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RIO Country Report 2017: Slovak Republic

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RIO Country Report 2017

The R&I Observatory country report 2017 provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. Data is from Eurostat, unless otherwise referenced and is correct as at January 2018. Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

Summary

Despite well performing economy and rising employment the public R&I funding was not conducive to the knowledge and innovation-based economic growth. Slovakia's share of project funding in total GBAORD was one of the lowest in the EU28 and the public research system received relatively low funding from the Horizon 2020.

Business research is mostly done by few companies in automotive and ICT sectors and the BERD remains significantly lower than the EU28 average. SMEs continue to compete with low costs of production inputs and innovate less than the average in EU28.

Slovak higher education institutes face low rankings in international scoreboards and the country suffers from the persistent emigration of young, particularly educated people abroad.

R&I challenges and policy responses

Improve the R&I Governance: Insufficient coordination and co-operation between ministries and their agencies and also fragmentation of resources for building R&I infrastructures are seen as major challenges for Slovakia.

In 2017 the governance challenge is addressed in the National Reform Programme and in new legislation for public research institutions. Also a government council (SGCSTI) has assigned a task for an international audit of the Slovak R&I system and has approved documents to target competitive finance in R&I and improvements in the efficiency and output of the R&I system.

Improve the quality of the science base: Slovakia ranks among the modest R&D performers within the EU28 in terms of R&D expenditure, and commercial and non-commercial R&D outputs. The incumbent system of HEIs' institutional finance favours mass education and is not conducive to high-quality research.

The '*Learning Slovakia*' document proposes many significant changes for e.g. university accreditations, financing, and international student mobility. If implemented in full, the quality of university research will improve in the coming years. Also a recently proposed law on public research institutions should increase flexibility in terms of PRI research funding and management.

Increase private innovation outputs and R&D investments: The dual structure of the Slovak economy impacts patterns of productivity, innovation outputs and R&D spending. The Slovak SMEs invest little in R&D intensive innovations and generate below-average R&D based commercial outputs. Slovakia's BERD intensity was one-fourth of the EU28 level in 2015 and Slovak companies produced low numbers of patents and industrial designs.

Since 2015 there is a law introducing new tax deductions for private companies investing in R&D. The impact of this legislation, however, is still a lot smaller than anticipated probably due to too complicated application procedures for SMEs. Also the OPRI schemes supporting the competitiveness of SMEs are way behind the schedule: only 1.2% of the total budget was spent by end of March 2017.

Strengthen synergies between science and industry: Co-operation between the industry and academia is the 'Achilles heel' of the Slovak R&I system and these two sectors still remain largely isolated.

A national programme exists for the co-operation between the academia and industry in the period 2016-2020, but its budget is rather low. First results may be expected in 2018-19. A Smart Industry Concept (Ministry of Economy, 2016) provides guidance for interconnecting academia and industry sectors, but lacks an action plan with concrete tasks, dates, milestones and financial resources. Slovakia accounted for only modest progress by 2017 with the resources stemming from the Horizon 2020.

Smart specialisation strategies

The Slovak Republic was one of the first EU Member States to develop the Smart Specialisation Strategy in 2013. The implementation of the RIS3 document faced administrative delays and in December 2016 the Ministry of Economy, Science, Research and Sports superseded the Action Plan by the '*Strategic document for passing the ex-ante conditionality in Thematic objective 1*'. The EC expressed concerns related to the strategic document, which were acknowledged by the MESRS. The MESRS superseded the strategic document with the '*Implementation Plan for the RIS3 Strategy*', which was finally approved in the summer of 2017. This delay is likely to slow down the implementation of the RIS3 document in Slovakia even further.

The Slovak research and innovation system is highly centralised and the smart specialisation strategy is at the national level. No explicit regional R&I programmes and/or policy measures have been developed in Slovakia. The eight regional governments have limited powers in support to innovation and no competences in support to R&D.

Foreword

The R&I Observatory country report 2017 provides a brief analysis of the R&I system covering the economic context, main actors, funding trends & human resources, policies to address R&I challenges, and R&I in national and regional smart specialisation strategies. Data is from Eurostat, unless otherwise referenced and is correct as at January 2018. Data used from other international sources is also correct to that date. The report provides a state-of-play and analysis of the national level R&I system and its challenges, to support the European Semester.

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1 Economic context for R&I

1.1 Structure of the economy

During the period 2006-2016 the Slovak economy accounted for solid growth rates. The average growth in per capita GDP was 3.6% per annum in Slovakia, while 0.8% in the EU28 (Eurostat, 2017a). The Autumn Economic Forecast of the European Commission indicated the Slovak economy should grow by 3.3% in 2017 and 3.8% in 2018 (EC, 2017a). It should also benefit from falling unemployment rates (8.3% in 2017 and 7.4% in 2018) and improving structural budget balance (-1.6% GDP in 2017 and -1.2% GDP in 2018).

The high economic growth originated from high growth in productivity of labour. The real labour productivity per hour worked grew by 2.8% per annum in Slovakia, while 0.9% in the EU28 in the abovementioned period (Eurostat, 2017b). High increases in labour productivity resulted from solid influx of the foreign direct investment and massive technology transfer by the branches of multinational companies (MNCs).

The 2017 European Semester Report for the Slovak Republic finds that 'while Slovakia's economy is highly integrated into global value chains, production is concentrated in only a few sectors and regions' (EC, 2017e). The Slovak economy has a dual structure. Branches of MNCs are cornerstones of the Slovak economy. The MNCs use top-notch technologies and advanced organizational innovations. The MNCs sector is highly productive and generates two thirds of the Slovak exports of goods. Some 250,556 domestically-owned SMEs create the second sector of the Slovak economy. The SMEs account for much lower productivity levels than MNCs (SOSR, 2017). The Slovak SMEs compete with low prices of production inputs and organizational and marketing innovations. Only some 4.3% of the total Slovak SMEs did their business in the high-tech industries in 2015 (Hungary: 10.2%, Denmark 9.4%. Austria: 7.1%) (SBA, 2017).

The Slovak economy is skewed toward manufacturing. The Eurostat data indicate that the manufacturing industries accounted for some 22% of the total jobs in 2016 (EU28: 13.8%). Manufacture of cars, car parts, machinery, consumer electronics, metals and metal products, and electrical engineering were key export items of Slovakia in 2000s and 2010s.

The Eurostat data indicate that shares of the employment in the knowledge intensive activities increased from 31.59% to 33.21% in period 2009-2016 (EU28: from 37.58% to 37.2%). Exports of high technology products as a share of total exports increased from 5.9% to 9.8% in Slovakia, while decreased from 17.1% to 17.0% in the EU28 in 2009-2015 (Eurostat, 2017c). The European Service Innovation Scoreboard (ESIS) indicates that the Slovak service sector generally is less innovative than the EU28 average, in terms of innovation inputs and throughputs (EC, 2017). Slovak service sectors account for rather a low level of innovation expenditure and limited stock of human resources.

1.2 Business environment

Slovakia's economy is open and dependent on foreign investment in manufacturing industries. Various international rankings (e.g. Doing Business, Global Competitiveness Report) tend to appreciate the high degree of internationalisation, openness to foreign investment and macroeconomic stability in Slovakia. Quality of national public institutions and ability of domestic research sector to innovate, however, is considered rather problematic by international standards.

The World Bank's Doing Business ranked Slovakia no 39 on the list of 190 countries in 2017/2018 ranking. Slovakia performed better than Hungary (no 48), but slightly worse

than Austria (22) and the Czech Republic (30)¹. Slovakia's strengths relate to ease of trading across the borders (no 1) and ease of registering property (no. 7). The ranking also indicated that Slovakia has made significant progress in access to credit and reducing the burden of paying taxes since 2008. The most problematic areas are business environment related to dealing with construction permits (no. 91), protecting minority investors (no. 89) and enforcing contracts (no. 84). These areas accounted for no improvements in the period 2008-2016.

The 2017–2018 edition of the Global Competitiveness Report (GCR) by the World Economic Forum ranked Slovakia no 59 out of 137 countries of the world. The GCR respondents had generally positive views about Slovakia's openness to foreign trade and macroeconomic policies. Negative opinions related to the performance of public institutions, and co-operation between public and private sectors in research, development and innovations. Slovakia received medium-good rankings in pillars of financial market development (no. 32 out of 137 countries), macroeconomic stability (no. 35), technological readiness (no. 42) and good market efficiency (no 55). The weakest pillars included higher education and training (no. 62), innovation (no. 67), labour market efficiency (no. 87) and institutions (no. 93). Poor rankings in the innovation pillar relate to the low intensity of university-industry collaboration in R&D and limited procurement of advanced technology products by the Slovak Government. As for the institutions, the GCR survey respondents stated 'favouritism in decisions of government officials' (no. 130) and 'efficiency of legal framework in settling disputes' (no 131) are the most problematic areas for international competitiveness of the Slovak Republic. The respondents, on the other hand, had positive opinions on the prevalence of foreign ownership (no. 6), low trade tariffs (no. 6) and imports in GDP (no. 8) (WEF, 2017).

The Slovak SMEs employed some 72.1% of total labour force and generated 54.4% of the total valued added in the non-financial business economy in 2016 (EU28: 66.8% and 57.4%) respectively. The industry-level data show that value added (VA) disproportionately concentrates in manufacturing industries (22.6%) in Slovakia (EC, 2017d).

The EC's *2017 SBA Factsheet for Slovakia* (p. 4) found that Slovakia 'combines a couple of areas where performance appears to be strong (access to finance and environment) with areas where performance is lagging behind compared to the EU average ('second chance', 'responsive administration', skills & innovation, and internationalisation)... In terms of policy, Slovakia's progress since 2008 has been rather uneven. Overall, the recent policy progress in implementing the SBA has been patchy, with improvements in some areas and stagnation in others'. According to the 2017 SBA factsheets for the 'internationalisation', 'entrepreneurship' and 'second chance' (resolving insolvency) dimensions Slovakia belongs to the 'low performance – improving progress' quartile in the period 2008-2017. In dimension 'access to finance' Slovakia belongs to quartile of 'higher performance – progress'. As for the 'skills and innovation', and 'responsible administration' dimensions, Slovakia belongs to the 'low performance – deteriorating progress' quartile.

The 2017 *Digital Economy and Society Index* (DESI) shows that the Slovak Republic underperformed in the Connectivity, Human Capital, Integration of Digital Technology and Digital Public Services dimensions. Slovakia achieved the EU average only in the dimension 'Use of Internet'. Slovaks are particularly active users of video calls (rank 5 in DESI) and online shoppers (rank 10). As for the major trends, Slovakia was catching up in Digital Public Services, due to increasing use of open data. Mobile broadband take-up increased significantly and digital public services improved, also thanks to the use of

¹ The Doing Business rankings are based on hard data. The data describe the procedure related to the activities of a typical LTD-type company. The company is domestically owned, has 10-50 employees and a turnover equal to 100 annual personal incomes. Source: Doing Business 2017.

Structural Funds for new innovative projects. Slovak businesses, however, were slow adopters of digital technologies to improve productivity or sales².

2 Main R&I actors

The Slovak Republic is a centralised state. The central government has all competences in science and technology policy (S&T) and higher education. The eight regional governments have some limited competences in secondary education and vocational training, and regional innovations.

The key advisory body for coordination of the Slovak S&T policies is the Slovak Government Council for Science, Technology and Innovation (SGCSTI). The central government ministries, HEIs, research institutions and industry and employer associations have their representatives in the council. The council, however, is an advisory body of the Slovak Government in matters of science, research and innovation and has no executive powers in research and innovation (R&I) policies. The council is chaired by the Prime Minister. Co-chairs of the SGCSTI are the Minister of Education, Science, Research and Sport of the Slovak Republic, Minister of Economy of the Slovak Republic, Minister of Finance and Chairman of the Slovak Academy of Sciences.

Design and implementation of the R&I policies is divided between the Ministry of Economy and Ministry of Science, Education, Research and Sports (MESRS). Each ministry manages its own network of agencies (Figure 2, Annex). Innovation policy measures are implemented by the Ministry of Economy and its agencies. The Ministry of Economy manages the Slovak Business Agency (SBA), the Slovak Investment and Trade Development Agency (SARIO) and the Slovak Innovation and Energy Agency (SIEA). The SIEA implements innovation-related projects from the OPRI (Operational Programme Research and Innovation). The MESRS administers funds for 23 public higher education institutions. It also directs funding agencies for basic research (VEGA, KEGA), applied research (the Slovak Research and Development Agency, SRDA), and the Research Agency. The latter agency implements public research projects funded from the OPRI. The RIS3 document proposed a closer co-operation by two ministries and merging the abovementioned agencies to two bodies. The integration has not taken place so far. MoE implements the Operational Programme of Competitiveness and Economic Growth (OPCEG). The MESRS implements the Operational Programme Research and Development (OPRD) and the Operational Programme Education (OPE).

The **Slovak Research and Development Agency (SRDA)** is responsible for R&D promotion in all research fields, including international research cooperation. It also plays a key role in managing R&D grant schemes.

The higher education institutions (HEIs) and the Slovak Academy of Sciences (SAS) are key research performers in Slovakia. There are 34 HEIs (of which 23 public) in 2017 in Slovakia. The 2017 State Budget Act set the total institutional support to public HEIs at €481.8m (2016: €451.2m), of which support to R&D and art activities is €157.6m and support to teaching €254.8m. The SAS institutional budget was set to €62.7m. The HEIs and SAS complemented their institutional budgets by project grants from the VEGA agency (SAS: €9.4m; HEIs: €4.52m in 2016), SRDA, and OPRI.

The Eurostat data on intramural R&D expenditure by sectors of performance indicate that business sector performed 28.0% of the total GERD in 2016. Data on major R&D spenders are quite scarce in Slovakia. The annual accounts by some large domestically-

² The government, for example, introduced a mandatory electronic communication between the state and business managers/owners in December 2016, but had to postpone electronic communication till July 2017. Still more than 40 percent of the owners/managers did not apply for an electronic identity card even in July 2017.

owned companies indicate that R&D intensive companies concentrate in automotive, machinery, manufacture of metals and metal products, and the information and communication technologies.

The private non-profit sector performed quite limited volume R&D activities (0.4% of the total GERD in 2015).

3 R&I policies, funding trends and human resources

Main R&I policy developments in 2017

Document title, hyperlink and date of publication/announcement	Short description
The Law on Public Research Institutions , No 243/2017.	<p>The law transforms state research organisation to public research institutions (PRIs). The law sets that the PRI performs following tasks: (a) research activities; (b) provision and governance of the research infrastructure; (c) provision, processing and dissemination of the scientific and technology information; (d) co-operation with higher education institutions in field of tertiary education programmes; (e) co-operation with the higher education institutions, other legal persons and businesses in field of science and technology.</p> <p>The law increases flexibility of the PRI in terms of research funding and management. The PRI are able to form consortia and partnerships with private bodies and increase share of private finance in total PRI funding.</p>
National Programme for Education Development ("Learning Slovakia"). March 2017.	The MESRS drafted the 'Learning Slovakia' document. The draft proposes a comprehensive reform of the Slovak system of education. The document inter alia suggests new rules for accreditation of the Universities and financing University science.
Task for Audit of the research and innovation system , 16 March 2017	The Government Plenipotentiary for the Research and Innovation drafted a plan for the audit of the research and innovation system. The audit should evaluate 'efficient use of resources provided by the state budget and the European Union in the field of research and innovation'. According to the document, the audit will be carried out by a renowned international evaluating body. The audit should contribute to the 'simplification and optimisation of R&I governance in Slovakia'.
The National ESFRI Roadmap document, 15 December 2016	The Slovak Government passed the Government Resolution No. 665/2013. The resolution credited the MESR with the task to draft the National ESFRI roadmap. The MESRS submitted the draft of the roadmap at end of 2016. The document defines key types of the research infrastructures

	in Slovakia. It also sets procedures for infrastructure financing and evaluating.
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3.1 Public allocation of R&D and R&D expenditure

The total government budget appropriations or outlays for research and development, (GBAORD) peaked with 0.46% GDP in 2011, but dropped to 0.34% by 2016 (EU28: 0.64% GDP in 2016) because the growth in nominal GDP was higher than the growth in nominal GBAORD.

The structure of the Slovak GBAORD was not conducive to the knowledge and innovation-based economic growth. The institutional funding accounted for 80.4% of the total GBAORD in 2016 in Slovakia (2015: 76.3%). Slovakia's share of project funding in total GBAORD was one of the lowest in the EU28. The Slovak public research system was rather isolated from the excellent research within the European Research Area. This is confirmed by the low funding Slovakia obtained from the Horizon 2020³, but also by the Eurostat data on the national public funding to transnationally co-ordinated R&D (EC, 2016). The transnationally co-ordinated R&D funding was much lower in Slovakia (€7.4m) than that in other small EU Member Countries in 2015 (e.g. Austria: €121.8m; the Czech Republic: €39.0m; Denmark: €68.6m; Slovenia: €11.3m).

The Slovak Government Council for Science, Technology and Innovation (SGCSTI) approved the Implementation Plan for the RIS3 document on 30 June 2017 (SGCSTI, 2017a). The Implementation Plan confirmed the commitment of the Slovak Government to introduce a mandatory indicator on the share of public support to R&D. The total GBAORD should rise on annual basis and reach 0.40% GDP by 2020 (Table 1)⁴. The overall nominal expenditure should increase by one third in period 2016-2020. Substantial part of the total increase in GBAORD refers to increase in project finance. The project budget by the Slovak Research and Development Agency increases by 82%. The State R&D Programmes are reintroduced since 2018. The state budget expenditure should total €402.9m in 2020. The OPRI expenditure financed European and national public resources should provide €409.5m by 2020.

³ Slovakia had some 184 participants receiving €43.84m in H2020 programme, of which 50 SMEs (€10.40m) and three ERC grantees (€4.71m) by November 2016. The average success rate was 13.7%. In terms of budget share Slovakia ranked 22nd out of 28 EU Member Countries.

⁴ The R&D is supported by the central government in Slovakia. The local and regional governments have no powers in R&D funding.

Table 1: Public national resources for R&I in Slovakia in 2016-2020 (€m)

	2016	2017	2018	2019	2020
Gross domestic product (estimated)	81,011	84,580.4	89,351	95,073	100,730
State budget expenditure on R&D (% GDP)	0.364	0.360	0.370	0.385	0.400
State budget expenditure total	294.709	304.824	330.599	366.031	402.919
A. National Programme for Support to R&D (MESRS resources)	47.573	47.573	74.453	109.609	127.000
Slovak Research and Development Agency (project finance))	27.964	27.964	34.844	45.000	51.000
State R&D Programmes	0	0	20.000	45.000	55.000
R&D stimuli (subsidises and tax incentives)	3.895	3.895	3.895	3.895	4.000
fees for membership in international organisations	9.097	9.097	9.097	9.097	10.000
cross-cutting R&D issues	6.617	6.617	6.617	6.617	7.000
B. University science (including researcher wages)⁵	145.782	151.927	153.000	154.000	165.000
of which University VEGA	9.400	10.400	12.000	13.000	16.000
C. Slovak Academy of Sciences⁶	56.494	59.161	61.000	62.000	64.000
of which SAS VEGA	4.517	4.600	5.500	6.000	8.000
VEGA total (SAS and Universities)	13.917	15.000	17.500	19.000	24.000
D. Ministry of Economy	21.611	22.884	19.060	17.186	18.000
E. Other departmental R&D	23.249	23.279	23.085	23.236	28.919
MESRS	8.382	8.597	8.597	8.597	9.719
Ministry of Agriculture	3.840	3.840	3.840	3.840	5.000
Ministry of Defence	3.896	4.818	5.270	5.619	7.000
Ministry of Culture	1.497	1.041	1.078	1.080	1.700
Other ministries	5.634	4.983	4.300	4.100	5.500
The OPRI, of which	0	88.100	409.500	409.500	409.500
European resources	245.277	256.379	268.264	280.991	287.894
Slovak public cofinancing	24.890	26.025	27.231	28.523	29.224
Total public expenditure on R&D	294.709	392.924	740.099	775.531	812.419

Source: SGCSTI (2017a): The Implementation Plan for the RIS3 Strategy, 30 June 2017

3.2 Private R&D expenditure

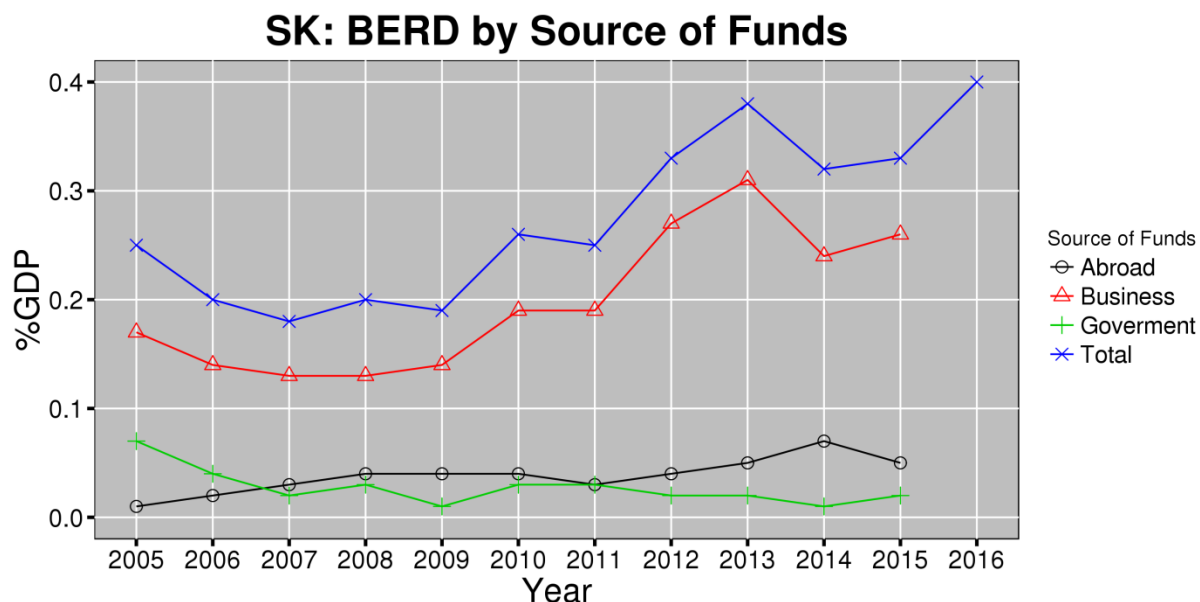
The Slovak business research experienced a long and deep decline during 1990s and 2000s. The share of business expenditure on R&D (BERD) was mere 0.18% GDP in 2007. The same year, however was a turning point in the Slovak business research (Figure 1 below). Slovakia started to tap into the European resources provided by the Structural

⁵ The budget originally approved for 2016. The budget later increased to €160.522m

⁶ The budget originally approved for 2016. The budget later increased to €62.282m

and Cohesion funds. Two operational programmes ('Research and Development' and 'Competitiveness and Economic Growth') boosted BERD to 0.40% GDP in 2016. The total BERD, however, remains significantly lower than the EU28 average 1.31% GDP in 2016.

Figure 1: BERD by source of funds (Eurostat, 2017e)



The detailed Eurostat data on BERD by economic activity (NACE Rev. 2) indicate that the top performing sectors are manufacture of motor vehicles (20.5% of the total BERD), manufacture of other transport vehicles (3.7%), manufacture of rubber and plastic products (7.6%), manufacture of machinery (9.8%), manufacture of electrical equipment (8.5%) and information and communication technologies (15.4%) in 2015. The abovementioned industries also generated over half of the total Slovak exports of goods and services.

The 2016 EU Industrial R&D Investment Scoreboard ranks no Slovak company among 1000 largest R&D spenders in Europe. In Slovakia the business research is mostly done by few large domestically-owned companies in automotive and ICT sectors, and R&D departments of few multinational (MNC) branches. The MNCs were slow to reallocate their research units to Slovakia. The Slovak Government used the investment stimuli (the State Aid schemes) to promote knowledge-intensive foreign direct investment. In 2015 it e.g. funded a technology centre for experimental development, design and innovation in industry automation (€0.6m and 30 jobs) and another technology centre for experimental design of the car interiors (€0.8m and 44 jobs). The domestic SMEs continue to compete with low costs of production inputs. The 2017 European Innovation Scoreboard data indicate that shares of in-house innovating SMEs was much lower in Slovakia (13.9%) than that in the EU28 (28.8%) in 2016.

3.3 Supply of R&I human resources

Supply of the human resources is determined by the quality of secondary and tertiary education, demographic trends and migration developments in Slovakia.

The unemployment rates were high in the Slovak Republic in 2000s. Young people, including tertiary graduates, found it difficult to get employment. However, the labour market accounted for dramatic change in the last three years. Strong population cohorts from 1950s left for retirement and were replaced by weak cohorts born in 1990s. The

booming manufacturing industries generated a strong demand on people with upper secondary education. The unemployment rate for secondary graduates in age group 30-34 dropped from 14.9% in 2013 to 9.6% in 2016. The tertiary graduates also were on high demand. The unemployment rate for tertiary graduates in age group 30-34 was 5.8% in 2016 (EU28: 5.6%).

High enrolment rates increased shares of people with the tertiary educational attainment in age group 30-34 from 22.1% to 31.5% in 2010-2016. Slovakia has a reasonable chance to achieve its target of 40% population with tertiary educational attainment by 2020. The absolute numbers of tertiary graduates, however, were shrinking. They peaked with 48,872 in 2010 but dropped to 36,427 by 2016.

The Slovak HEIs face low rankings in international scoreboards and emigration of students abroad. The 2017 (July) edition of the [Webometric Ranking of Universities](#) ranked the best Slovak HEIs no. 792 (the Comenius University in Bratislava), no. 1050 (the Technical University of Košice) and no. 1173 (the Slovak University of Technology), while the best Czech University was no. 247 and the best Hungarian University no. 472. Some 15% of Slovak tertiary students looked abroad for good quality education in 2015. The Czech Republic, Hungary, Austria and the UK were their favourites.

The industry associations indicate mismatches between structure of qualifications by secondary and tertiary graduates and market demand. The Slovak Government entered into negotiations with the industry associations and passed the 61/2015 Law on dual education and vocational training in 2015. Some 51 secondary schools, 142 employers and 1,393 students participated in the dual education in academic year 2016/2017 (Pravda daily, 2017). The employers, however, complained about the low interest of potential students. The Slovakia-based branches of the multinational car companies (VW, Hyundai-Kia and Peugeot-Citroen) found it increasingly difficult to secure technically-skilled labour. They turned to recruitment agencies to import factory workers from the Czech Republic, Romania, Bulgaria, Serbia, Ukraine and other countries.

The 'trade in human resources' had unfavourable results for Slovakia in 2010s. Shares of foreign workers with ISCED 0-2 education increased from 7.1% to 14.5%, while shares of workers with ISCED 5-8 education decreased from 29.5% to 18.0% in period 2012-2016. The change in the structure of human resources corresponded with change in structure of occupations by foreign workers. Shares of foreign-born plant / machine workers and operators increased from 18.1% to 23.3%, while shares of professionals and technicians decreased from 25.8% to 17.10% in 2012-2016 (Ministry of Interior, 2017). In the same time, Slovakia coped with brain drain by tertiary graduates. The *Institute for Financial Policy* (IFP) of the Slovak Ministry of Finance published a pilot study on Slovak brain drain in January 2017 (IFP, 2017). The study was based on the health insurance data in 2000-2015. Data from the health insurance registries suggested that numbers of people covered by the Slovak national health insurance dropped by 279,760 in period 2000-2015. Majority of the total population loss (227,863 people) were in age group 16-35 years. The emigration rate by the university graduates was 12-14% in the period of 2010-2013. Graduates of medical faculties and technical faculties accounted for the highest emigration rates in the same period (14-20%).

The Eurostat data on human resources in science and technology indicate that the number of persons with tertiary education and employed in science and technology increased from 347.5 to 385.0 thousands, and number of scientists and engineers from 80.5 to 89.1 thousands in 2010-2016. The Eurostat data on total R&D personnel and researchers by sectors of performance indicate Slovakia had lower share of researchers (in full-time equivalent, FTE) in total employment (0.57%) than the EU28 (0.86%) in 2016. The Eurostat data on total R&D personnel by sectors of performance, occupation and sex reveal Slovak R&D system was dominated by public institutions in terms of employment. It explains the low share of researchers in the business sector (19.4%) in 2016 (EU28: 48.7%). Dominance of public sector in R&D employment also explains the relatively high share of women researchers in total researchers (42.2%) in Slovakia (EU28: 33.2%) in 2015 on head counts.

4 Policies to address innovation challenges

4.1 Challenge 1: Improve the R&I Governance

Description

The 2017 European Semester Country report for Slovakia notes 'Upgrading Slovakia's Research and Innovation (R&I) performance requires improvements in the governing policy framework. --- The main challenges are linked to the need to improve governance in R&I and to increase coordination among governing institutions for developing and implementing R&I policy.' (EC, 2017e). The major weaknesses of the R&I governance in Slovakia were already summarized in the Chapter 5 of the RIS3 document: (1) the Ministry of Economy and MESRS and their agencies 'co-operate insufficiently, which leads to fragmentation and duplication of support'; (2) the support to R&I is channeled via high number of government agencies; (3) there is also 'fragmentation of resources for building R&I infrastructure on a national level (state budget, structural funds)'. The RIS3 document suggested following measures for improving R&I governance in Slovakia: (a) creation of the Slovak Government Council for Science, Technology and Innovation (SGCSTI); (b) merging incumbent support agencies to two bodies: Technology Agency (directed by the Ministry of Economy) and Scientific Agency (directed by the MESRS); (c) reform of higher education, transformation of SAS and departmental research institutes to public research institutions.

Policy response

The 2017 National Reform Programme (NRP) concentrated on the reform of the R&D governance (EC, 2017f). The NRP reiterated intention of the Slovak Government to accomplish thorough reform of the public R&D organisations and higher education institutions. The NRP also declared intention of the government to amend statute of the SGCSTI as to improve co-ordination of the Slovak R&I bodies and policies.

The Slovak Parliament passed Law on Public Research Institutions, No 243/2017 on 7 September 2017 (Slovak Parliament, 2017). The law enters in force on 1st July 2018 (see Table in Chapter 3 for more details). The Slovak Academy of Sciences (SAS) is the prime state research institution in Slovakia and a major target of the law. The law intends to increase co-operation between the SAS and the private sector and diversify founding resources for the SAS. The MESRS also submitted the National Programme for Education Development ("Learning Slovakia") for public discussion. The document proposes new quality assurance standards, and new rules for institutional finance for the Slovak HEIs (see challenge 2).

The SGCSTI charged MESRS with a task of auditing Slovak R&I system (SGCSTI, 2017b). The audit should be carried out by a renowned international evaluating body. The audit should target following areas: (a) efficient use of the ESIF and national resources for R&I; (b) increasing shares of competitive finance in total support to R&I; (c) decreasing fragmentation of support among research themes; and (d) identification of top researchers and research teams in Slovakia. Results of the audit will be used for 'simplification and optimisation of R&I governance in Slovakia'. The SGCSTI also approved 'Guidelines for support to competitive finance in R&I', and 'Proposal for increasing efficiency and output by the R&I system' on 16 March 2017 (SGCSTI, 2017c and SGCSTI, 2017d).

The SGCSTI approved the National ESFRI Roadmap on 15 December 2016. The document defines: (a) key types of the research infrastructures (national, central, unique); (b) provisions for selecting and financing important research infrastructures in 2014-2020; (c) evaluation procedures for infrastructures; (d) Slovakia's membership in the European infrastructures; and (e) long-term plans for development and financing research infrastructure in 2016-2023 (SGCSTI, 2016)

Assessment

The Slovak Government approved or drafted several documents important for the improvement of governance of R&I. The National ESFRI Roadmap and Law on Public Research Institutions are of particular significance for the reform of public support to R&D. The system of implementing agencies, however, remains fragmented.

4.2 Challenge 2: Improve the quality of the science base

Description

Slovakia ranks among the modest R&D performers within the EU28 in terms of R&D expenditure, and commercial and non-commercial R&D outputs. The 2017 EIS data indicate that Slovakia published 407.8 international scientific co-publications per million population, but only 5.5% of publications ranked to the top 10% most cited ones (EU28: 493.6 publications and 10.6%). Slovak science base was able to boost numbers of publications by 46% (EU28: 57%), but the share of top 10% cited publications remained about the same in Slovakia in period 2009-2016. As for the commercial R&D outputs, numbers of the PCT patents applications per billion GDP (in PPSE) decreased from 0.52 to 0.45 in Slovakia and from 3.98 to 3.70 in the EU28 in 2008-2015. Slovakia was catching up with the EU28, but from a very low base. There was a visible progress in some more simple types of intellectual property rights. Numbers of trademark applications per billion GDP (in PPS) increased from 3.37 to 4.30 in Slovakia and from 6.80 to 7.60 in the EU28 in the abovementioned period.

The Eurostat data on the total intramural R&D expenditure (GERD) by sectors of performance indicate that most research is performed by HEIs and government sector in Slovakia (27.8% and 21.5% of the total GERD in 2016). The incumbent system of HEIs' institutional finance favours mass education and is not conducive to high-quality research. The volume of the institutional finance for the SAS changed little over five years.

Policy response

The 'Learning Slovakia' document rejects the current system of university accreditations. The document argues that the accreditation cycle is six-year long and cannot react to actual developments in higher education. The Slovak Accreditation Commission did not pass audit by the European Association for Quality Assurance in Higher Education (ENQA) in 2012. The 'Learning Slovakia' intends to replace the Accreditation Commission with the Accreditation Agency. The agency should pass the ENQA audit. The Slovak higher education institutions (HEIs) should follow [Standards and Guidelines for Quality Assurance in the European Higher Education Area](#) (ESG). Any HEI should implement the ESG via its own internal quality regulations, but would consult these regulations with the Accreditation Agency. The 'Learning Slovakia' document also criticizes the current system of teaching and research jobs in the Slovak HEIs. The 131/2002 Law on Higher Education sets the HEIs to use their own committees and procedures to award academic titles and job posts of the assistant professor ('docent') and full professor. The academic title is a necessary precondition for a job application. The 'Learning Slovakia' document suggests that academic posts should not depend on titles, but be opened to any individual with an excellent track-record. All job advertisements should be published centrally by the MESRS and the Euraxess system, both in Slovak and English language.

The Slovak HEIs currently account for low levels of international student mobility (ISM). The document defines that the student mobility should increase. Each PhD student, for example, should spend part of his/her studies abroad. All Slovak HEIs must publish data on their ISM.

The 'Learning Slovakia' document suggests new rules for financing University science. The institutional finance should consist of two parts. Major part of the grant (80% of total) should be determined by the 'stable and high-quality performance' of the HEI. The remaining 20% should be subject to 'projected output' (evaluated on 3-years basis) and 'actual output' (evaluated on 1-year basis) criteria. The document also targets the issue of University Science Parks and Research Centres. Seven parks and five centres were built from the Structural Funds of the EU in 2015, but 'there is no model of sustainable financing' in period 2014-2020. The document also states that the MESRS should evaluate current operations and financial resources and suggest rules for long-term sustainability of the University Science Parks and Research Centres.

The Accreditation Panels evaluated 57 institutes of the SAS. Two institutes were ranked 'top European quality'; nine 'good European quality', 24 'European quality', 17 'average quality' and five 'below-average quality'.

Assessment

The 'Learning Slovakia' document proposes many significant changes. If implemented in full, the quality of University research will improve. The impact of accreditation on the SAS performance is rather unclear. The Ministry of Finance decided to add €1.1m for the 11 best institutes (MoF, 2017a). The SAS is also likely to benefit from the Law on Public Research Institutions. The law intends to increase co-operation between the SAS and private sector. Excellent research teams will be able to obtain higher financial resources for their research.

4.3 Challenge 3: Increase private innovation outputs and R&D investments

Description

Dual structure of the Slovak economy impacts patterns of productivity, innovation outputs and R&D spending. The nominal labour productivity (per hour worked, in PPPs) increased from 68.4% to 76.9% of the EU28 average in period 2006-2016 (Eurostat, 2017d). Labour productivity in Slovakia surpassed that of Czech Republic's, Portugal's and Greece's in 2015. Impressive increases in labour productivity are at odds with Slovakia's position in the European Innovation Scoreboard (no. 22 out of the 28 EU Member Countries in 2016). Slovakia's productivity-innovation paradox is partially explained via the structure of the EIS indicators. The EIS oversamples indicators on the SME innovations, but has no indicators on transfer of technologies and organisational practices by the MNCs. The Slovak SMEs invest little in the R&D intensive innovations and generate below-average R&D based commercial outputs. The BERD intensity in Slovakia (0.40% GDP) was a quarter of the one in the EU28 (1.31%) in 2016. The Slovak firms also produced extremely low numbers of patents and industrial designs. As noted by the Slovakia's country file in the 2016 EIS *'Except for Human resources, Slovakia performs below the EU average for all dimensions, and also for most indicators. Large relative strengths in terms of indicators are in Sales share of new innovations and New doctorate graduates. Large relative weaknesses are in License and patent revenues from abroad, PCT patent applications in societal challenges, Non-EU doctorate students, Venture capital investments, and PCT patent applications'*.

Policy response

The Slovak Government tried to address the challenge with the help from national and European funding. A law introducing additional tax deductions for private companies investing in R&D entered into force in January 2015. The R&D performers can deduct from their tax bases 125% of all R&D costs plus up to 25% of labour costs in R&D in

current year⁷. Moreover the R&D performers can deduct 25% of all R&D costs accrued in the previous year. The OPRI invests €401.0m from the European and €213.6m from national resources to schemes supporting competitiveness of the SMEs. The Slovak Government amended the 595/2003 Income Tax Law at the end of 2017. The amendment raises the total deductible R&D cost to 200% as from 2018.

Assessment

The Ministry of Finance originally estimated costs of tax reliefs for €26.4m in 2015 and €28.7m in 2016. The actual data (as of November 2017) indicate that 110 companies claimed €2.936m in 355 projects in the 2016 tax year⁸. Many Slovak SMEs found rules for tax deduction too complicated to apply. The manufacturing and ICT sectors obtained 59% of the total tax reliefs.

The OPRI schemes are way behind the schedule. The Ministry of Economy launched just six OPRI calls by April 2017. Only 1.2% of the total OPRI budget was spent by end of March 2017 (MoF, 2017b).

4.4 Challenge 4: Strengthen synergies between science and industry

Description

The 2017 European Semester Country report for Slovakia notes 'Poor links between the public sector, research institutions and businesses are evident from the low number of public-private co-publications per million inhabitants (SK: 8.1; EU:33.9) and the below-EU-average scores in indicators for commercial and non-commercial research outputs in Slovakia'. Co-operation between the industry and academia sectors is an 'Achilles heel' of the Slovak R&I system. The two sectors remain largely isolated. The national resources primarily provide institutional funding for the HEIs and SAS, while private resources support research performed by businesses. The business to HEIs/PROs funding flows accounted only for 3.1% of the total flows in 2015. The EIS data also indicate very low levels of firm investment in R&D. Some 15% of Slovak SMEs innovated in-house, but 28.7% in the EU28 in the same year.

Policy response

The Slovak Research and Development Agency supports applied research from general calls and specialised programmes. The Slovak Government approved a national programme of the SRDA for the co-operation between the academia and industry in the period 2016-2020 (€58.3m). The rules on tax deductions for private companies investing in R&D favour collaborative projects between academia and industry sectors.

The OPRI launched 19 calls in the period 2014 - April 2017. The calls inter-alia supported the second phase of University science parks, industry R&D centres, strategic research in the areas of specialisation of the RIS3, applied and experimental research, creative industries, start-ups and technology transfers.

The Smart Industry Concept (Ministry of Economy, 2016) for Slovakia provides guidance for interconnecting academia and industry sector in specific research agendas.

⁷ The Slovak Government amended the Law on Income Tax in December 2017. The R&D-related tax deduction increase to 200% in 2018.

⁸ Source: Slovak Financial Administration (2017): [Zoznam daňových subjektov, ktorí si uplatnili odpočet výdavkov na výskum a vývoj](#) (List of tax subjects claiming R&D tax reliefs).

Assessment

The general SRDA budget is rather low and remained unchanged between 2016 and 2017 (€29.3m). The SRDA's national programme for the co-operation between the academia and industry may bring first results in 2018-2019. The Smart Industry Concept would require an action plan with concrete tasks, dates, milestones and financial resources to be implemented efficiently. Most activities presented in the document are likely to be financed from the OPRI. Yet, the implementation lags behind the schedule. As for the resources stemming from the Horizon 2020 programme, Slovak Republic accounted for modest progress by 2017 in terms of success rate (see chapter 3.1 for more details).

5 Focus on R&I in National and Regional Smart Specialisation Strategies

New policy developments

The Slovak Republic was one of the first EU Member States to develop the Smart Specialisation Strategy (RIS3 document) in 2013. The document should have been implemented by the Action Plan for the RIS3 in 2014-2016. The implementation of the RIS3 document, however, faced some administrative delays. The Slovak Government rejected three drafts of the Action Plan. The plan was not ready by end of 2016. In December 2016 the Ministry of Economy and the Ministry of Education, Science, Research and Sports superseded the Action Plan by the 'Strategic document for passing the ex-ante conditionality in Thematic objective 1'.

The European Commission expressed some concerns about the strategic document (EC, 2017g). The Commission noted that the SGCSTI remained an advisory body and received no executive powers. As for the RIS3 budget the Commission found that the mandatory increase of the R&D expenditure was not visible in the budget so far and 'the overall allocation for R&D from the state budget will actually decrease in 2018 and then stay the same as in 2010. The budgetary contribution and effective accomplishment of the RIS3 objectives require an overall reform of the R&D funding system in Slovakia'. The contribution from private resources to European resources, for example, 'relies on a number of policy measures which have not yet been implemented'.

The Commission pointed out the fact that 'the most important step of the RIS3 process – the identification of a limited set of smart specialisation priorities is still missing'. It also reiterated concerns about 'ownership of the RIS3, its governance and time management of the whole prioritisation process, which seems to be weakest point of the Slovak RIS3' and demanded a 'provision of strong monitoring mechanism of activities to be implemented'.

The Commission invited the Slovak authorities (a) to submit the RIS3 Implementation Action Plan for 2017-2019; (b) to provide firm assurance on the capacity to co-finance ESIF interventions in RIS3 by either private or public national resources; and (c) to provide evidence that the assessment of the effectiveness of the use of existing research infrastructure is finalised.

Progress on implementation

In reply to European Commission's concerns the Ministry of Economy cancelled two calls on industry research and experimental development (€200m + €17m) on 5 May 2017 (MoE, 2014). The ministry officially acknowledged reservations of the Commission on inadequate formulation of smart specialisation priorities. The abovementioned developments are, however, likely to slow down the implementation of the RIS3 document in Slovakia even further.

The Slovak research and innovation system is highly centralised. The eight regional governments have limited powers in support to innovation and no competences in support to R&D. No explicit regional R&I programmes and/or policy measures have been developed in Slovakia. The regional governments passed their own regional innovation strategies, but had no financial resources for their implementation. All R&I policy measures are designed and implemented by the Slovak Government or its agencies. The slowdown in implementation of the RIS3 document therefore impacts development of the regional innovation systems as well.

Monitoring mechanisms and the feedback loop

The MESRS listed the monitoring mechanisms for implementation of the ESIF in the 'Strategic Document'. The monitoring mechanisms include a plan and set the context, output and result indicators. The monitoring methods combined desk research, in-depth analyses, questionnaire surveys, peer reviews, evaluation of the entrepreneurial discovery process, comparative analyses and a technology foresight exercise. The evaluation studies should be undertaken by the internal staff of the MESRS, SIEA and external experts (including foreign ones). The strategic document set the indicative budget for the evaluation studies at €0.5m. The monitoring and evaluation activities start after the approval of the ex-ante conditionality document⁹.

Evidence of impact

The ESIF spending was very slow in the period 2014-2017. Most evaluation targeted projects were implemented in period 2007-2013/15¹⁰. They included (a) Assessment of Cohesion Policy Impacts on the Development of Slovakia Using a Sustainable Econometric Model; (b) Contribution of Implementing Structural Funds and Cohesion Fund to Reduce Regional Disparities in Slovakia; (c) the Pilot Projects on the EU 2020 Contributions to targets in Education, Research and Development, and Climate Change and Energy Sustainability.

The abovementioned studies employed a range of quantitative and qualitative methods and found positive impacts of the Structural and Cohesion Funds on economic and social development of the Slovak Republic. For example the HERMIN econometric model indicated that structural funds and the Cohesion fund (SF and CF) helped to decrease unemployment rates in the less developed Slovak regions. The SF and CF also helped to decrease regional disparities in GDP between western and eastern parts of Slovakia. The pilot project on the EU 2020 Contribution to Target in Research and Development indicated that the R&D-intensive firms supported from the SF and CF improved their turnover and profitability.

The Slovak Government also commissioned a methodology manual for evaluating synergic effects of the ESIF.

⁹ The Slovak Government approved the Implementation Plan for the RIS3 document (the ex-ante conditionality document) on 30 June 2017 and the Commission in July 2017. The Slovak Government Council for Science, Technology and Innovation (SGCSTI) speeded up works on specialisation priorities in second half of 2017. The Implementation Plan set five domains of smart specialisation for Slovakia. The platforms for entrepreneurial discovery process were set in each domain in August 2017. The SGCSTI discussed reports for three out of five platforms on 09 November 2017 ('Transport vehicles for 21st Century', 'Industry for 21st Century' and 'Healthy food and Healthy Environment').

¹⁰ See webpage of the National Strategic Reference Framework for more details on evaluation studies.

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Abbreviations

BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
EIS	European Innovation Scoreboard
ECS	Electronic Contract System
ERA	European Research Area
ESA	European Space Agency
ERC	European Research Council
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
EU	European Union
EU-28	European Union including 28 Member States
FDI	Foreign Direct Investments
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
GVC	Global value chain
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HEIs	Higher education institutions
HGIE	High-growth innovative enterprises
IP	Intellectual Property
KEGA	KEGA Grant Agency (Grantová agentúra KEGA)
MESRS	Ministry of Education, Science, Research and Sports (Ministerstvo školstva, vedy, výskumu a športu)
MNC	Multinational company
NRIR	National Research Infrastructures Roadmap
PCT	Patent Cooperation Treaty
PRO	Public Research Organisations
OECD	Organisation for Economic Co-operation and Development
OPCEG	Operational Programme 'Competitiveness and Economic Growth' (Operačný program Konkurencieschopnosť a hospodársky rast)
OPE	Operational Programme 'Education' (Operačný program Vzdelávanie)
OPRD	Operational Programme 'Research and Development' (Operačný program Výskum a vývoj)
OPRI	Operational Programme Research and Innovation (Operačný program Výskum a inovácie)
R&D	Research and development
R&I	Research and innovation
RI	Research Infrastructures
RIS3	Research and Innovation Strategies for Smart Specialisation
RNP	Research Networking Programmes
RTDI	Research Technological Development and Innovation
SAS	Slovak Academy of Sciences (Slovenská akadémia vied)
SBA	Slovak Business Agency
SGCF	Slovak Growth Capital Fund (Slovenský fond rastového kapitálu)
SGCSTI	Slovak Government Council for Science, Technology and Innovation (Rada vlády SR pre vedu, techniku a inovácie)
SIEA	Slovak Innovation and Energy Agency (Slovenská inovačná a energetická agentúra)
SJCR	Scimago Journal and Country Rank
SME	Small and Medium Sized Enterprise

SRDA	Slovak Research and Development Agency (Agentúra pre výskum a vývoj)
SRDP	State Research and Development Programmes (Štátne programy výskumu a vývoja)
S&T	Science and technology
TFP	Total Factor Productivity
VEGA	VEGA grant agency (Grantová agentúra VEGA)
VC	Venture Capital
WEF	World Economic Forum

Factsheet

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GDP per capita (euro per capita)	11800	12400	13100	13400	13700	14000	14600	14900		
Value added of services as share of the total value added (% of total)	62.72	61.96	61.11	61.09	62.96	60.96	61.74	61.55		
Value added of manufacturing as share of the total value added (%)	17.73	20.81	21.06	20.85	20.22	21.7	21.89	22.62		
Employment in manufacturing as share of total employment (%)	21.77	21.27	21.73	21.57	21.42	21.55	21.64	21.92		
Employment in services as share of total employment (%)	63.87	64.58	64.68	65.28	65.4	65.65	65.84	65.77		
Share of Foreign controlled enterprises in the total nb of enterprises (%)	5.57	0.9	0.99	0.83	0.8	0.83	0.84			
Labour productivity (Index, 2010=100)	95.1	100	101.7	103.6	107	109.1	111.5	113.4		
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	1.48	2.09	1.35	1.89	1.8	1.84	1.65			
Summary Innovation Index (rank)	22	22	21	20	20	21	20	21		
Innovative enterprises as a share of total number of enterprises (CIS data) (%)				34		31.8				
Innovation output indicator (Rank, Intra-EU Comparison)			15	17	16	14				
Turnover from innovation as % of total turnover (Eurostat)		23.3		19.6						
Country position in Doing Business (Ease of doing business index WB)(1=most business-friendly regulations)						29	29	33	33	39
Ease of getting credit (WB GII) (Rank)						34	39	40		
EC Digital Economy & Society Index (DESI) (Rank)						20	21	22	20	
E-Government Development Index Rank		43		53		51		67		
Online availability of public services – Percentage of individuals having interactions with public authorities via Internet (last 12 months)	38	50	48	42	33	57	51	48	47	
GERD (as % of GDP)	0.47	0.62	0.66	0.8	0.82	0.88	1.18	0.79		
GBAORD (as % of GDP)	0.36	0.37	0.46	0.41	0.39	0.38	0.42	0.37		
R&D funded by GOV (% of GDP)	0.24	0.31	0.33	0.33	0.32	0.36	0.38			
BERD (% of GDP)	0.19	0.26	0.25	0.33	0.38	0.32	0.33	0.4		
Research excellence composite indicator (Rank)	22	24	24	24	21	26				
Percentage of scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country		4.91	4.92	5.2	5.08	5.26				
Public-private co-publications per million population	15.98	19.66	17.06	20.54	15.89	17.17	9.96			
World Share of PCT applications	0.02	0.02	0.03	0.03	0.02	0.04	0.02			
Global Innovation Index				36	37	36	37	34		

Data sources: various, including Eurostat, European Commission and International scoreboard data.

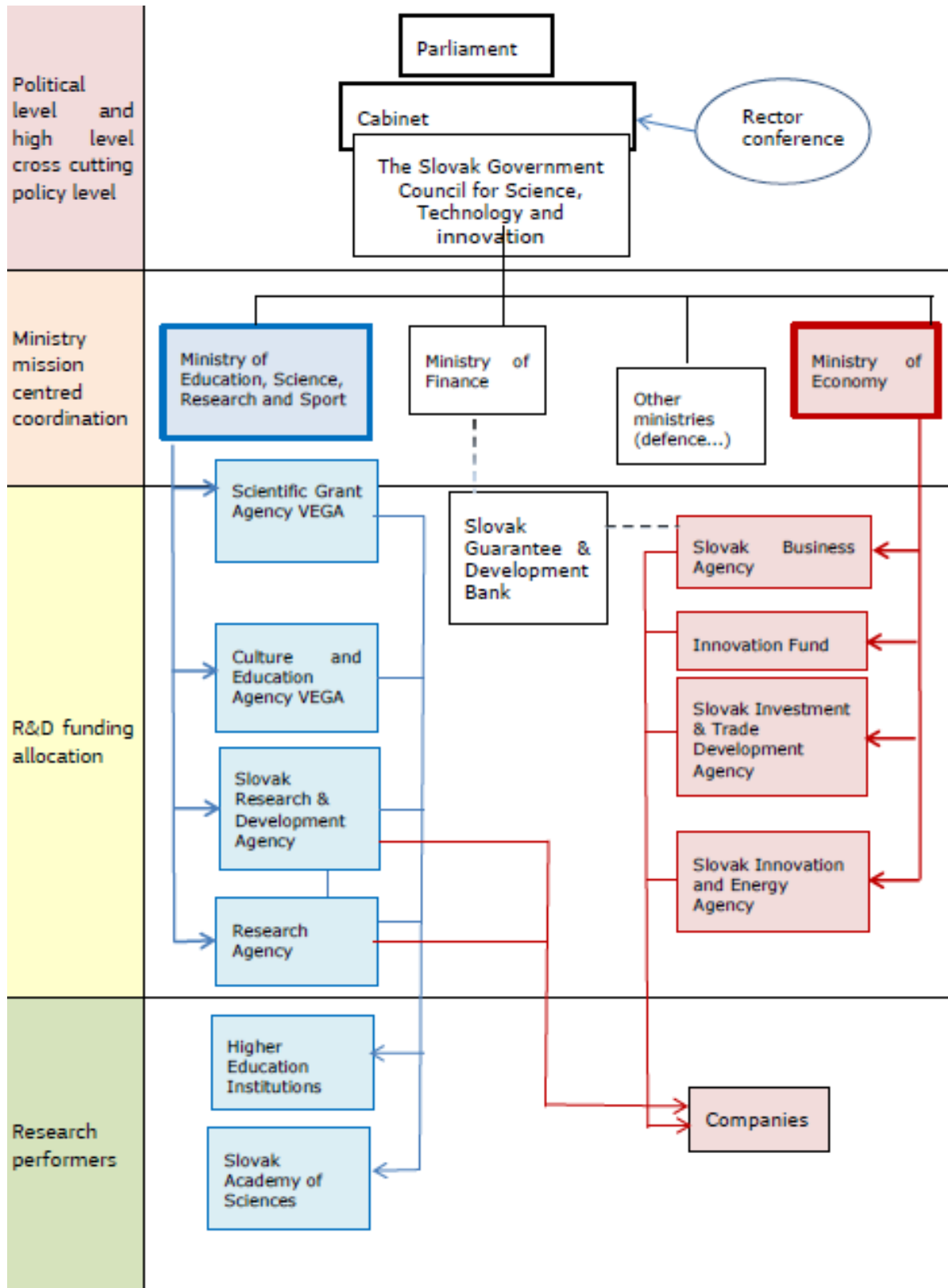
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Figure 2: The organisation of the Slovak national research and innovation system.



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