over 2012-2015 and is projected to remain roughly at the same level in the medium-term budget outlook until 2018. As 80% of institutional support has become block funding and only 20% continues to be competitively allocated on performance criteria, the funding of research organizations has been stabilized in recent years. Nevertheless, due to the problematic evaluation methodology, decisions on changes in the distribution of institutional funding among the main providers started to be based on budget negotiations and political agreements rather than performance.

The predominantly formulae-based evaluation of research organizations, on which allocation of institutional funding is supposed to be based, aims to incentivise both increased output and scientific quality, but largely succeeds in promoting only the former, possibly at the cost of undermining the latter. The evaluation methodology invites gaming behaviour in maximizing the evaluation "points" for pre-defined outputs without the regard for purpose and impact.

Other important concerns, such as research environment, human resource management, international networking and societal relevance, tend to be overlooked. Metodika 2013, which added small bonuses for top outputs and acquiring external funding, was a step in the right direction, but did not fix the key problems that contribute to the sub-optimal functioning of the research system. IPN Metodika proposed a far more complex and satisfactory methodology of both evaluation of research organizations and allocation of institutional funding, however, a clear political decision on its implementation has not been made so far. The dispute among the key stakeholders over the evaluation methodology represents a major impediment for tackling other problems that are related to it.

Until recently the government stimulated RDI in the private sector predominantly through the traditional direct subsidies to internal R&D activities. Yet there has been a positive shift towards a wider portfolio of support measures. R&D tax credits significantly expanded in both their scale and scope. New measures were introduced that promote joint public-private circulation, collaboration and transfer of knowledge. More attention is paid to supporting commercialisation of research results and innovation activities at large.

Nevertheless, venture capital market is underdeveloped and public measures to boost the access to venture capital through the establishment of public-private seed fund have failed so far; there are plans to re-launch this effort, the results of which remain to be seen. Evaluation of public R&I support programmes is underdeveloped, hence there is only anecdotal evidence on the extent to which direct and indirect public financial support to business R&I succeeds in leveraging business R&I expenditure.

Generally speaking, the key challenge that needs to be addressed for achieving more efficient and effective functioning of the funding allocation system is the underdeveloped evaluation culture. As also pointed out by the International Audit of Czech RDI (Arnold, 2011, pg. 56), the system of R&D evaluation is grossly outdated, focused on counting outputs rather than aiming at assessing policy interventions, outcomes and their impacts, and hence provides limited feedback to the policy and programme development; there is a need for a fundamental upgrade of evaluation practices.

4. Quality of science base and priorities of the European Research Area

4.1 Quality of the science base

According to European Commission (2015a and 2014c), in particular the quality of scientific production and technological development, in other words the level of excellence in S&T, is markedly behind than the EU28 average and changing very slowly. On one hand, there is clearly a catching up trend in research productivity with the EU28 average, but on the other hand the research and innovation system as a whole still lags behind the EU28 average in terms of top research outputs, such as highly cited scientific publications and international patents, per capita or per GDP. As far as these high-quality R&D outputs are concerned, there are several fields that stand out, including organic chemistry, nuclear physics, medical sciences, textile materials, machine tools, electrical engineering, combustion engines and vehicles in general.

In 2013, the Czech Republic produced 1.73 publications per 1,000 population, slightly above the EU28 average (1.43), of which 37.6% were internationally co-published, which is the seventh lowest share in the EU28. The Czech Republic had 0.65 international scientific publications per 1,000 population, which roughly corresponds to the EU28 average. In 2010 only about 9% of the Czech scientific publications were in the top 10% most cited publications worldwide, however, well below 12.3% of top scientific publications produced in the EU28. In the period 2011-2013, the share of public-private co-publications was 1.0% in the Czech Republic against 1.8% in the EU28. Overall, therefore, the quantity of scientific publication outputs is already in par or even exceeds the EU28 average, however, the quality of research continues to lag behind.

One aim that has been repeatedly stressed is promoting excellence in research. Yet this has been grossly mismanaged by introducing the formulae-based system of evaluation of research institutions, regardless of other concerns. Arnold (2011) recommended that the evaluation practice should be the subject of root and branch reform, refocusing on outcomes and impacts in addition to outputs. The latest modification of the evaluation methodology, the so-called Metodika 2013 (CRDI, 2013b), established two new pillars that involve international peer review and bonuses for research excellence; however, the formulae-based pillar remains dominant. IPN Metodika project has prepared preparing a new more complex evaluation methodology, however, the roadmap for implementation of which has not been set yet.

Indicator	Year	EU-28
Number of publications per thousand of population	1.73 (2013)	1.43 (2013)
Share of international co-publications	37.6% (2013)	36.4% (2013)
Number of international publications per thousand of population	0.65 (2013)	0.52 (2013)
Percentage of publications in the top 10% most cited publications	8.98 (2010)	12.25 (2010)
Share of public-private co-publications	1.0% (2011-2013)	1.8% (2011-2013)

Source: JRC IPTS RIO elaboration on Scopus data collected by Sciencemetrix in a study for the European Commission DG RTD (Campbell, 2013). The share of public-private co-publications is derived from the Scival platform and is also based on Scopus data (September 2015). SciVal ® is a registered trademark of Elsevier Properties S.A., used under license. The data on public-private co-publications is not fully compatible with the data included in the IUS, due to differences in the methodology and the publication database adopted.

4.2 Optimal transnational co-operation and competition

4.2.1 Joint programming, research agendas and calls

In the context of the National Policy of RDI 2009-2015 implementation, new long-term national priorities of oriented RDI (for the period until 2030) that are largely in line with the grand challenges of Horizon 2020 were prepared by panels of experts at the end of 2011 and approved by the government in mid- 2012 (CRDI, 2012). More specifically, the priority research fields were identified within six broader areas: i) Competitive knowledge-based economy; ii) Sustainable energy and material resources; iii) Environment for quality life; iv) Social and cultural challenges; v) Healthy population; and vi) Safe society. The governmental ministries, CAS, GA CR and TA CR have responsibility for implementing these priorities within their authority and they have been taken into account in the national R&I budget expenditures from 2014 onwards.

The Czech Republic participates in the European Space Agency, the European South Observation, the European Molecular Biology Conference, EUROATOM, EFDA and other programmes. MEYS manages a number of programs that support within EU cooperation in research, for instance EUREKA CZ, COST CZ, EUPRO II and INGO II. As a member of the European Science Foundation, GA CR coordinates and co-funds its programs in the European Collaborative Research (EUROCORES) framework; these programs comprise less than 1% of GA CR budget. GA CR further provides funding for international bilateral research grants, including with the neighbouring Deutsche Forschungsgemeinschaft in Germany and Fonds zur Förderung der wissenschaftlichen Forschung in Austria; however, the combined funding comprises only less than 2% of GA CR budget. The Visegrad fund and the Financial Mechanisms of the EEA/Norway also promote research cooperation with the respective countries.

The National Information Centre for European Research (NICER) that operates under the Technology Centre of the CAS provides comprehensive support for the participation of national teams in international research cooperation, especially in the EU Framework Programmes. The Czech Liaison Office for Research, Development and Innovation (CZELO) in Brussels supports the successful integration of the Czech research into the European research cooperation, particularly through the EU Framework Programmes for Research and Development. The office provides free services to researchers from all fields and all research bodies in the Czech Republic. CZELO is a project managed by the Technology Centre of the CAS and financially supported by the MEYS.

The Czech Republic has become a member of five Joint Programming Initiatives (JPIs), all four from the first wave of 2009 and only one from the second wave of 2010: 1) Neurodegenerative Disease Research, 2) Agriculture, Food Security and Climate Change, 3) Cultural Heritage and Global Change, 4) Healthy Diet for a Healthy Life and 5) The Microbial Challenge – An Emerging Threat to Human Health. However, the Czech Republic plays a rather passive role in the JPIs. The Czech Republic is also formally engaged in all five Joint Technology Initiatives (JTIs).

According to Acheson et al. (2012), the main constraints regarding to Czech participation in the JPIs are budgetary restrictions, limited human resources, lack of coordination at the national level and insufficient compatibility of the national and European rules and procedures. It is therefore no wonder that albeit there are several programmes at the national level which support research on topics relevant to the strategic research areas of the JPIs, the national funding providers have not come forward with direct involvement in terms of financial participation so far. Šebková, et al. (2011) conclude that national financial support to joint programs is very low; ERA-NETs funding is close to zero and bilateral agreements account for a very low part of research funding. Overall, there is a weak link between the Czech joint programmes on one hand and the European programs on the other hand. Not much has changed in this respect in recent years.

4.2.2 RI roadmaps and ESFRI

The Czech Republic is a member of projects of large European infrastructures (ESFRI). The Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic was approved by the Government in March 2010 and updated in May 2011 and May 2015 (MEYS 2011 and 2015a). Several large research infrastructural projects financed by the OP RDI, including pan-European infrastructures, are under construction and gradually opening, which have a potential to open new avenues for international co-operation: i) ELI - Extreme Light Infrastructure (€271m); ii) BIOCEV - Biotechnology and Biomedicine Research Centre (€92m); iii) CEITEC - Central European Institute of Technology (€209m); iv) Centrum excellence IT4Innovations (€72m); and v) ICRC - International Clinical Research Center (€94m); vi) SUSEN - Udrzitelna energetika (€97m)..

National program sustainability I. and the prospective National program sustainability II. have been established to secure immediate funding for operation of the newly constructed research centre and infrastructure projects until 2020. Nevertheless, their funding demands are expected to send ripples throughout the public research sector, as according to preliminary estimates their operating expenses may account for as much as one fifth to one third of the current public R&I budget. Hence, the induced pressures in allocation of institutional funding and the broader picture of their integration into the national system remains a challenge. Unless the amount of public R&D outlays is significantly expanded, which is not expected in the medium-term outlook, public research organisations, including the newly build projects, may end up being underfunded.

4.3 International cooperation with third countries

The Czech Republic maintains a number of bilateral agreements with third countries either on intergovernmental level or on inter-institutional level, involving, for instance, GA CR, TA CR and CAS. MEYS which is the main intermediary body responsible for international cooperation in research manages programme KONTAKT II devoted to financing bilateral projects based on intergovernmental agreements with a host of third countries and programme GESHER/MOST for bilateral project with Israel. GA CR provides funding for international bilateral research grants with National Research Foundation of Korea of South Korea and Ministry of Science and Technology of Taiwan. TA CR operates DELTA programme with the aim to facilitate international cooperation of support to applied research and experimental development through joint programmes with technological (and innovation) agencies in non-European countries. However, judging from the funding flows, the activity under these agreements has been limited so far. Except only of the GA CR and TA CR bilateral grants, calls organized under these agreements are not regular. Generally speaking, there is a very weak link between these bilateral programmes on one hand and the European programs on the other hand.

Bilateral agreements under GA CR recognize the assessment of proposals conducted by the partner funding agency, hence the National Science Foundation of Korea, Ministry of Science and Technology of Taiwan; however, it is not obligatory that the evaluation conforms to international peer-review standards, although this is typically the case. DELTA programme of TA CR recognizes evaluations of the partner technology (or innovation) agency as the basis for national funding decisions. Again, it is not explicitly required in the background documentation that the evaluation process of the partner agency conforms to international peer-review standards.

4.4 An open labour market for researchers.

4.4.1 Introduction

In 2013, there were about 43 thousands researchers (full-time equivalent), of which nearly half were based in the business sector, a third in the higher education sector and slightly less than a fifth in the government sector. In terms of intensity, there were 3,300 researchers per million people, which means close to the EU28 average but roughly half of the level maintained in top performing countries. The number of researchers roughly doubled during the ten-year period between 2004 and 2013, whereas it remained roughly stable during the main crisis period of 2008-2010 and even increased by about 17% over the recent period of 2010-2013; hence researcher workforce is steadily expanding (Eurostat, 2014).

Labour market for researchers is characterized by high institutional autonomy. However, the approach to research human resource management is unsystematic in most public institutions. Human resources management practices in the public sector need to be modernised in order to reduce the widespread in-breeding, make career progression paths more transparent and intensify competition for posts. As shown by National Training Fund (2012), opportunities for early career researchers are weak, post-doc funding remains limited and especially in the university sector often not allocated on competitive basis, which reinforces in-breeding. Arnold (2011) reported that management of research groups is underdeveloped, the groups tend to be very small, locked into existing research trajectories and lacking interdisciplinarity, there is little use of career development plans and mobility among researchers is poor and there is a considerable scope for making better use of research internationalization. Much remains to be done in improving the labour market for researchers, such as reducing the in-breeding problem, stimulating both horizontal and vertical mobility, making research careers more attractive for young people and increasing internalization in the public setor.

4.4.2 Open, transparent and merit-based recruitment of researchers

General conditions of employment and the role of the state administration (especially the Ministry of Labour and Social Affairs) are regulated by the Labour Code (Act no. 262/2006 Coll.) and the Act on Employment (Act. no. 435/2004 Coll.), if not stipulated by a special regulation. Most public research institutions conduct their activities in accord with the Act on Public Research Institutions (Act no. 341/2005 Coll.). For higher education institutions the main human resources issues are defined by the Tertiary Education Act (Act No. 111/1998 Coll.), which has been amended seventeen times and a novelization of which is in the pipeline, sets rules for the operation of higher education institutions, including the appointment of professors and docents.

Nevertheless, the system is based on a high level of institutional autonomy. Research institutions have extensive self-governing rights and decision-making powers which have been further decentralized to the faculty and departmental level. Research institutions employ individual academics in a market driven decentralized system; the recruitment process is an internal affair of every institute. Hence, it is hard to assess policy-measures that define the way researcher's recruitment is carried out.

Likewise, career development is a matter for internal institutional regulations in higher educational institutions. The Higher Education Act gives the task of appointing professors and obtaining venium docendi (habilitation) to the Scientific Board of the higher education institution. Professors are appointed by the President of the Czech Republic on the recommendation of the higher education institution's council, submitted through the MEYS. Academic careers are hierarchical and consecutive and the academic titles have lifelong and countrywide validity, even though the underlying conditions vary by institution.

The legislation rules provide an open access for foreign researchers to be employed at academic positions, especially in case of EU citizens. There are also measures simplifying inward mobility of researchers from the non-EU countries, such as the Scientific Visa Package. Inward flows of researchers are supported also by the EURAXESS network funded by the MEYS, which provides information support to incoming researchers. Attracting talented doctoral students from abroad is high on the agenda on some research institutes, albeit the achievement of this goal is rather difficult because of low financial support available (through there is the Fellowship J. E. Purkyně awarded at the CAS). A programme called NÁVRAT, i.e. "return" in English, administered by the MEYS is aimed to improve conditions for re-integration of top researchers coming back from abroad. Only a small number, not more than several dozens, of researchers have been supported by these programmes so far.

Yet the academic labour market is quite internally oriented. As argued by Arnold (2011), there is a considerable scope for making better use of research internationalization in the public sector, the limited extend of which is in a sharp contrast to the pivotal role of foreign affiliates in the business sector. Only less than 10% of researchers are foreign, and half of those are Slovaks, which is very small proportion by international standards. An explicit internationalization strategy of the public research system is lacking. There is a very low horizontal mobility of academic staff leading to a clear pattern of inbreeding and limited competition for posts. Opportunities for early career researchers are weak, post-doc funding remains limited and often not allocated on competitive basis.

None of the Czech institutions or organisations have received the Commission acknowledgement for progress in the context of the HR Strategy so far, i.e. there is no HRS4R acknowledged organisation with the so-called "HR Excellence in Research" badge. Three institutions, namely the CAS, Charles University in Prague and CEITEC - Central European Institute of Technology, have endorsed the Charter & Code, so the underlying principles have been transposed at national level by individual institutions, most notably in the sector of public research institutes.

In contrast, with the major exception of Charles University, there is generally little awareness and support of the principles in the higher education sector. So far national authorities have not encouraged public funded institutions to adhere to the Charter & Code.

Apart from several smaller initiatives, the most prominent measure to increase the attractiveness of research careers is the Česká hlava (Czech Mind) project which awards an annual prize to distinguished Czech scientists. Recently this award has been extended for talented secondary students. Series of projects supported by the EU Structural Funds entitled Otevřena věda I, II, III and IV (Open Science) and Otevřená věda regionům (Open Science for Regions) have been organized by the CAS since; the projects were targeted at secondary school teachers and assisted them in directing students to research careers. In addition, activities aimed at increasing the attractiveness of research careers and popularising research include science and technology popularisation courses under the OP EC and development of science learning centres under the OP RDI.

Unfortunately, reform of the labour market for researchers that was in preparation for three years largely ended up in doldrums. The higher education reform initially involved bold plans for modernization of conditions for human resources development. The reform was supposed to be implemented already but the drafting process has been derailed due to instability of the government and disagreements among the stakeholders The push for enacting a new law has been first relegated to an amendment that has been delayed by the collapse of the centre-right government in mid-2013 and then watered down significantly. The amendment is a compromise with the existing establishment that falls short of expectations if compared to the ambitious aims of the reform agenda. The main merit of the new regulation is in changes of the system for accreditation of teaching programmes in the higher education sector, however, it has not alteredthe current system of recruitment, hence not tackling the problem of inbreeding.

4.4.3 Access to and portability of grants

Overall, public research funders, such as GA CR and TA CR, support almost exclusively resident researchers, with the exception of special programmes and funding based on agreement for international research cooperation, which is however fairly limited. Funding for non-residents is generally not possible, unless they become residents for the purpose of conducting the research project. Language barriers for participation of foreign researchers are important; the main exception represents the grant programmes of GA CR and MEYS´s funding instrument for large infrastructures for research, experimental development and innovation that require applications exclusively in English.

National research funding programmes do not allow transferability of a grant to another country, thus research projects funded by national research programmes must be performed in the Czech Republic. An entity from other EU country may participate in a public R&D tender provided that such participant does not apply for support from the public funds of the Czech Republic. Hence, reciprocity is required in any international partnership..

4.4.4 Doctoral training

Universities are fairly autonomous in the way they develop doctoral training, which makes it extremely difficult to derive general conclusion on the degree to which the Principles for Innovative Doctoral Training are taken into account. Generally speaking, there are very large differences in this respect. Standardisation of PhD programmes is being currently tackled within the reform of tertiary education based on the debate corresponding to challenges identified in the White Paper on Tertiary Education (adopted by the government already in 2009). However, the policy does not refer nor takes into account the Principles for Innovative Doctoral Training so far, i.e. there is no support that specifically promotes the setting up and running of innovative doctoral training programmes.

4.4.5 Gender equality and gender mainstreaming in research

Overall, gender situation in research is unsatisfactory (NKC – ženy a věda, 2015). The share of female researchers (full-time equivalent) is very low, only 24% in FTE in 2014 and decreasing in recent years, which is far below the EU28 average. The share of female reseachers is far lower in the business sector with 15% only than in the higher education sector with 32% and the government sector with 36% (CZSO, 2015a). Nevertheless, gender equality issues are almost entirely ignored in research policy, the testimony to which is the fact that there is very little, if anything, on this topic in the key strategic documents, there are no formal regulations addressing gender imbalances in decision making processes, there are no public sector funding measures targeting female researchers in place.

General legislation guides the behaviour of funders and employers on matters of non-discrimination and equal opportunities (the Act No. 262/2006, Coll. on labour code, the Act No. 435/2004 Coll. on employment and the Act No. 198/2009, Coll. on antidiscrimination). Hence, there are hard laws on treating job candidates and employees equally as regards their recruitment, working conditions, remuneration and professional development. Also the general laws require that employers do not enquire about arguably irrelevant matters that might bias their decision (such as questions about pregnancy, etc.).

The Czech Labour Code guarantees to female employees restoration to the same position after a maternity leave. However, an extension of the contract due to maternity leave in the case that an employee works in a fixed-term contract is not guaranteed by the law. The employee only has right to receive financial aid for the protective period of 180 days after the termination of the contract. Such conditions may be a barrier for female researchers' career considering the fact that work contracts in research organizations are often on the fixed-term basis.

In government proceedings (or law), the so-called "Jednací řád vlády", there is requirement to assess gender impact of every government resolution, i.e. there must be an appendix evaluating gender impact. However, this has a limited impact on gender equality in the RDI policy, as the CRDI – formally only an advisory body of the government - is not obliged to follow this rule, hence the governance system ensuring that gender issues are considered is bypassed, because gender equality is rarely considered when the actual decisions are made in the council (before submitting the results to the government for a formal approval).

In 2009, the Working group for equal opportunities for women and men, including a committee for science, has been launched at the MEYS, the purpose of which is to formulate priorities of the ministry on gender equality. In 2001, furthermore, as the follow up on the establishment of the Helsinki Group, the Working group for women in science in the Czech Republic started to operate in the MEYS. However, both of the working groups have limited powers, operate at the lowest level of hierarchy and appear to have a rather small impact on decision making.

In 2001, the government adopted Resolution No. 1033 on the Council of the Government for Equal Opportunities for Women and Men. The Council is a permanent advisory board of the government for equal opportunities policies. At the meeting on the 23rd February 2010, the Council of the Government for Equal Opportunities for Women and Men addressed for the first time the problem of gender equality in science, and drafted a suggestion to the government regarding fair representation in expert and advisory bodies and grant competitions. However, while acknowledging this suggestion, the government did not initiate any action in this respect. Furthermore, there are ministerial gender focal points. Since 2001 ministries are required to create a systemic job to take care of the equal opportunities agenda. However, the gender focal points do not have any powers.

Female researchers have the possibility to interrupt or postpone solving a postdoctoral or junior grant of GA CR due to maternity leave for exactly one year only; they are obliged to inform the agency about their pregnancy when they become aware of it and the leave can start only on the 1tst of January or the 1st of July. Other grant provides still do not allow female researchers to interrupt of postpone research grants due to maternity leave. In April 2012, the GA CR maternity leave regulation was challenged by a formal complaint to the Public Defender of Rights, who in January 2013 confirmed its discriminatory nature and recommended GA CR to adjust the rules accordingly. GA CR agreed to relax the rules. However, only minor changes in the specification of the junior grant recipients have been implemented so far.

The main agent promoting cultural change in women in science is National Contact Centre for Women and Science. Established in 2001, the centre contributes to building gender equality in science and research by stimulating debates and petition for measures and steps to eliminate discrimination and gender inequalities. Moreover, they urge action from responsible institutions, offer solutions to improve the professional advancement of women, i.e. lobby for gender equality. Also the team carries out analyses that address the asymmetrical distribution of power between men and women in science in order to raise awareness about gender issues and give visibility to women researchers and their work. The centre is a project of the Institute of Sociology of the CAS.

Milada Paulová Award is organized jointly by MEYS and National Contact Centre for Women and Science for lifelong achievement of female researchers to Czech science since 2009. The award aims to publicly and financially appreciate research achievements of prominent Czech women researchers, who provide role models and inspires women researchers and students at the beginning of their research careers. The winner receives an award of 150,000 CZK. L'ORÉAL Scholarship Czech Republic for Women in Science is awarded by L'ORÉAL in cooperation with CAS and UNESCO for young female scientists in the field of natural sciences (no more than 35 years old) since 2007. The winner receives a fellowship grant of 250,000 CZK.

4.5 Optimal circulation and Open Access to scientific knowledge

4.5.1 e-Infrastructures and researchers electronic identity

The keystone of the Czech e-infrastructure for research is CESNET (Czech Education and Scientific NETwork); national partner of GÉANT and EGI.eu and the coordinator of NGI (National Grid Infrastructure). CESNET, association of legal entities, was established in 1996 as a joint venture of universities and the CAS. Its main goals are: i) Operation and development of the Czech NREN; ii) Research and development of advanced network technologies and applications; and iii) Broadening of the public knowledge about the advanced networking topics. CESNET participates in a number of international projects (DANTE shareholder, TERENA member, Internet2 partner, European GN2 project and GLIF participant).

CESNET is an integral part of the Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic, updated in May 2015 (MEYS 2015a). The CESNET is developing this infrastructure with support from public budgets under two major RIs projects, namely CESNET Large Infrastructure and Extension of the National R&D Information Infrastructure in Regions (eIGeR). The reconstruction of the CESNET2 backbone network started in 2011; it forms the necessary foundation for the other components of the national information e-infrastructure.

IT4Innovations is a unique project (integrated in the ESFRI Roadmap) of a national Centre of Excellence in the field of information technologies. The centre enables the concentration of a wide range of scientific disciplines relating to information technologies and thus achieves development in respective spheres. Part of the project is acquisition of a high-performance supercomputer which has been put into operation in 2014 and which ranks among the top 100 most powerful supercomputers in the world. IT4Innovations is the national partner of PRACE (Partnership for Advanced Computing in Europe).

EDUROAM infrastructure has been implemented by CESNET. The purpose of the eduroam.cz project is to support and spread IP mobility and roaming within the Czech NREN. CESNET task is to in coordinate and propagate eduroam ideas at national level, supporting academic organisations interested in cooperation with eduroam.cz project. Moreover, CESNET operates the Czech academic identity federation eduID.cz project. The eduID.cz federation is based on the Shibboleth project developed by Internet2 and is a member of eduGAIN and participates in REFEDS. CERIT Scientific Cloud offers storage and computing resources and related services, including support for their experimental use.

4.5.2 Open Access to publications and data

Generally, there is growing consensus in the scientific community to allow open access to publications whenever possible, but the concern is about the funding for such arrangements. Hence, open access to both scientific publications and data for research purposes hinges on poorly developed infrastructure and institutional framework. The awareness of open access movement ideas is concentrated among library staff, but there are efforts to raise the awareness, such as the portals www.openaccess.cz and www.dspace.cz, which promote the open access ideas among researchers. Policies with regards to access to scientific publications are fragmented; the deals are negotiated separately by the individual research organizations. Research grants rarely consider costs of gold publishing and the funding agencied do not stimulate the researchers to do so. National open access repository does not exist.

Archambault, E., et al. (2014) reported that during the period 2008-2013 the percentage of peer-reviewed articles published in open access journals was 6.8% compared to the EU28 average of 9.4% in the green category, i.e. self-archiving of final peer-reviewed manuscripts in institutional or subject repositories and 9.6% compared to the EU28 average of 8.6% in the gold category, i.e. pay to publish in open access, respectively. Hence, there is a noticeable room for improvement in using the green open access, but there is already a sizeable potential for leveraging the possibility of gold open access, which however makes a difference only if the author actually pays for it. Unfortunately, no data is available on the latter.

According to OpenAIRE, there is no official government mandate to deposit research output arising from grants, no research funding agency requires that, nor exists any university which mandates to deposit published journal articles in its open repository. OpenAIRE gives a list of 11 open access repositories and 4 research data repositories scattered in libraries of various research organisations and universities. Although the Berlin Declaration has been signed by eight organisations, including the GA CR, CAS and Masaryk University, and there is a growing number of open access journals published by the Czech research organisations, the adoption of open access to scientific publications remains in the early phase.

The Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 admits that policies with regards to access to scientific publications, i.e. journal subscriptions, are fragmented; the deals are negotiated separately by the CAS and universities, which leads to inefficiencies, and that there is a need for forming consortium at the national level for this purpose (CRDI, 2013a). It is concluded that "access to information infrastructure for the system of research, development and innovation is not provided in a satisfactory manner". Admittedly, there is a looming deficit in this respect that represents a major challenge for policy. The CRDI at its 291st meeting in February 2014 approved a resolution on open access to publicly funded scientific publications that recommends to develop a national strategy of open access, intensify support to efforts of research organizations to facilitate open access and encourages research funding agencies to require open access. Nevertheless, there are currently no measures or funding at the national level for promoting open access publishing.

The Czech Statistical Office (CZSO) provides confidential statistical data for scientific research purposes. Microdata can be provided only on the basis of a special contract, which stipulates conditions for the data confidentiality protection and the exact way of data use in accordance with the legislation. Data is provided in the form not allowing the direct identification of reporting units only to domestic and foreign legal entities the primary mission of which is scientific research. However, microdata is provided only from a handful of surveys, especially access to firm-level data is severely limited. In addition, there is no safe-room in the CZSO and on-line remote access to micro data for scientific purposes is not provided; each data release needs to be negotiated separately, which hinges merging of datasets, creating longitudinal panel data and hence undermines efforts to conduct research on the data systematically over long-term.

The CRDI administers the Research and Development and Innovation Information System of the Czech Republic (ISVaV), a well-developed information system for a collection, processing, publication and utilisation of data about publicly funded research activities, projects and their outputs. Access to this information system is required to be open and available on-line by the law. The system consists of the following databases: 1) Central register of R&D projects (CEP); 2) Central register of Institutional Research Plans (CEZ); 3) Information register on R&D results (RIV); 4) Central register of R&D Activities (CEA); and 5) Register of public R&D tenders (RES). Most of the datasets are updated quarterly and direct searching in the databases is possible through the user application.

5. Framework conditions for R&I and Science-Business cooperation

5.1 General policy environment for business

According to the index of the general policy environment for doing business by World Bank (2015), the Czech Republic is ranked on the 44th position in 2015 up from the 47th spot in 2014 worldwide, 19th in the EU28 and 7th among the new EU member countries; just short of Belgium but ahead of Romania, Slovenia, Hungary, Italy or Greece. The main strenghts are in the components for registering property, enforcing contracts, resolving insolvency and getting credit; the latter also registered the largest year-on-year improvement. The main weaknesses are highlighted in the realm of starting a business, dealing with construction permits, getting electricity, protecting minority investors and paying taxes. The results are remarkably uneven across the individual components of the index, ranging from the 23th to 139th position, which indicates highly uneven progress in improving the general business environment.

In 2008, a comprehensible reform of the research, development and innovation system was launched. The reform is outlined in the National RDI Policy of the Czech Republic 2009–2015 (CRDI, 2009) and the Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 (CRDI, 2013a). The reform profoundly changed the governance of system, established the TA CR as the dominant supporter of applied research and brought to the attention of policy-makers the role of innovation and private-public research linkages for national competitiveness.

Business investment in research and innovation is not only supported by direct subsidies anymore, which used to be the dominant policy measure, but by much broader portfolio of instruments, including R&D tax credits both for internal activities as well as purchase of external inputs from research organizations, support programmers for joints research projects between the public and private sectors, regional innovation voucher programmes. Nevertheless, RDI policies continue to neglect the potential of using demand side instruments and continue to be deeply rooted in the linear model of innovation. Coordination between the various policy instruments, including within the supply side, is underdeveloped and their synergies remain unexploited. Public procurement is not seen as an instrument to promote innovation.

According to the Research and Innovation Performance Country Profile by the the European Commission (2014c), structure of the economy is generally favourable, the high- and medium-high-technology sectors are relatively large, but business R&D investment is relatively low, despite a positive trend, thus the innovation performance is deemed to remain below its potential. Another evergreen weakness that was highlighted refers to the limited cooperation between the science and business sectors. The key science and technological strengths were identified in the fields of automobiles, other transport, construction, materials, energy and environment.

5.2 Young innovative companies and start-ups

A major weakness of the public research sector has traditionally been limited knowledge transfer from science to practical applications, poor commercialization of scientific outputs and underdeveloped entrepreneurship culture among scientists. Professors rarely get involved in spin-offs. No official data is available on the number of start-ups involving scientists, which is at least partly attributable to the fact that anecdotal evidence suggests that they are extremely rare. The evaluation system, including the allocation of institutional funding at the organization level and career progression paths at the individual level, heavily relies on indicators of scientific output and does not motivate scientists to get involved in commercialization activities. The only exception is Pillar III. of Metodika 2013 (for more details see Section 3.4.2.), however, only a relatively small proportion of the evaluation points (and hence funding) is awarded to these activities.

Public R&I support programmes have been seldom focused on funding innovative start-ups so far. TA CR has been established in 2009 as the dominant supporter of applied research and innovation and launched a portfolio of new programmes; however, none of its programmes has been devoted to supporting young innovative companies. Only several smaller programmes of the OP EI under the MIT, most prominently Start, helped start-ups to overcome the limited availability of external funding, while the Cooperation programme supports the establishment of technology platforms and clusters. Regional governments are increasingly implementing innovation voucher programmes, including in South Moravia, Moravia-Silesia and Prague; however, the latter has prematurely terminated the programme and in any case the regional voucher funding is rather limited.

Nevertheless, there have been bottom-up efforts to promote university spin-offs at the level of individual institutions that deserve to be mentioned. Several business incubators for start-up companies of university students have been opened in the higher education sector, for example, InovaJET at the Czech Technical University in Prague has already supported about 80 projects since 2010 and xPort at the University of Economics in Prague and Point One at the Czech University of Life Sciences Prague have been just launched. In addition, the CAS has published, as a part of its new Strategy AV21 released in December 2014, the overview of the so-called "application laboratories" (CAS, 2014), which provides a commercial presentation of 24 facilities with the aim promote linkages to the industry, technology transfer and harness the potential fo contractual research. Yet the results of this measure remain to be seen.

5.3 Entrepreneurship skills and STEM policy

Labour market for researchers continues to suffer from an insufficient supply of experts with an appropriate mix of skills, especially in science, technology and engineering. According to the data from the Czech Statistical Office (2015a), the number of PhD graduates has stagnated in recent years and there is a long-term tendency for the proportion of science and technology tertiary students to decrease in comparison to those of social science and humanities, however, policies to boost the supply of (post)graduates in science and technology are lacking. The assessment of MIT (2011b) concluded that because the reform of tertiary education remains uncompleted, there has been an unchecked expansion of university graduates, the quality of which is however hard to judge. Education and training curricula in higher education are heavily traditional, generally not equipping people with critical thinking, problem solving, teamwork and communication skills. Entrepreneurship educational programmes are missing in higher education. Projections of the future development of the human resource base in research are lacking.

5.4 Access to finance

The European Commission (2015a) vindicates that the utilisation of venture capital to support innovative businesses and spin-off firms is one of the lowest among European countries and that the limited access to external sources of finance for innovation is perhaps the single most important obstacle to the improvement of the innovative performances. Venture capital investment dropped to less than €1m in 2012 and 2013 and was limited to €6m in 2014. Only several companies receive venture capital funding each year (Eurostat, 2015). Statistics on crowdfunding and business angels is not available, at least not reliable data from official sources, probably because it also very rare. Unfortunately, a lack of experience among potential clients and rather traditional entrepreneurial culture do not form an environment favourable to venture capital expansion.

Public measures to support venture capital are missing. Since 2011 the MIT has attempted to establish a public-private seed fund to kick-start the market. A budget of €53m funded from the OP EI was earmarked for the fund. The seed fund was ready to start operation; however, in 2013 the launch of the project has been derailed by the ruling of the Office for the Protection of Competition due to dispute over the tender for the fund's custodian and in 2014 the project was eventually terminated (CzechTrade, 2014). Nevertheless, MIT re-launched this effort under the OP EIC in the new programming period, as the results of which in October 2015 the government gave a green light for the the establishment of a pilot National Innovation Fund (NIF) to provide jointly with private investors capital to innovative SMEs that have difficulty to access credit funding

INOSTART programme, a joint effort of the main commercial bank Česká spořitelna and the MIT launched in 2014 that is backed by the Partnership Fund of Czech-Swiss Cooperation and the state-owned Czech-Moravian Guarantee and Development Bank, remains the only major instrument that supports innovative business start-ups in terms of loan guarantees for innovative projects and consultancy services.

5.5 R&D related FDI

CzechInvest, an agency of MIT, is responsible for attracting R&D related FDI. The main policy instrument is the general investment incentive programme; however, there are no incentives specifically devoted to FDI in R&D in place. As far as support to FDI in R&D is concerned, CzechInvest mainly engages is reducing information asymmetries by organizing matchmaking events between foreign investors and indigenous actors, including from the public research sector. Hence, all of the available direct and indirect R&I support instruments are available both for domestic and foreign firms under equal terms.

Official statistics of R&D intensive FDI investments does not exist. Yet the Czech economy apparently managed to attract sizeable amount of R&D related FDI, the testimony to which is the fact that most of the largest R&D spenders are well-known to be foreign affiliates (for more details see Section 1.2.3), as also vindicated by the tripling of R&D investment expenditure, i.e. the part of R&D expenditure that refers to investment in tangible and intangible assets excluding operating R&D costs, of foreign affiliates from €57m (CZK 1.56b) in 2010 to €105m (CZK 2.90b) in 2012 and to €172m (CZK 4.74b) in 2015 (CZSO, 2015a).

5.6 Knowledge markets

Formal methods of intellectual property rights (IPRs) protection, in particular patents and their licensing, remain underutilized, as clearly shown by European Commission (2015a), in spite of the continuous effort to improve the use of public R&D outputs in innovation processes and despite the fact that state of the art IPRs legislation is in place. Too few experts and little experience can be found in this domain, especially in the public sector, except only perhaps of a few exceptions under the umbrella of CAS, such as the Institute of Organic Chemistry and Biochemistry (IOCB), that prove the rule. Poor commercialisation of R&D outcomes in general requires systematic attention as well as support to research excellence to produce high valuable research outcomes being worth of patenting costs.

While statistics on applications to national patent office are not always comparable across countries, they can provide some indication of technological development activities that are not captured by EPO/PCT data. In the Czech Republic, according to the data by INCENTIM KU Leuven and Bocconi University (2014), 1.3 thousand patent applications were made at the EPO, 1.5 thousand patent applicants took the PCT route and the Industrial Property Office of the Czech Republic received about 8 thousand applications in the period 2000-2010; these figures are based on fractional counting. In terms of patenting per capita, however, the Czech Republic remains far below advanced countries.

According to the survey of licenses by CZSO (2015a), between 2008 and 2014 the number of organizations with licensed patents increased from 42 to 67 and the number of licensing agreements on patents increased from 253 to 402, respectively, hence there is a positive trend, despite the low levels. In 2014, public research organizations and universities had a share of 29% in the number of licensed patents but accounted for 89% of €99m income from licence fees from patents, however, a lion share of the latter can be traced back to income of a single organization, namely the IOCB, from licencing of patents for antiretroviral drugs developed by professor Antonín Holý to U.S. pharmaceutical companies. Hence, this is not a systemic feature.

As far as the policy in the area of IPRs is concerned, the owner of invention developed in the public sector, i.e. supported by institutional or project funding, is nominally the university or the government research institute and its utilization needs to be specified by their internal regulations. However, the oversight and enforcement of this rule is weak and there is a large scope for opportunistic behaviour of researchers when deciding on who owns IPRs on knowledge generated within public support. In practice, commercialization of inventions originating from the public sector follows both formal and informal rules established at the level of individual organizations, much depends on governance of the particular workplace, and hence there are wide differences in this respect throughout the system. National strategy of IPRs utilization is lacking.

5.7 Public-private cooperation and knowledge transfer

5.7.1 Indicators

Funding: BES-funded public R&D

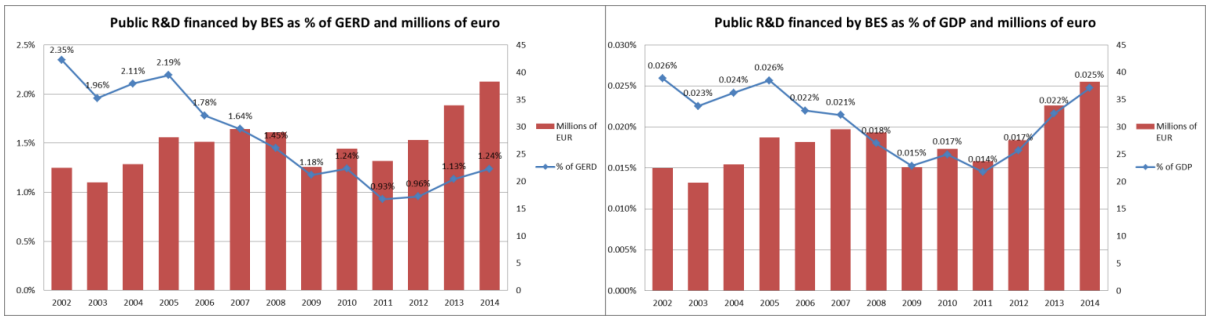
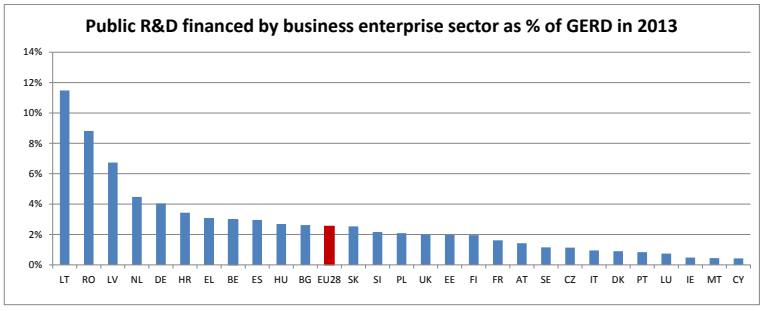


Figure 17 BES-funded public R&D in the CZECH REPUBLIC as % of GERD (in €MLN) and % of GDP

The level of the Czech business enterprise (BES)-funded public R&D expenditure as a percentage of GERD was decreasing in the period 2002-2009 to start increasing in the last years (2012-2014). The same pattern is visible when we expressed it as % of GPD, in this case the growth of this indicator commenced already in the 2012. The amount of the expenditure however is so insignificant (oscillating between €23m and €29m) that the analysis of the trends would not bring many insights.



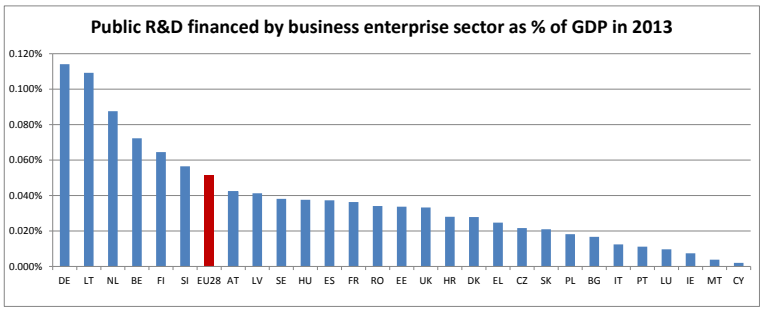


Figure 18 BES-funded public R&D as % of GERD and as % of GDP in 2013 in Member States[13]

The two charts in Figure 18 show the values of BES-funded public R&D in all EU-28 as percentages of GERD and GDP respectively.

The Czech Republic's levels are far below the EU-28 average for both indicators.

The low level of the BES-funded public R&D indicator can be explained by the structure of the R&D intensive sector in the Czech Republic: An important part of the Czech BERD is performed by multinational companies that tend to carry out their R&D in-house.

Funding: Structural funds devoted to knowledge transfer

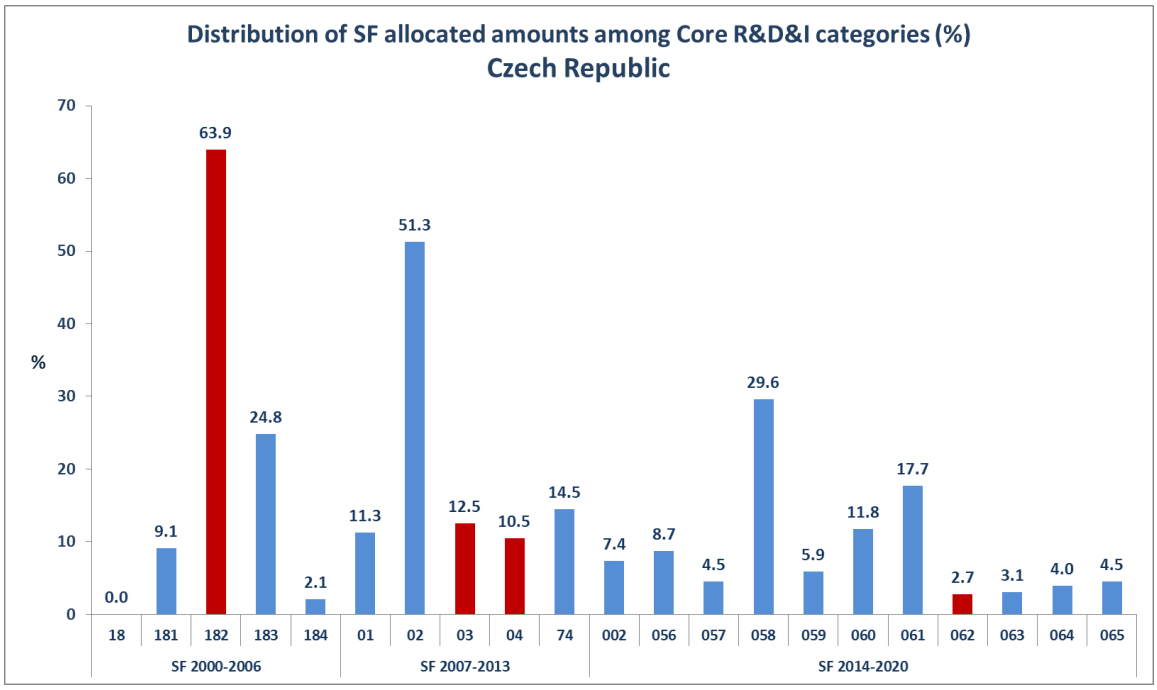


Figure 19 Structural Funds for core R&D activities 2000-2006, 2007-2013 and 2014-2020[14]. We use the categories: 182 (2000-2006)[15], 03 and 04 (2007-2013)[16] and 062 (2014-2020) as proxies for KT activities[17].

[13] 2013 was chosen as the latest data series providing a full comparison within EU-28.

[14] Figure 19 provides the Structural Funds allocated to the Czech Republic for each of the above R&D categories. The red bars show the categories used as proxies for KT. Please note that the figures refer to EU funds and they do not include the part co-funded by the Member State.

The Czech Republic has allocated only 2.7% of its structural funds to core R&D activities to "Technology transfer and university-enterprise cooperation primarily benefiting SMEs" (compared to 63.9% for 2000-2006 and 23% in the 2007-2013 programming period). It is significantly lower than the EU average of 15.7% (the EU average was 26.1% for 2000-2006 and 30.1% for 2007-2013) and much lower than in the last two programming periods. The Czech Republic still invests a very important part of the structural funds in the public research infrastructures and public research centres activities.

[15] The categories for 2000-2006 include: 18. Research, technological development and innovation (RTDI); 181. Research projects based in universities and research institutes; 182. Innovation and technology transfers, establishment of networks and partnerships between business and/or research institutes; 183. RTDI infrastructures; 184. Training for researchers.

[16] The categories for 2007-2013 include: 01. R&TD activities in research centres; 02. R&TD infrastructure and centres of competence in specific technology; 03. Technology transfer and improvement of cooperation networks; 04. Assistance to R&TD particular in SMEs; 74. Developing human potential in the field of research and innovation.

[17] The categories for 2007-2013 include: 01. R&TD activities in research centres; 02. R&TD infrastructure and centres of competence in specific technology; 03. Technology transfer and improvement of cooperation networks; 04. Assistance to R&TD particular in SMEs; 74. Developing human potential in the field of research and innovation.

[17] The categories for 2014-2020 include: 002. Research and Innovation processes in large enterprises; 056. Investment in infrastructure, capacities and equipment in SMEs directly linked to Research and Innovation activities; 057. Investment in infrastructure, capacities and equipment in large companies directly linked to Research and Innovation activities; 058. Research and Innovation infrastructure (public); 059. Research and Innovation infrastructure (private, including science parks); 060. Research and Innovation activities in public research centres and centres of competence including networking; 061. Research and Innovation activities in private research centres including networking; 062. Technology transfer and university-enterprise cooperation primarily benefiting SMEs; 063. Cluster support and business networks primarily benefiting SMEs; 064. Research and Innovation processes in SMEs (including voucher schemes, process, design, service and social innovation); 065. Research and Innovation infrastructure, processes, technology transfer and cooperation of enterprises focusing on the low carbon economy and on resilience to climate change.

Cooperation: Share of innovative companies cooperating with academia

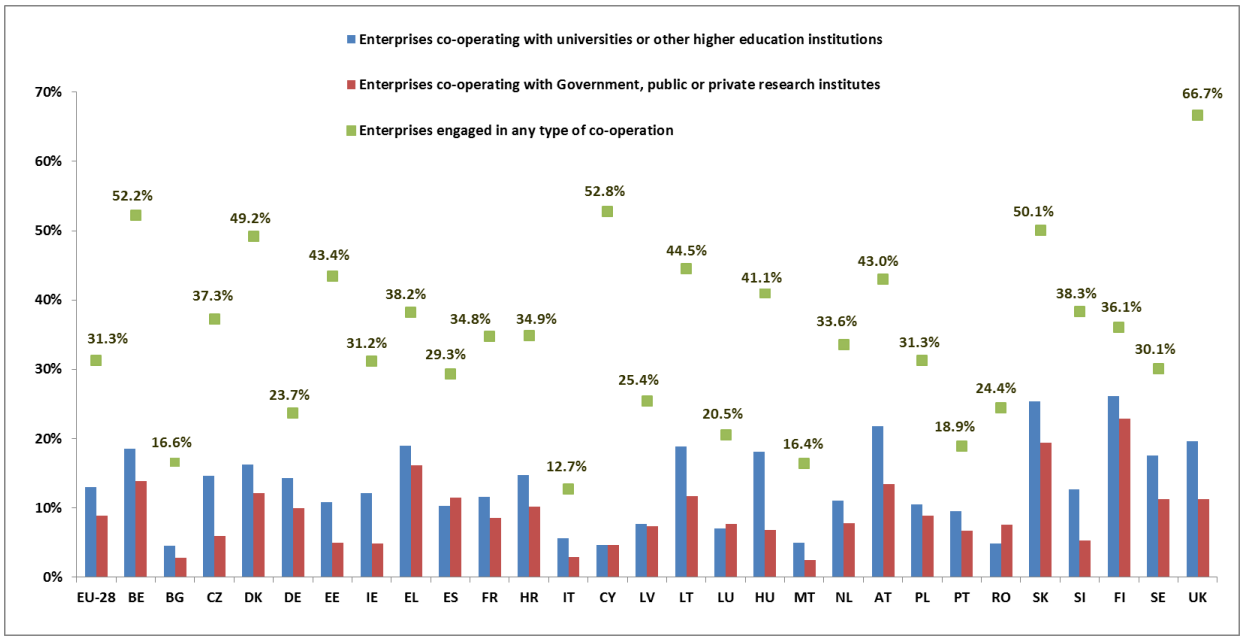


Figure 20 CIS survey 2012 – share of enterprises cooperating with academia

Figure 20 depicts the level of cooperation activities of innovative companies in the EU-28, according to the CIS 2012. The percentage of "enterprises engaged in any type of co-operation" (green dot) is in the Czech Republic relatively high - 37.3%, a bit higher than the EU-28 average of 31.3%. The percentage of enterprises involved in cooperation with universities or other HEIs (blue bar) is 15% compared to the EU-28 average of 13%, whereas government, public or private research institutes (red bar) is 6% compared to 8.9% of the EU-28 average.

Cooperation: Technology Transfer Offices (TTOs offices), incubators and technological parks

The Czech Republic has at least 10 Business and Technology Incubators[18] (that can be part of larger science parks). There are 14 Science and Technology Parks[19] accredited by the Czech Science and Technology Park Association and another 30 are in a process of accreditation as well as 7 parks under preparation. There are at least 20 TTOs offices, 10 are within public universities, two within research institutions, five established by municipalities, one by a private research institute and two established jointly by universities and research institutes[20]. The Academy of Sciences also has a central office for patents and licensing. TTOs have been mainly financed from structural funds in the last programming period (priority Axis 3 "Commercialisation and popularisation of R&D of the OP).

Establishing technology transfer points and offices in research institutions as a way to use research results is one of the activities eligible within the Priority Axis 3 "Commercialisation and popularisation of R&D " of the OP RDI administered by the MEYS. The first technology transfer offices were supported from this programme at the beginning of 2012.

[18] http://www.czechinvest.org/en/incubators
[19] http://www.svtp.cz/en/catalog/
[20] http://knowledge-transfer-study.eu/fileadmin/KTS/workshop/European/KTS_WS_CZ-SK-HU-SI_2012-04-25_Presentation_M.Pazour.pdf

Cooperation: Share of public-private co-publications

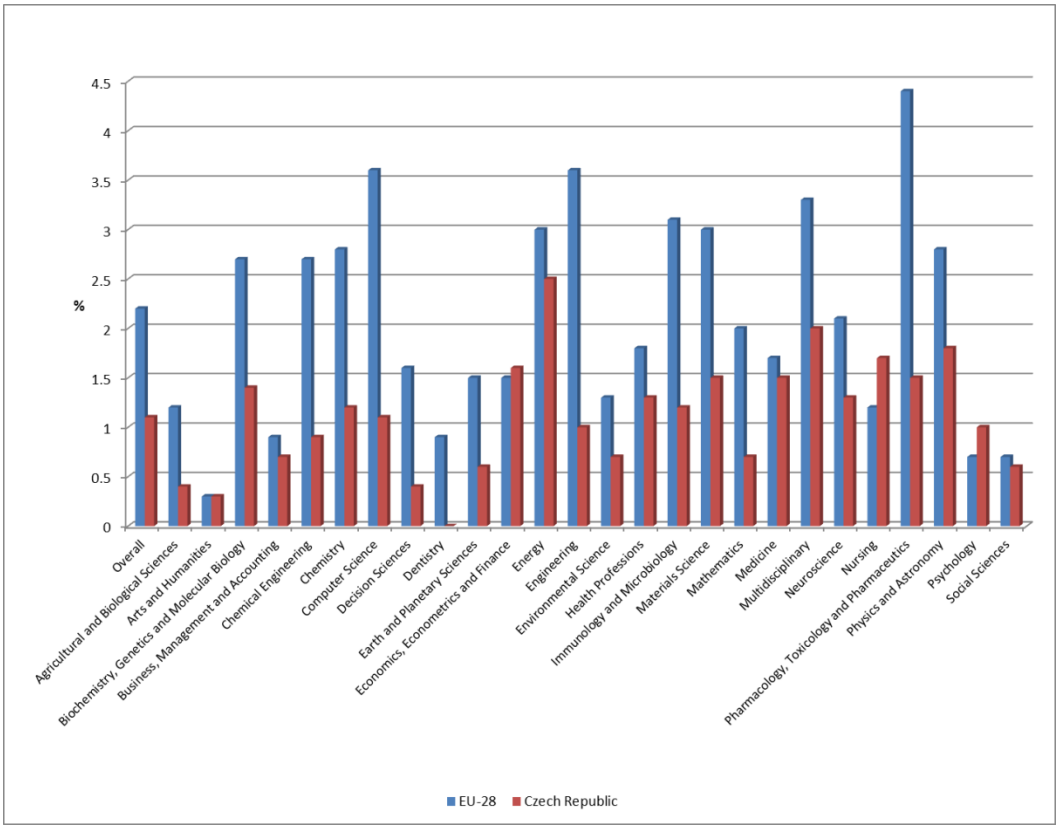


Figure 21 Co-publications by field 2003-2013 in the Czech Republic. Scopus database

The Figure 21 shows the 2003-2013 average percentage of academia-industry co-publications by field in the Czech Republic compared to the European average. The total share of co-publications, displayed by the red "overall" bar on the left of the chart, is 1.1%, half of the EU-28 average of 2.2%. Excluding multidisciplinary publications and nursing, the domains recording the highest share of co-publications are: energy, physics and astronomy, and pharmacology, toxicology and pharmaceutics.

Scopus data indicates that with 17.5 co-publications per million population, the Czech Republics is below the EU-28 average of 29.0 and performing better than neighbouring countries with 9.8 for Poland and 12.8 for Hungary. Still, the Czech Republic is situated very far from the Innovation Leader countries (Denmark stands at 182.1, Finland at 155.0, Germany at 57.8 and Sweden at 113.3).

Cooperation: Patenting activity of public research organisations and universities together with licensing income

The patenting activity of public research organisations has grown in the recent years (from 108 patents granted by the Czech Industrial Property Office in 2008 to 221 in 2014)[21]. The Knowledge Transfer Study also locates the Czech Republic above the European average of 4.5 with 7.8 granted patents per 1 000 research staff.

The growth in patenting activity has not been matched with the increase of licensing agreements which may suggest that most of the public sector patents are unused and were prompted by the methodology of the evaluation of the public research results. In 2014, 30% of licensors of patents and utility models come from public universities and

[21] https://www.czso.cz/csu/czso/22-science-and-research

PROs (25 in absolute numbers, including 14 new licensors which is a slight decrease compared to 2013). The Knowledge Transfer Study reports 1.6 licensing agreements per 1 000 research staff compared with the European average of 6.5.

The PROs licenses generate an impressive rate of 84% of the total licensing income which amounts to 2.467bn CZK in licensing fees. Yet only 1.5m CZK in 2014 was generated by the new licences[22]. Nevertheless, the situation of the Czech Republic is particular. If one does not take into account the licensing revenue of the Institute of Organic Chemistry and Biochemistry AS CR, which generates a considerable income from patents for antiretroviral drugs, the licensing revenue is very low as confirmed by the low value of the new licenses (CDRI 2015).

Sold patent and utility model licenses by type of licensors in 2014

Sektor *Sector*	Počet poskytovatelů (1) *Number of licensors (1)*		Počet licencí *Number of licenses*		Licenční poplatky (tis. Kč) *License fees (CZK thous.)*	
	Celkem *Total*	s novou lic. *incl.: new*	Celkem *Total*	nových *incl.: new*	Celkem *Total*	za nové *incl.: new*
Veřejné vysoké školy *Public universities*	**12**	9	**82**	21	**60 502**	1 329
Veřejné výzkumné instituce *Public research institutions*	**13**	3	**70**	17	**2 406 559**	257
Podniky *Business*	**64**	16	**357**	32	**460 315**	33 578
Fyzické osoby *Individuals*	**15**	5	**61**	7	**17 167**	5 445
Ostatní *Others*	**4**	1	**34**	6	**238**	56
Celkem ***Total***	**108**	34	**604**	83	**2 944 781**	40 665

1) Počet poskytovatelů licencí na patenty a užitné vzory se nemusí rovnat součtu poskytovatelů licencí na patenty a poskytovatelů na užitné vzory, neboť jeden poskytovatel může poskytnout licenci na patent a zároveň licenci na užitný vzor.

1) Number of licensors with valid patent and/or utility model license agreement do not need to be equal to sum of licensors with valid patent license agreement and licensors with valid utility model license agreement because one licenser can have both valid patent license agreement and valid utility model license agreement.

Table 5 Patent sales and utility model licenses by type of licensors in 2014[23]

1) Number of licensors with valid patent and/or utility model license agreement do not need to be equal to sum of licensors with valid patent license agreement and licensors with valid utility model license agreement because one licenser can have both valid patent license agreement and valid utility model license agreement

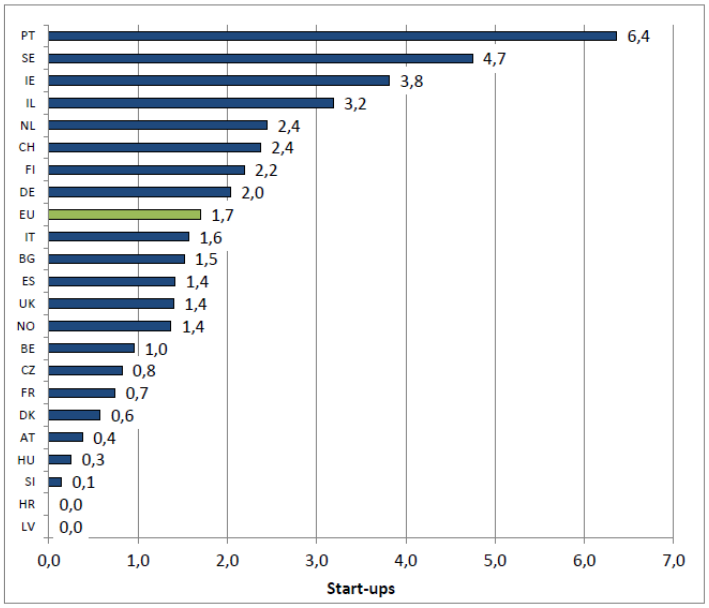
Cooperation: Companies

According to the KT study results, the Czech universities and public research institutes have 0.8 start-ups per 1 000 research staff compared to the European average of 1.7.

[22] http://www.czso.cz/csu/2014edicniplan.nsf/engp/213002-14, http://www.czso.cz/csu/2014edicniplan.nsf/p/213002-14

[23] Czech Statistical Office, Licences 2014. https://www.czso.cz/documents/10180/20555107/2130021503.pdf/e3790421-79a4-46ad-bbaf-87da2261417c?version=1.0

Exhibit 3-33: Number of start-ups per 1,000 research staff by country, EKTIS 2011 and 2012 results combined



Source: MERIT, European Knowledge Transfer Indicator Survey 2011 and 2012.

Figure 22 Number of start-ups per 1000 research staff by country. Source: KT study 2010-2012

Cooperation: intersectoral mobility

Private-public mobility of researchers appears to be weak. In 2012, about 7% of R&D employees in the business sector were doctorate holders (CZSO, 2014a), hence received research training in the university sector. Unfortunately, no direct data is available on the circulation between the private and public sectors, such as the share of researchers in public organisations with experience in the private sector and vice-versa. Other relevant information, including the share of professors whose primary occupation is in industry and the number of researchers benefiting from academia-industry exchange contracts, is probably not collected, because it is very close to zero. Also there is no official data on the number of invention disclosures, public-private research partnerships and start-ups stemming from public-private cooperation, because these events are fairly rare.

5.7.2 Policy Measures

"Cooperation and knowledge transfer between academia and industry" is one of four priority areas of the National Innovation Strategy of the Czech Republic (NIS) that has been produced jointly by the MIT and MEYS in line with recommendations of the Innovation Union strategy of the EU in 2011. In April 2013, also the national research, development and innovation (RDI) policy for 2009-15 was updated and its stress on knowledge transfer and the innovative capacity of the business sector was reinforced.

The National RIS3 Strategy has been approved by the government and submitted to the European Commission in December 2014. The key enabling technologies have been specified as: i) Advanced materials; ii) Nanotechnology; iii) Micro- and nano-electronics; iv) Advanced production technologies; v) Photonics; vi) Industrial biotechnology; vii) Knowledge for digital economy, cultural and creative industries; and viii) Social science knowledge base for non-technical innovation. Four national S3 platforms have been formed: i) Engineering; ii) Information and telecommunication services and software; iii) Transport equipment; and iv) Pharmaceuticals and life technologies; more are expected to be added through the entrepreneurial discovery over time.

The projects run by the Technology Agency of the Czech Republic that are related to knowledge transfer include:

The GAMA Programme supporting the preparation for subsequent commercialisation of R&D outputs. The main objective of the programme is to support and significantly streamline the transformation of R&D&I results achieved in research organizations and/or in collaboration between research organizations and enterprises into practical applications to enable their commercialisation and support their implementation. The total expenditure on the programme will be **2 770m CZK**, of which **1 798m CZK** covered from the state budget. It runs from 2014 till 2019. Awarded projects will have to bring at least one of following outputs: patents, technically realised results (prototypes, functional samples), pilot operations, verified technologies, software, results with legal protection (utility models, industrial designs).

The DELTA programme aims at supporting collaboration in applied research and experimental development projects through joint projects of enterprises and research organizations with major foreign technological and innovation. It will run from 2014 till 2019 with 1 039.2m CZK budget. The programme will be monitored by number of patents, utility models and industrial designs, functional prototypes and samples, number of certified methodologies and procedures, software and pilot operation, verified technologies.

The recently launched EPSILON programme, a follow-up on ALFA (see below), aims at supporting applied research and experimental development with a high potential for rapid application in innovations in three priority areas of competitive knowledge-based economy, sustainability of energy and material resources and environment for quality of life with a budget allocation of €373m over 2015-2025.

The ALFA programme supported applied research and experimental development especially in the field of advanced technologies, materials and systems, energy resources and the protection and creation of the environment and the sustainable development of transport. The programme placed emphasis on strengthening public-private partnerships in research, development and innovation and research, development and innovation projects requiring rigorous co-financing from private sources. It had a budget 7.5bn CZK (65% of public financing, the rest funded from private sources) for 2011-2016.

The Competence Centre programme supports the establishment and operation of centres for research, development and innovation in advanced fields with high application and innovative potential. The centres will create the conditions for the development of long-term cooperation in research, development and innovation between the public and private sectors. The duration of the programme is from 2012 to 2019 with three-stage public tenders (2011, 2013 and 2015) with a budget of 6bn CZK (70% publicly funded, the other 30% from private sources).

The Ministry of Industry and Trade manages the TIP programme 2009-2017 (12.4bn CZK), ALFA predecessor. Further to that the Ministry introduced in 2015 a new programme TRIO for support of business R&I and public-private research collaboration in key enabling technologies with a budget of €134m over 2016-2021, which largely overlaps with the purpose of the TA CR's program EPSILON.

CzechInvest (MIT executive agency) manages two programmes Innovation which targets knowledge transfer and Prosperity which supports the creation of science and technological parks, TTOs and business angels networks.

All but one Czech regions run innovation vouchers programmes (first introduced by the South Moravian Innovation Centre in 2009). South Moravian Region offers a subsidy worth up to 6 000 Euro covering 75% of the supported project intended for a purchase of knowledge from one of regional research institutions. Still, the largest programme in the capital city of Prague had a budget of only €0.5m in 2014 and was discontinued in 2015. Due to its success at regional level the innovation vouchers are to be continued in the new programming period.

Finally, in 2014, the Czech government has extended the existing tax credits to external R&D services, i.e. contractual research purchased from research organizations. This change was aimed at stimulating industry-academia collaborations. The amendment was expected to bring a 60% increase of the intensity of contractual research in 2014 while the total estimated volume of newly claimed deductions from income tax pursuant to the amendment was put at 0.25 billion CZK in 2014[24].. The 2014 National Statistical Office data do not support this claim given a general decrease in theamount of tax relief in 2014[25] (unfortunately there is no information about the new relief uptake). The intensity of contractual research has risen by less than 20% in 2014 (Eurostat 2015).

Commercialization of know-how in the research organizations (Proof-of-concept programme) will be financed by OP EIC under NIF (along with venture capital programmes for start-ups) trough equity finance measures.

The project EF-TRANS (Efficient Transfer of Research and Development Outputs in Production and their Subsequent Utilisation[26]) carried out in 2009-2013 was aimed at identifying barriers to knowledge transfer in the Czech Republic. The EF-TRANS project analysed the legal environment and the knowledge transfer situation in the Czech Republic and abroad. The main objectives of the EF-TRANS were: to improve the cooperation between research institutions and universities with industry in order to facilitate the commercialisation of R&D results; to enhance the utilisation and legal protection of intellectual property; and to motivate students, employees of universities and research institutions and to instruct them on which steps to take in this process. The project developed methodologies for the Czech PROs (on a commercialisation system, IP protection, cooperation with business, licenses use, company establishment, result evaluation, and entrepreneurship education) as well as a Guide for Commercialisation[27].

Policy measures supporting horizontal mobility such as traineeships or integration in the organization of industry-oriented PhD programmes are still missing however mentioned in the National Smart Specialisation Strategy.

The Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014[28], an annual overview of the R&I system presented to the government in September 2015 refers to the low level of public-private collaboration and technology transfer and recommends deepening the support of public-private linkages that stimulate R&I efforts in the business sector.

[24] http://www.tacr.cz/index.php/en/14-novinky/356-income-tax-impetus-czech-research.html The Czech Statistical Office should publish the new data on the indirect aid in April 2016.
[25] https://www.czso.cz/csu/czso/neprima-verejna-podpora-vyzkumu-a-vyvoje-v-ceske-republice-2014
[26] http://eftrans.reformy-msmt.cz
[27] http://eftrans.reformy-msmt.cz/soubory-ke-stazeni/guide/
[28] http://vyzkum.cz/FrontClanek.aspx?idsekce=759405

The Czech Republic has implemented a series of policy measures based on the National Innovation Strategy of the Czech Republic 2005-2010 and subsequent National Research, Development and Innovation Policy of the Czech Republic for the years 2009 – 2015. The funding schemes (introduced as from 2007 via structural funds and more recently as from 2011 by TACR) target commercialisation and are reinforcing the links between academia and business.

Since the most important KT policies were implemented in the last five years and most of the projects are in its initial phase it is too early to evaluate the impact of the policies put in place. Therefore, the output indicators (especially those with a long time lag as co-patenting or co-publications) are not yet influenced by those policies.

The major weaknesses of the KT systems are the low absorption capacity of the industry due to the structure of the economy (Czech business enterprises tend to perform their R&D in-house and the high-technology industries are mostly multinationals performing their R&D in the headquarters[29]) and on the supply side: the traditional low level of industry-academia relations, low incentives for researchers to commercialise their results and lack of qualified staff in academia to facilitate cooperation.

The strength of Czech Republic lies in a well-defined IPR law and in a recently implemented set of R&D funding programmes by TACR that focus on commercialisation, public-private partnerships and supporting collaboration in applied research and experimental development. The potential lies in the, for its region, strong performance of the Czech public research system and the importance of the medium technology sector in the economy.

Yet, since foreign-owned businesses play a significant role in the innovation system, it is a challenge to create tighter and long-term connections between these businesses and the public research performers (CDRI 2015).

The extension of the existing tax credit to contract research in public research organisations may increase the volume of privately financed public performed R&D and the effects should be monitored in the next years.

5.8 Regulation and innovation

Evaluation framework is underdeveloped, there have been no policy actions assessing the impact of regulation on innovation.

5.9 Assessment of the framework conditions for business R&I

Generally speaking, the framework conditions for business R&I investment are improving, however, the progress has been uneven and the success has been at best partial so far. A major positive policy shift has been from a system traditionally focused on science towards more attention devoted to boosting innovation. Structurally, the business sector appears sound; the high- and medium-high-technology sector is large. However, there is a lingering gap in innovation performance, as the business sector is specialized in low value added segments of value chains. Foreign affiliates are poorly integrated in the national innovation system, access to venture capital is limited and path-breaking innovation is rare. Innovation activities performed by enterprises are focused on the absorption of technologies new to the firm and experimental development rather than research and the inflow of young innovation start-up remains small. Given the historical separation of science and business, improving public-private circulation, collaboration and transfer of scientific knowledge is a constant policy challenge.

[29] http://www.technopolis-group.com/wp-content/uploads/2011/09/1315-International-Audit-CR_Final-report_Synthesis.pdf

6. Conclusions

6.1 Meeting structural challenges

The policy mix in the Czech Republic related to the five identified structural challenges is discussed in Table 6**:** Policy measures addressing structural challenges in the Czech Republic., which lists relevant policy actions, assesses their appropriateness, efficiency and effectiveness, and provides links to relevant evidence (based on evaluations or empirical analyses).

Table 6: Policy measures addressing structural challenges in the Czech Republic.

The policy mix in the Czech Republic related to the five identified structural challenges is discussed in Table 9, which lists relevant policy actions, assesses their appropriateness, efficiency and effectiveness, and provides links to relevant evidence (based on evaluations or empirical analyses).Structural challenge	**Policy actions addressing the challenge**	**Assessment in terms of appropriateness, efficiency and effectiveness**	**Evidence on the impact and outcomes of policy actions**
Challenge 1 **Improve the research excellence and internationalisation of Czech science system**	updated national RDI policy Smart Specialisation Strategy several projects supporting the Czech researchers in participation in the EU programmes RETURN programme	little financial resources spent on internationalisation lack of regulatory policy measures that encourage brain circulation and opening up of the Czech research system new R&I infrastructures may however be one of the pull factors	Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014 (Office of the Government of the Czech Republic, 2015a).

Challenge 2 **Finalising the governance reform and introducing an efficient system of allocation of public research funding**	Plans for the new Ministry for Research and Innovation draft of the new law on Support for Research, Experimental Research and Innovation adoption of the Civil Service Law preparations of a new system of evaluation of the results of research organizations and their institutional public funding	The concentration of the RDI policy under the new Ministry may increase the coordination It depends highly on the details and its implementation The new system of evaluation will not be operational before 2017	Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014 (Office of the Government of the Czech Republic, 2015a). TA CR project on "Increasing the effectiveness of TA CR in RDI intervention and improving RDI public administration capacities". Metodika 2013 (CRDI, 2013b). Results of the individual national IPN Metodika project (Arnold and Mahieu, 2015; IPN Metodika, 2014 and Srholec, 2015).
Challenge 3 **Strengthening the public-private collaboration**	national research, development and innovation (RDI) policy for 2009-15 Competence Centres, DELTA and EPSILON programmes of TA CR TIP and PROSPERITY programme of MIT Regional innovation voucher programmes Extension of existing tax credits to allows for to the purchase of external R&D services from research organisations	The new tax credit in its first year has not considerably increased the volume of external research services	Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014 (Office of the Government of the Czech Republic, 2015a). Innovation capacity 2014+ (INKA) project that maps the national innovation landscape.
Challenge 4 **Increasing the innovativeness of domestic companies**	OP EI (2007-2013) funded programmes supported SMEs innovativeness Extension of existing tax credits to allows for to the purchase of external R&D services from research organisations Czech Invest internationalisation programme	Current policy mix is dominated by grant funding with limited efforts devoted to support venture capital or business angels and revolving funds. The new programming period introduces a seed funding programme	Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014 (Office of the Government of the Czech Republic, 2015a). Innovation capacity 2014+ (INKA) project that maps the national innovation landscape.

6.2 Other structural challenges of the national R&I system

In addition to the challenges presented in the executive summary of the report, the conclusions bring additional challenges of the R&I system in the Czech Republic.

Stagnating public funding and new large infrastructures

New large research centres and infrastructural projects with a total amount of subsidy of nearly €900m that are under construction and gradually opening with the support from the EU Structural Funds represent a great promise for boosting the national research output. However, the new projects represent a major funding puzzle, because the EU support is for the initial investment only. Later on, wage, maintenance and other operating expenses must be covered from other sources. So there is a danger that these projects turn from blessing to a curse for the public R&D system, as sizeable opportunity costs needs to be resolved. Many of these projects pledged when approved to obtain funding from private sources. But this seems to cover only a fraction of their needs and their operating costs start draining public R&D funding from the existing facilities. It is a major challenge for the RDI policy to integrate these new projects into the national system.

In the meantime, national public R&D funding stagnates. Unless there is a breakthrough in the near future, unless the government noticeably expands outlays for R&D, public research organisations, including the newly build projects, may end up being underfunded. According to preliminary estimates the full operating costs of the new research centres and infrastructures might amount from CZK 5b to 10b (€190m to 385m) per year, which roughly represents as much as one fifth to one third of the current public R&D budget. Either the new projects or the existing infrastructure might need to shrink; possibly quite significantly. And in the final analysis this can have major disruptive impact for functioning of the national RDI system.

Another critical bottleneck for success of the new large research centre and infrastructure projects is availability of qualified human resources, not to mention star scientists, on the labour market. Arguably, this can turn out to be a major problem, as the expected demand by far exceeds domestic supply in the relevant scientific fields. Some of the new staff will have to be poached from the existing infrastructure. Some of them, perhaps even their majority, will have to come from abroad. But attracting large numbers of top foreign researchers in a relatively short span of time required for launching the full operation of the projects is not going to be easy, if one considers the above mentioned funding uncertainties, the unresolved rigidities of national labour market for researchers, the lingering difficulties with attracting foreign talent and last but not least given the fact that the remuneration of scientist in the national system is far below the international competitive wage level.

Policy response

The SRI and CRDI that has assumed a central role in the new governance system needs to be provided with resources that allow them to live up to this task. The GA CR and TA CR that have become responsible for competitive funding need to be further supported to mitigate the fragmentation of support programs. Several large research infrastructural projects, including pan-European infrastructures, are opening or under construction, which, if their funding is secured, have a potential to both open new avenues for international co-operation and make the system more competitive.

Skills shortages and rigid labour market for researchers

According to the assessment of MIT (2011b), because the reform of tertiary education remains uncompleted, there has been an unchecked expansion of university graduates, the quality of which is however hard to judge. Not much has changed in this respect in the meantime.

The lack of highly skilled personnel is often cited as not only hampering the quality of research in public institutions but even more so as the major obstacle of innovation in the private sector. Yet modernization of the higher education system is long overdue, the higher education act has been amended seventeen times and it is broadly acknowledged that a comprehensive reform of the education system is necessary.

Human resources management practices in the public sector need to be revised in order to reduce the widespread in-breeding, make career progression paths more transparent and intensify competition for posts. Horizontal mobility of academic staff is very limited. Arnold (2011) noted that management of research groups is underdeveloped, the groups tend to be very small, locked into existing research trajectories, lacking interdisciplinarity, there is little use of career development plans and only less than 10% of researchers are foreign, which is very small proportion by international standards. An explicit internationalization strategy of the public research system is lacking. Since the higher education reform ended up in doldrums, these caveats remain as relevant as ever. Overall, the approach to research human resource management in the public sector, including gender issues, is unsystematic.

Policy response

Much remains to be done in improving labour market for researchers and in fostering gender equality in research, particularly as far as limited mobility, internationalization, early career opportunities, rigid recruitment practices and widespread in-breeding are concerned.

Venture capital

Limited access to external private sources of finance for innovation is perhaps the single most important obstacle for improving the innovative performance, particularly in the sector of SMEs. Availability of venture capital to support innovative businesses and spin-off firms trying to commercialize research outcomes is well-known to be extremely low; one of the lowest among European countries. A lack of experience among potential clients and rather traditional entrepreneurial culture do not constitute a favourable environment to venture capital expansion. No tax measures supporting venture capital or business angels are in place.

Policy response

A major policy shift that needs to be applauded has been from a system traditionally based on direct public subsidies to RDI in the business sector towards introducing much wider portfolio of measures aimed at alleviating the problem of insufficient availability of funding for private R&D efforts, such as the R&D tax credits, loans, guarantees and venture capital; which target the type of applicants, including small and new firms, that typically do not use the direct support. More measures that go beyond the direct subsidies are clearly desirable in the future.

References

Acheson, H., Annenberg, R., Dammert, R., Klusacek, K., Kraus, W. and Lock, J. (2012) Review of the Joint Programming Process. Final Report of the Export Group. European Commission, Brussels.

Archambault, E., Amyot, D., Deschamps, P., Nicol, A., Provencher, F., Rebout, L. and Roberge, G. (2014) Proportion of Open Access Papers Published in Peer-Reviewed Journals at the European and World Levels—1996–2013. European Commission, RTD-B6-PP-2011-2, http://science-metrix.com/files/science-metrix/publications/d_1.8_sm_ec_dg-rtd_proportion_oa_1996-2013_v11p.pdf, accessed on 16/04/2015.

Arnold, E. (2011) International Audit of Research, Development & Innovation in the Czech Republic, Synthesis Report. Technopolis Group, http://audit-vav.reformy-msmt.cz/download-document/58-synteticka-zaverecna-zprava-aj, accessed on 16/04/2015.

Arnold, E. and Mahieu, B. (2015) R&D Evaluation Methodology and Funding Principles, Summary Report. Technopolis Groups, http://metodika.reformy-msmt.cz/souhrnna-zprava.

Campbell, D., Lefebvre C., Picard-Aitken M., Côté G., Ventimiglia A., Roberge G., and Archambault E., (2013) Country and regional scientific production profiles, Directorate-General for Research and Innovation,: Publications Office of the European Union.

CAS (2015) Výroční zpráva o činnosti Akademie věd České republiky za rok 2014, http://www.cas.cz/o_avcr/zakladni_informace/dokumenty/vyrocni_zpravy/archiv_vyrocnich_zprav/2014/index.html , accessed on 16/10/2015.

CAS (2014) Aplikační laboratoře Akademie věd České republiky. http://av21.avcr.cz/miranda2/export/sitesavcr/av21/dokumenty/141205-publikace-aplikacni-laboratore-akademie-ved-ceske-republiky.pdf, accessed on 31/12/2015.

CRDI (2008a) Reforma systému výzkumu, vývoje a inovací v České republice, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=495405, accessed on 16/04/2015.

CRDI (2009) National Research, Development and Innovation Policy of the Czech Republic 2009–2015, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=1020, accessed on 16/04/2015.

CRDI (2012) National Priorities of Oriented Research, Experimental Development and Innovation, http://www.vyzkum.cz/storage/att/BDEBEF2534A2EA16F06E7B23B378747D/National%20priorities.pdf, accessed on 16/04/2015.

CRDI (2013a) The Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=682145, accessed on 16/04/2015.

CRDI (2013b) Methodology of Evaluation of Research Organizations and Evaluation of Finished Programmes (valid for years 2013 - 2015),

http://www.vyzkum.cz/FrontClanek.aspx?idsekce=695512, accessed on 16/04/2015.

CRDI (2015a) Výdaje státního rozpočtu na výzkum, vývoj a inovace, http://vyzkum.cz/FrontClanek.aspx?idsekce=736349,, accessed on 16/10/2015.

CRDI (2015b) Návrh výdajů státního rozpočtu České republiky na výzkum, experimentální vývoj a inovace na rok 2016 s výhledem na léta 2017 a 2018, accessed on 16/10/2015.

CRDI (2015c) Národní politika výzkumu, vývoje a inovací České republiky na léta 2016 – 2020 s výhledem do roku 2025, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=736920&ad=1&attid=763503,

accessed on 16/12/2015.CzechTrade (2014) Seed fond – rizikový kapitál pro start a rozvoj firem, http://www.businessinfo.cz/cs/dotace-a-financovani/zdroje-financovani-z-eu/oppi/seed-fond.html, accessed on 16/04/2015.

CRDI (2016) National Policy of RDI of the Czech Republic 2016 – 2020, http://vyzkum.cz/FrontClanek.aspx?idsekce=682145, accessed on 29/02/2016.

CZSO (2014a) Science, Technology and Innovation, https://www.czso.cz/csu/czso/science_and_research_veda, accessed on 31/12/2014.

CZSO (2015a) Science, Technology and Innovation, https://www.czso.cz/csu/czso/science_and_research_veda, accessed on 16/10/2015.

CZSO (2015b) Nepřímá veřejná podpora výzkumu a vývoje v České republice - 2013, https://www.czso.cz/csu/czso/neprima-verejna-podpora-vyzkumu-a-vyvoje-v-ceske-republice-2013, accessed on 16/10/2015.

Edquist, C., Zabala-Iturriagagoitia, J.M. (2015). The innovation Scoreboard is flawed: the case of Sweden – not being the innovation leader of the EU. Lund University.

Eurostat (2015) Statistics Database, http://ec.europa.eu/eurostat/data/database, accessed on 31/12/2015.

Eurostat (2015) Statistics Database, http://ec.europa.eu/eurostat/data/database, accessed on 16/10/2015.

European Commission (2013a) The 2013 EU Industrial R&D Investment Scoreboard, http://iri.jrc.ec.europa.eu/scoreboard13.html, accessed on 16/04/2015.

European Commission (2014a) Innovation Union Scoreboard 2014, http://ec.europa.eu/enterprise/policies/innovation/files/ius/ius-2014_en.pdf, accessed on 16/04/2015.

European Commission (2014b) COUNCIL RECOMMENDATION on the National Reform Programme 2014 of the Czech Republic and delivering a Council opinion on the Convergence Programme of the Czech Republic, 2014, 2014/C 247/03, 8 July 2014, http://ec.europa.eu/europe2020/pdf/csr2014/csr2014_council_czech_en.pdf, accessed on 16/04/2015.

European Commission (2014c) Research and Innovation performance in Czech Republic, Country Profile 2014, http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2014/countries/czech_republic.pdf, accessed on 16/04/2015.

European Commission (2014d) European Research Area Progress Report 2014. Commission Staff Working Document, COM(2014) 575, http://ec.europa.eu/research/era/pdf/era_progress_report2014/era_fiches_eu-1_2014.pdf#page=104, accessed on 16/04/2015.

European Commission (2015a) Innovation Union Scoreboard 2015, http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/files/ius-2015_en.pdf.

European Commission (2015b) COUNCIL RECOMMENDATION on the 2015 National Reform Programme of the Czech Republic and delivering a Council opinion on the 2015 Convergence Programme of the Czech Republic, 2015/C 272/09, 14 July 2015, http://ec.europa.eu/europe2020/pdf/csr2015/csr2015_council_czech_en.pdf.

European Commission (2015c) Country Report Czech Republic 2015, COM(2015) 85 final, 26 February 2015, http://ec.europa.eu/europe2020/pdf/csr2015/cr2015_czech_en.pdf.

Hardeman S, Van Roy V., Vertesy D., with contributions from Michaela Saisana. 2013. An analysis of national research systems (I): A Composite Indicator for Scientific and Technological Research Excellence, JRC-IPSC Report.

INCENTIM KU Leuven, Universita Commerciale Luigi Bocconi, KITeS and Technopolis Consulting Group (2014) Measurement and analysis of knowledge and R&D exploitation flows, assessed by patent and licensing data." Study performed for DG Research and Innovation, 2009-2015.

IPN metodika (2014) Evaluation Methodology for Research Infrastructures. http://metodika.reformy-msmt.cz/evaluation-methodology-for-research-infrastructures-vystupy

Kejhová, H. (2015) Národnost kapitálu ovlivňuje strategické řízení firem. Moderní řízení, No. 9/2015, pg. 22.

Mana, M. and Štampach, M. (2015) Výzkum a vývoj. Presentation at a press conference on „Research ad Development in the Czech Republic", Czech Statistical Office, ,Prague, 15/10/2015.

MEYS (2011) Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic, May 2011 Update, http://www.msmt.cz/file/12262_1_1.

MEYS (2013) Annual Report on the Implementation of the Operational Programme Research and Development for Innovations for 2012, http://www.opvavpi.cz/filemanager/files/27916-cs.pdf, accessed on 16/04/2015.

MEYS (2014) Národní výzkumná a inovační strategie pro inteligentní specializaci České republiky (Národní RIS3 strategie), http://www.msmt.cz/strukturalni-fondy/ris3-strategie-cr?lang=1, accessed on 16/04/2015.

MEYS (2015a) Aktualizace Cestovní mapy ČR velkých infrastruktur pro výzkum, experimentální vývoj a inovace, http://www.msmt.cz/vyzkum-a-vyvoj/aktualizace-cestovni-mapy-cr-velkych-infrastruktur-pro-vavai?lang=1. http://www.msmt.cz/strukturalni-fondy/ris3-strategies-for-the-czech-republic

MIT (2011a) Strategie mezinárodní konkurenceschopnosti České republiky pro období 2012 až 2020, http://www.mpo.cz/dokument87682.html, accessed on 16/04/2015.

MIT (2011b) Národní inovační strategie České republiky, http://www.mpo.cz/dokument91200.html, accessed on 16/04/2015.

National Economic Council (2011) Rámec strategie konkurenceschopnosti, http://www.vlada.cz/assets/ppov/ekonomicka-rada/aktualne/Ramec_strategie_konkurenceschopnosti.pdf, accessed on 16/04/2015.

National Training Fund (2012) Systém na podporu postdoktorských míst, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=665503, accessed on 16/04/2015.

NKC – ženy a věda (2015) Postavení žen v české vědě. Monitorovací zpráva za rok 2014. Sociologický ústav AV ČR, http://www.genderaveda.cz/files/postaveni-zen-v-ceske-vede-2014-web.pdf, accessed on 31/12/2015.

OECD (2014), "Czech Republic", in *OECD Science, Technology and Industry Outlook 2014*, OECD Publishing. http://dx.doi.org/10.1787/sti_outlook-2014-69-en

Office of the Government of the Czech Republic (2014a) National Reform Programme of the Czech Republic, http://ec.europa.eu/europe2020/pdf/csr2014/nrp2014_czech_en.pdf, accessed on 16/04/2015.

Office of the Government of the Czech Republic (2014b) Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad, http://www.vyzkum.cz/FrontClanek.aspx?idsekce=8304, accessed on 16/04/2015.

Office of the Government of the Czech Republic (2015a) Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad, http://vyzkum.cz/FrontAktualita.aspx?aktualita=757600.

Office of the Government of the Czech Republic (2015b) National Reform Programme of the Czech Republic, http://ec.europa.eu/europe2020/pdf/csr2015/nrp2015_czech_en.pdf.

Office of the Government of the Czech Republic (2015c) Basic principles of the preparation and evaluation of programmes and groups of grant projects for research, development and innovation, mimeo.

Office of the Government of the Czech Republic (2015d) Usnesení vlády ČR k návrhu výdajů státního rozpočtu ČR na výzkum, experimentální vývoj a inovace na rok 2016 s výhledem na léta 2017 a 2018. https://apps.odok.cz/attachment/-/down/VPRA9X3GGLR2.

RISJMK (2013) Regional Innovation Strategy of South Moravian Region, http://www.risjmk.cz/en/, accessed on 16/04/2015.

Radosevic, S. and Stancova Ciampi, K. (2015). External dimensions of smart specialisation: Opportunities and challenges for trans-regional and transnational collaboration in the EU-13, JRC.

ScienceMetrix (2014) Analysis and Regular Update of Bibliometrics Indicators, study conducted for DG RTD, see also http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies, accessed on 16/04/2015.

Šebková, H., Beneš, J. and Šima, K. (2011) National report on joint and open programmes: Czech Republic. Joint and Open REsearch Programs (JOREP). European Commission, Brussels.

Srholec, M. (2015a) Návrh obecných zásad hodnocení programů účelové podpory výzkumu, vývoje a inovací a potřebných systémových změn, IPN Metodika project. MEYS, http://metodika.reformy-msmt.cz/hodnoceni-programu-ucelove-podpory-vvi-a-potrebnych-systemovych-zmen.

Srholec, M. (2015b) RIO Country Report 2015. JRC Science and Policy Reports. Luxembourg, European Union. https://rio.jrc.ec.europa.eu/en/country-analysis/Czech%20Republic/country-report: September 2015.

Stairway to Excellence Cohesion Policy and the Synergies with the Research and Innovation Funds Czech Republic Facts & Figures 2015. http://s3platform.jrc.ec.europa.eu/facts-figures

Science Europe (2013), *Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility*. http://www.scienceeurope.org/uploads/PublicDocumentsAndSpeeches/SE_and_Elsevier_Report_Final.pdf

Vaněček, J. (2011): *Field-based and institutional analysis of R&D results in the Czech Republic* www.vyzkum.cz/Priloha.aspx?idpriloha=645356 *)*.

VERA (2011) Position of the Czech Republic (CZ) on the European Research Area (ERA) Framework in the Public Consultation. Committee for European Research Area (VERA), Ministry of Education, Youth and Sports of the Czech Republic, Prague, http://www.msmt.cz/vyzkum-a-vyvoj/vybor-pro-evropsky-vyzkumny-prostor?highlightWords=VERA, accessed on 16/04/2015.

World Bank (2015) Doing Business: Measuring Business Regulations, http://www.doingbusiness.org/rankings.

Zizalova P. (2015) Stairway to Excellence , Czech Republic.

Abbreviations

Abbreviation	English	Czech
AIE	Association of Innovative Entrepreneurship	Asociace inovačního podnikání ČR
API	Agency for Entrepreneurship and Innovation	Agentura pro podnikání a inovace
AVO	Association of Research Organizations	Asociace výzkumných organizací
BERD	Business Expenditure on Research and Development	Výdaje na výzkum a vývoj v podnikatelském sektoru
CAS	Czech Academy of Sciences,	Akademie věd ČR
CCEG	Council for Competitiveness and Economic Growth	Rada pro konkurenceschopnost a hospodářský růst
CERN	European Organisation for Nuclear Research	Evropská organizace pro jaderný výzkum
CHEI	Council of Higher Education Institutions	Rada vysokých škol
COST	European Cooperation in Scientific and Technical Research	Evropská spolupráce ve vědeckém a technickém výzkumu
CRC	Czech Rectors Conference	Česká konference rektorů
CRDI	Council for Research, Development and Innovation	Rada pro výzkum, vývoj a inovace
CZK	Czech koruna	Česká koruna
CZSO	Czech Statistical Office	Český statistický úřad
EC	European Commission	Evropská komise
ELI	Extreme Light Infrastructure	Extreme Light Infrastructure
ERA	European Research Area	Evropský výzkumný prostor
ERDF	European Regional Development Fund	Evropský fond pro regionální rozvoj
ESF	European Social Fund	Evropský sociální fond
ESFRI	European Strategy Forum on Research Infrastructures	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds	Evropské strukturální a investiční fondy

ESO	European Southern Observatory	Evropská jižní observatoř
EU	European Union	Evropská unie
EU28	European Union including 28 Member States	Evropská unie s 28 členy
FP	European Framework Programme for Research and Technology Development	Evropský rámcový program pro výzkum a vývoj
FP7	7th Framework Programme	7. rámcový program pro výzkum a technologický rozvoj
GA CR	Czech Science Foundation	Grantová agentury ČR
GBAORD	Government Budget Appropriations or Outlays on R&D	Státní rozpočtové výdaje a dotace na výzkum a vývoj
GDP	Gross Domestic Product	Hrubý domácí product
GERD	Gross Domestic Expenditure on R&D	Celkové výdaje na výzkum a vývoj
HEI	Higher education institutions	Vysokoškolský sektor
ICT	Information and Communication Technologies	Informační a telekomunikační technologie
IOCB	Institute of Organic Chemistry and Biochemistry of CAS	Ústav organické chemie a biochemie AV ČR, v.v.i.
IPO	Industrial Property Office of the Czech Republic	Úřad průmyslového vlastnictví
IPR	Intellectual Property Rights	Práva duševního vlastnictví
IS VaVaI	Research and Development and Innovation Information System of the Czech Republic	Informační systém výzkumu, experimentální vývoje a inovací
MEYS	Ministry of Education, Youth and Sports of the Czech Republic	Ministerstvo školství, mládeže a tělovýchovy ČR
MIT	Ministry of Industry and Trade of the Czech Republic	Ministerstvo průmyslu a obchodu ČR
MRD	Ministry of Regional Development of the Czech Republic	Ministerstvo pro místní rozvoj ČR
MoLSA	Ministry of Labour and Social Affairs of the Czech Republic	Ministerstvo práce a sociálních věcí ČR
NABS	Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets	Nomenklatura pro analýzu a srovnání vědeckých programů a rozpočtů

NIF	National Innovation Fund	Národní inovační fond
NIS	National Innovation Strategy	Národní inovační strategie
OP	Operational Programme	Operační program
OP EI	Operational Programme Enterprise and Innovation	Operační program Podnikání a inovace
OP EC	Operational Programme Education for Competitiveness	Operační program Vzdělávání pro konkurenceschopnost
OP EIC	Operational Programme Enterprise and Innovation for Competitiveness	Operační program Podnikání a inovace pro konkurenceschopnost
OP HRE	Operational Programme Human Resources and Employment	Operační program Lidské zdroje a zaměstnanost
OP PGP	Operational Programme Prague – Growth Pole of the Czech Republic	Operační program Praha – pól růstu ČR
OP RDI	Operational Programme Research and Development for Innovation	Operační program Výzkum a vývoj pro inovace
OP RDE	Operational Programme Research, Development and Education	Operační program Výzkum, vývoj a vzdělávání
PROs	Public Research Organisations	Veřejné výzkumné organizace
R&D	Research and development	Výzkum a vývoj
RDI	Research, Development and Innovation	Výzkum, vývoj a inovace
RIs	Research Infrastructures	Výzkumné infrastruktury
RIS3	Research and Innovation Strategy on Smart Specialisation	Strategie inteligentní specializace
SRI	Section for Science, Research and Innovations at the Office of the Government	Sekce pro vědu, vývoj a inovace vznikla při Úřadu vlády
S&T	Science and Technology	Věda a technologie
TA CR	Technology Agency of the Czech Republic	Technologická agentura ČR

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Annex 1 – List of the main research performers

Czech Academy of Sciences
Charles University
Masaryk University
Palacký University Olomouc
Brno University of Technology
Czech Technical University
Škoda Auto
Honeywell
Škoda Transportation
Zentiva

Annex 2 – List of the main funding programmes

Name of the funding programme	Timeline	Budget	Target group
ALFA programme of TA CR	2011-2019	€342m	Business enterprises
Competence Centres of TA CR	2012-2019	€231m	Business enterprises and research organizations
EPSILON programme of TA CR	2015-2025	€355m	Business enterprises
NAKI I program of the Ministry of Culture	2011-2017	€70m	Research organizations
NAKI II program of the Ministry of Culture	2016-2022	€105m	Research organizations
National Sustainability Programme I of MEYS	2013-2020	€325m	Large RIs
National Sustainability Programme II of MEYS	2016-2020	€234m	Large RIs
OP EIC under the MIT	2014-2020	€7.91b	Business enterprises
OP PGP administered by the Prague City Hall	2014-2020	€0.4b	Business enterprises and research organizations
OP RDE under the MEYS	2014-2020	€3.4b	Research organizations

Standard projects of GA CR	1993-onwards	€100m (2015)	Research organizations
Support for excellence of GA CR	2012-2018	€114m	Research organizations
TIP programme of MIT	2009-2016	€440m	Business enterprises
TRIO programme of MIT	2016-2021	€136m	Business enterprises

Annex 3 – Evaluations, consultations, foresight exercises

Metodika 2013 that provides official guidelines for evaluation of public R&I support for both research organizations and programmes (CRDI, 2013b).

Results of the individual national IPN Metodika project (Arnold and Mahieu, 2015; IPN Metodika, 2014 and Srholec, 2015).

Analysis of the State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2014 (Office of the Government of the Czech Republic, 2015a).

Innovation capacity 2014+ (INKA) project that maps the national innovation landscape.

TA CR project on "Increasing the effectiveness of TA CR in RDI intervention and improving RDI public administration capacities".

MEYS's evaluation of the sustainability of research centres supported from the OP RDI (MEYS 2015).

Two-stage assessment of all existing and planned projects of large R&D infrastructures carried out by the MEYS in the second half of 2014.

The Update of the National Research, Development and Innovation Policy 2009-2015 with an outlook to 2020 (CRDI, 2013a).

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