

International Comparison of the Innovation Environment in the Czech Republic



Czech
Republic
**The Country
For The Future**

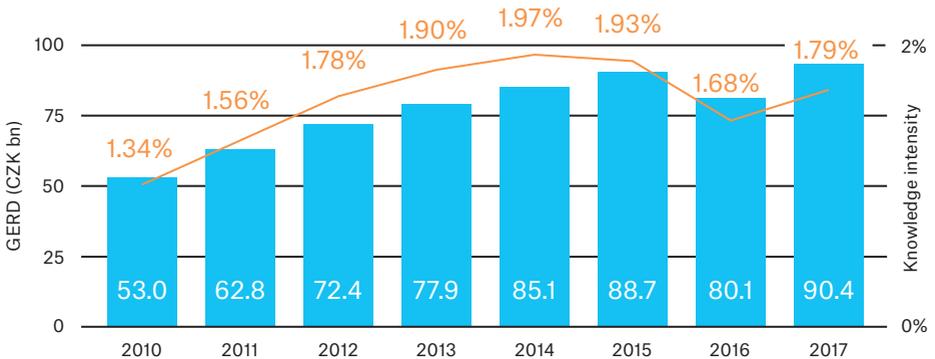
1 Innovation Performance of the Czech Republic

In order to measure innovation performance on an international basis, either simple or composite indicators are used. The advantages of simple indicators that rely primarily on financial data include their easy calculation and interpretation, the disadvantages include, in particular, the limited ability to find the true cause of innovation performance. Composite indicators have several dozen sub-indicators, and so better characterise the phenomenon described and are more useful for finding the true causes of innovation performance. Their disadvantage is a more complex interpretation of the influence of individual factors on overall innovation performance. It follows from this that it is necessary to use both types of indicator for a comprehensive and objective analysis of innovation performance.

1.1 Simple Innovation Indicators – Knowledge Intensity

Knowledge intensity is one of the basic and most commonly used simple indicators to determine innovation performance, expressing the ratio of total R&D expenditure (GERD) to Gross Domestic Product (GDP).

Fig. 1.1: GERD and knowledge intensity in the Czech Republic

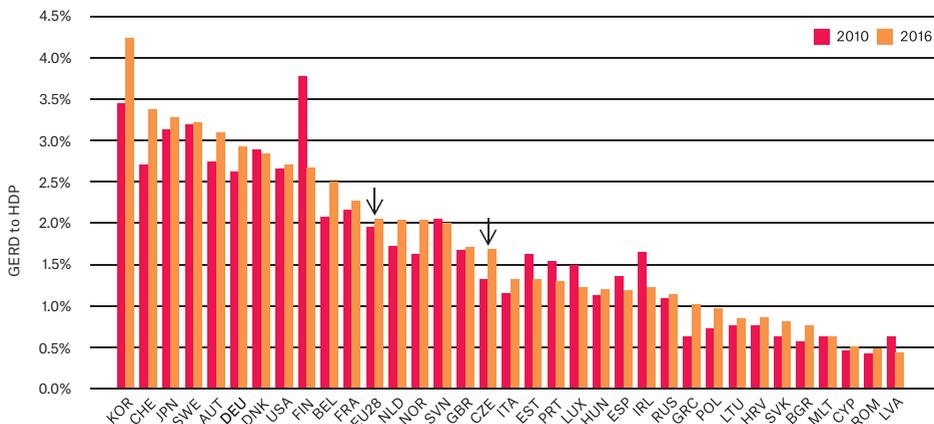


Source: CZSO, Research & Development

■ GERD — knowledge intensity

It is clear from Figure 1.1 that knowledge intensity in the Czech Republic is gradually increasing, for 2017 it is 1.79%. The temporary drop during the period under review was due to the transition between two periods of EU fund implementation.

Fig. 1.2: Knowledge intensity in the Czech economy in international comparison

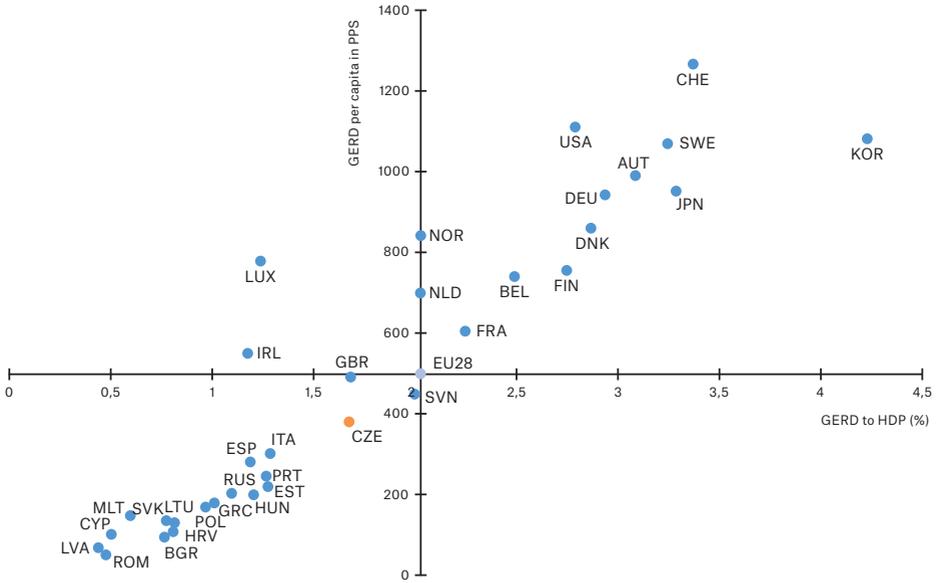


Source: Eurostat; OECD — MSTI database | For CHE, data for 2008 and 2015 are listed; for KOR, JPN, USA and RUS data from 2015.

Figure 1.2 shows the knowledge intensity of selected countries for 2010 and 2016 (ranked according to 2016). In 2014, the Czech Republic was just below the EU-28 average. In 2016, the Czech Republic moved significantly away from the EU-28 average, with the Netherlands, Norway, Slovenia, the United Kingdom coming between the Czech Republic and the EU-28 average (of these countries the United Kingdom and Norway were behind the Czech Republic in recent years, while Slovenia was ahead of the Czech Republic and the EU-28). Economies such as Italy, Hungary, Russia, Poland and Slovakia remain behind the Czech Republic. Over the long term, Switzerland, Sweden, Austria and Germany have had the highest levels of knowledge intensity in Europe.

When comparing the 2010 and 2016 values, Greece (68.3%), Bulgaria (39.3%), Poland (34.7%), Slovakia (27.4%) and the Czech Republic (25.4%) show the greatest increases. On the other hand, the most intense decline between the reference years can be seen in Latvia (-27.9%), Finland (-26.3%) and Ireland (-25.8%), followed by Estonia, Luxembourg, Portugal, Spain, Slovenia and Denmark. It is clear, therefore, that knowledge intensity has the largest percentage increase for countries with a low baseline, and a year-on-year assessment is not sufficient. As mentioned above, simple indicators do not provide adequate information about the reasons for, for example, year-on-year changes. In 2016 total GERD expenditure for the EU28 was EUR 302.9 billion, with the following countries having the largest share of GERD: Germany (EUR 92.4 billion, 30.5%), France (EUR 50.1 billion, 16.5%) and the United Kingdom (EUR 40.5 billion, 13.4%). The Czech Republic share of EU-28 GERD is EUR 3.0 billion, or 1.0%.

Fig. 1.3: Comparison of countries by GERD to GDP and by R&D expenditure per capita (2016)



Source: own calculations based on Eurostat and OECD – MSTI Database
 Y-axis – GERD per capita in PPS (RUS data from 2014, USA, CHE, JPN, KOR data from 2015)
 X-axis – GERD to GDP in % (KOR, JPN, CHE, USA and RUS from 2015)

Knowledge intensity provides only basic information about the intensity of state expenditure on R&D, it does not account for the differences in the level of production achieved or the structure of R&D expenditure by area of financing. An increase in the predictive capacity for knowledge intensity makes it possible to compare it with the amount of R&D expenditure per capita in PPS. A comparison of countries by GERD to GDP and by R&D expenditure per capita is shown in Figure 1.3. PPS is expressed per capita at 2005 prices.

It is clear that of the countries under review the highest levels of knowledge intensity and GERD per capita in PPS are in South Korea, followed by Switzerland, Sweden and Japan. The Czech Republic is slightly below the EU-28 average in knowledge intensity on a per capita basis. Knowledge intensity in the Czech Republic and Great Britain are comparable, but the United Kingdom shows a higher GERD per capita in PPS.

The difference in the approach of individual EU countries to the importance of R&D can be seen from a comparison of the Czech, Austrian and Polish parameters. In 2015 compared to Austria, the Czech Republic achieved 2.6 times lower R&D expenditure per capita in PPS, but 2.5 times higher than Poland.

1.2 Composite Innovation Indicators (CII)

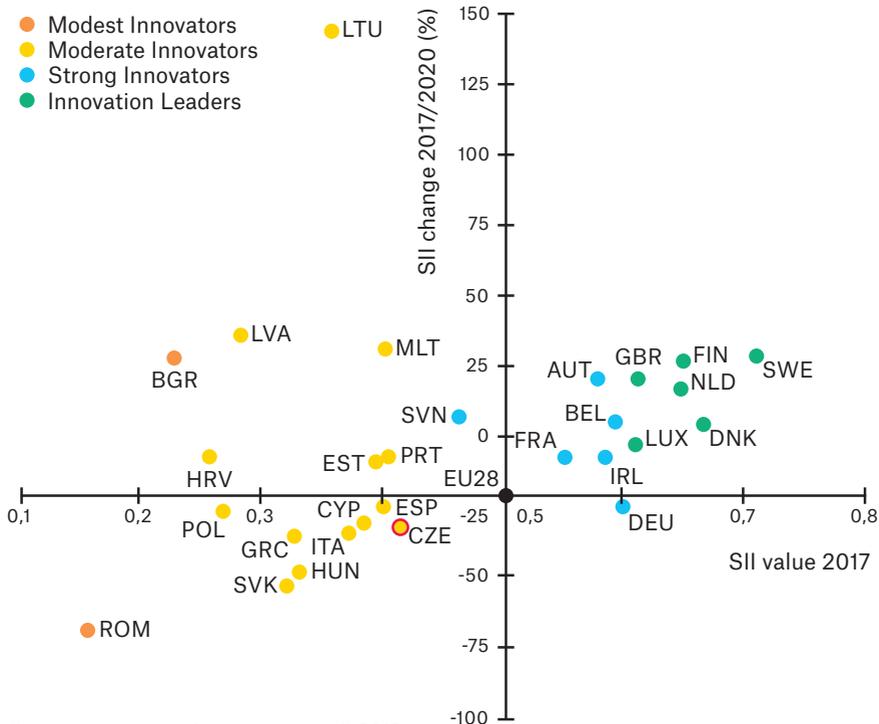
According to the most commonly used composite indicators, the Czech Republic is one of those countries that are not yet „at the top“ but obviously have the potential to become an innovation leader. Below, we compare the most commonly used indicators — the Summary Innovation Index (SII), the Global Innovation Index (GII) and the Innovation Output Indicator (IOI). The use of all three indicators gives relatively comprehensive information on the situation in the Czech Republic and in international comparison (see also section 1.2.4 below).

1.2.1 Summary Innovation Index (SII)

The European Innovation Scoreboard (EIS) allows for an annual comparison of the innovativeness of EU Member States and selected third countries. EIS 2018 is assembled based on data from 2017 and is already the seventeenth issue, which on one hand respects a consistent processing methodology, but it also testifies SII value in 2017 to the changing factors for the innovation potential of individual EU member states. The most significant changes in recent years include the inclusion of broadband penetration in the factors that positively influence an innovation-friendly environment. The Summary Innovation Index; SII) consists of four indicator areas — Framework Conditions, Investments, Innovation Activities, Impacts. These areas contain ten innovation sub-groups and consist of 27 indicators with different weightings. According to their achieved SII value, assessed countries are divided into four groups — Innovation Leaders, Strong Innovators, Moderate Innovators, Modest Innovators.

Figure 1.4 shows the SII value for EU Member States for 2017 and the relative change between 2010 and 2017. The figure also shows the division of the countries into the four groups mentioned above. Two countries, Romania and Bulgaria, have long been Modest Innovators, and have the lowest levels of both SII values for 2017 and relative change between 2010 and 2017. The Czech Republic belongs to the most numerous group, the Moderate Innovators, where we reach the highest level of SII (as was the case in previous years). The highest relative change between 2010 and 2017 in this group and overall in the SII was achieved by Lithuania (from 0.2 to 0.4).

Figure 1.4: EU Member State CII for 2017 and change between 2010 and 2017



Source: own calculations based on EIS 2018
The colour coding of countries corresponds to the SII breakdown.

The Strong Innovators include 6 EU Member States - Slovenia, France, Austria, Belgium, Ireland and Germany. The Innovation Leaders include Great Britain, Luxembourg, Finland, the Netherlands, Denmark and Sweden, which achieved the highest SII value.

As can be seen from the conclusions of EIS 2018, the innovation performance of the EU continues to grow and progress in recent years is and will in the future be even faster. Within EU countries, however, progress is very unevenly distributed. From a global perspective, the EU approaches the performance of the US, Japan and Canada, while it lags behind South Korea. Compared to 2010, innovation performance in 18 EU countries increased in 2017, while performance in 10 EU countries declined. At the same time, we are aware of China's growing importance in R&D, where R&D expenditure in recent years is close to US spending in absolute terms, so that these two countries currently account for 80% of all R&D spending worldwide.

Table 1.1: Innovation performance of the Czech Republic against the EU27 average by SII in 2010 and 2017 and the change thereof

	Relative performance to EU 2010 in		Relative performance to EU 2017 in
	2010	2017	2017
Czech Republic			
SUMMARY INNOVATION INDEX	90.0	87.1	82.3
Human Resources	76.2	93.5	78.4
New doctorate graduates	92.3	114.4	82.1
Population with tertiary education	45.5	74.6	65.8
Lifelong learning	92.7	90.6	88.8
Attractive research systems	58.5	82.4	72.5
International scientific co-publications	132.1	244.6	150.4
Most cited publications	51.8	57.3	55.2
Foreign doctorate students	42.8	62.3	56.3
Innovation friendly environment	78.7	106.0	79.2
Broadband penetration	88.9	133.3	75.0
Opportunity-driven entrepreneurship	72.7	89.8	83.3
Finance and support	116.1	50.9	47.3
R&D expenditure in the public sector	73.4	85.8	89.0
Venture capital investments	170.9	6.1	5.0
Firm investments	108.4	116.2	103.9
R&D expenditure in the business sector	58.9	86.0	77.2
Non-R&D innovation expenditure	155.4	139.5	127.6
Enterprises providing ICT training	121.4	128.6	112.5
Innovators	105.5	74.1	86.1
SMEs with product or process innovations	98.8	81.5	99.6
SMEs with marketing or organisational innovations	120.1	51.7	62.5
SMEs innovating in-house	97.0	89.7	96.1

Source: EIS 2018

Note: Dark green — normalized performance above 120% of EU; light green — normalized performance between 90% and 120% of EU; yellow — normalized performance between 50% and 90% of EU; orange — normalized performance below 50% of EU.

Data in red show a decline in compared to 2010.

Czech Republic	Relative performance to EU 2010 in		Relative performance to EU 2017 in
	2010	2017	2017
Linkages	80.6	78.4	77.6
Innovative SMEs collaborating with others	101.1	88.6	88.1
Public-private co-publications	81.0	72.3	71.6
Private co-funding of public R&D expenditures	59.2	74.7	73.7
Intellectual assets	45.6	63.2	62.7
PCT patent applications	25.2	25.2	26.3
Trademark applications	64.1	77.0	68.2
Design applications	50.8	88.6	91.8
Employment impacts	115.3	115.7	115.1
Employment in knowledge-intensive activities	85.7	93.5	84.7
Employment in fast-growing enterprises	136.4	131.6	140.7
Sales impacts	104.2	98.7	94.8
Medium- & high-tech product exports	124.8	131.6	124.3
Knowledge-intensive services exports	41.1	53.0	50.6
Sales of new-to-market and new-to-firm innovations	153.4	112.9	111.7

Although the innovation performance of the Czech Republic is growing, the SII shows that it is not keeping pace with the EU's innovation performance. The share of the population with higher education is growing rapidly, we also exceed the European average in the number of joint publications of Czech and foreign scientists, mainly due to the residential study abroad of Czech co-authors of publications. We are also above the European average in corporate investment in innovation and ICT training, in employment growth in fast-growing firms and the export of medium high-tech products, mainly driven by the export performance of the automotive industry. However, our country is exceptionally weak in protecting intellectual property and investing venture capital in new companies, especially in start-ups.

1.2.2 Global Innovation Index (GII)

The Global Innovation Index (GII) is used by the UN (through WIPO) to compare the situation in a number of Member States, to describe the overall context of their (innovation) development, where the indicator focuses on the impact of innovation-oriented policies on economic growth and development. The GIi consists of innovation inputs and innovation outputs. Innovation inputs include institutions, human capital and research, infrastructure, market sophistication and business sophistication.

In the framework of the GIi 2018 (with the subtitle *Energising the World with Innovation*, which characterises the current main global challenge), calculated on the basis of 2017 data, 126 countries were evaluated. The highest GIi values were achieved, as in the previous year, by Switzerland, the Netherlands, Sweden, Great Britain, Singapore, the USA and Finland. In the GIi 2017, the Czech Republic was ranked 24th, falling to 27th position in the GIi 2018. The absolute value of the Czech Republic score was 51.0 in the previous rating. In the GIi 2018 rating, the score is 48.8 when the leading Swiss score is 68.4 and the last for the Yemen is 15.0.

In the Innovation Input Sub-Index, Singapore ranks first, followed by Switzerland, Sweden, the United Kingdom, Finland and the USA. The Czech Republic was in 30th place. On the Innovation Output Sub-Index, Switzerland was again in first place, followed by the Netherlands, Sweden, Great Britain, Germany and the United States. The Czech Republic is in 20th place.

The following table shows GIi 2018 values achieved by the Czech Republic in individual pillars and selected sub-pillars.

1.2.3 Innovation Output Indicator (IOI)

The Innovation Output Indicator (IOI), the so-called innovation results indicator, reports on the ability to achieve use for the ideas of innovation industries in the market, thereby contributing to more skilled jobs and increasing the competitiveness of the economy being analysed. The IOI was introduced by the European Commission in 2013. It is a composite indicator consisting of four basic parts. The first sub-index IOI (PCT) is the rate of

Table 1.2: The values of the Czech Republic within GII 2018 pillars and selected sub-pillars

Pillars / Sub-Pillars / Indicators	Czech Republic		
	score (0–100)	position (out of 126)	strong/weak points
1. Institutions	78.5	27	
1.1 Political environment	76.8	25	
– political stability and absence of violence/terrorism	87.6	16	strong
1.2 Regulatory environment	76.5	34	
– cost of redundancy dismissal	81.4	77	weak
2. Human capital & research	41.7	35	
2.1 Education	52.2	48	
– expenditure on education	33.9	79	weak
3. Infrastructure	55.2	31	
3.1 Information and communication technologies (ICT)	60.3	63	
– government's online service	47.8	88	weak
– online e-participation	55.9	74	weak
3.3 Ecological sustainability	53.1	15	strong
– GDP per unit of energy use	22.1	77	weak
– ISO 14001 environmental certificates	85.9	7	strong
4. Market sophistication	50.3	48	
4.2 Investment	33.9	98	weak
– ease of protecting minority investors	58.3	61	weak
– market capitalization	11.9	52	weak
4.3 Trade, competition & market scale	71.6	27	
– intensity of local competition	79.7	13	strong
5. Business sophistication	45.7	25	
5.2 Innovation linkages	40.5	34	
– joint venture/strategic alliance deals	5.7	81	weak
5.3 Knowledge absorption	43.5	20	
– hi-tech imports	61.4	8	
6. Knowledge and technology outputs	42.3	17	
6.1 Knowledge creation	39.7	21	
– utility model applications by origin	61.4	7	strong
6.2 Knowledge impact	54.3	11	strong
– ISO 9001 quality certificates	72.5	6	strong
– high-tech and medium high-tech output	74.6	7	strong
6.3 Knowledge diffusion	33.0	26	
– high-tech exports	67.9	6	strong

Pillars / Sub-Pillars / Indicators	Czech Republic		
	score (0-100)	position (out of 126)	strong/weak points
7. Creative outputs	44,1	25	
7.1 Intangible assets	49,6	39	
7.2 Creative goods and services	42,7	11	strong
– printing and publishing output	24,3	58	weak
– creative goods exports	91,6	4	strong
7.3 Online creativity	34,5	26	
– country-code top-level domains (ccTLDs)	49,6	15	weak

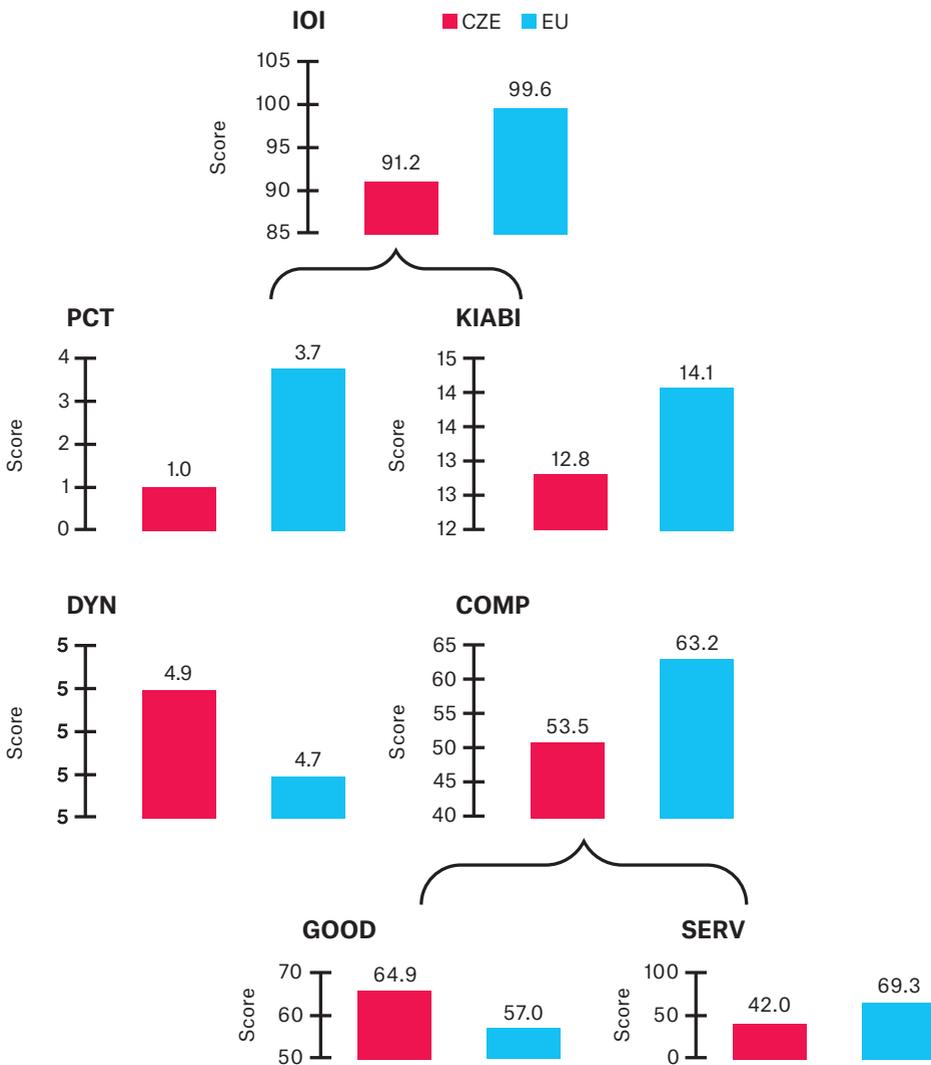
Source: own calculations based on GII 2018 report

Only selected relevant subpillars are listed in the table.

technical innovation measured by patents. The second area (KIABI) is made up of employment in knowledge intensive fields (percentage of total employment). The third part of the IOI (COMP) is the competitiveness of goods (GOOD) and services (SERV) requiring a high level of knowledge, and DYN is the rate of employment in fast-growing businesses within the innovation sector.

Figure 1.5 shows a comparison of IOI 2017 (data mostly for 2016, in some cases 2015 and 2014) for the Czech Republic and the EU-28. In terms of the number of patents per billion GDP in PPS the Czech Republic lags significantly behind. While the Czech Republic has only one patent per billion GDP in PPS, the EU-28 average is 3.7. Also, for the second IOI sub-indicator, the Czech Republic shows lower values — the share of employment in knowledge-intensive sectors. The opposite applies to the share of employment in fast-growing sectors in innovation sectors. Here the Czech Republic achieves excellent results. Similarly, the Czech Republic has a good result in the share of medium- and high-tech products in total exports. The opposite is true, however, for the share of knowledge-intensive services in the total export of services.

Fig. 1.5: IOI 2017 CR and EU



Source: own calculations based on Innovation Output Indicator 2017, Dániel Vértesy, JRC Technical Reports (http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108942/jrc108942_ioi_2017_report_final.pdf)

PCT = patent applications per billion GDP (PPS); data for 2014

KIABI = share of employment in knowledge intensive business industries; data for 2016

DYN = employment share in fast-growing enterprises in innovate sectors; data for 2014,

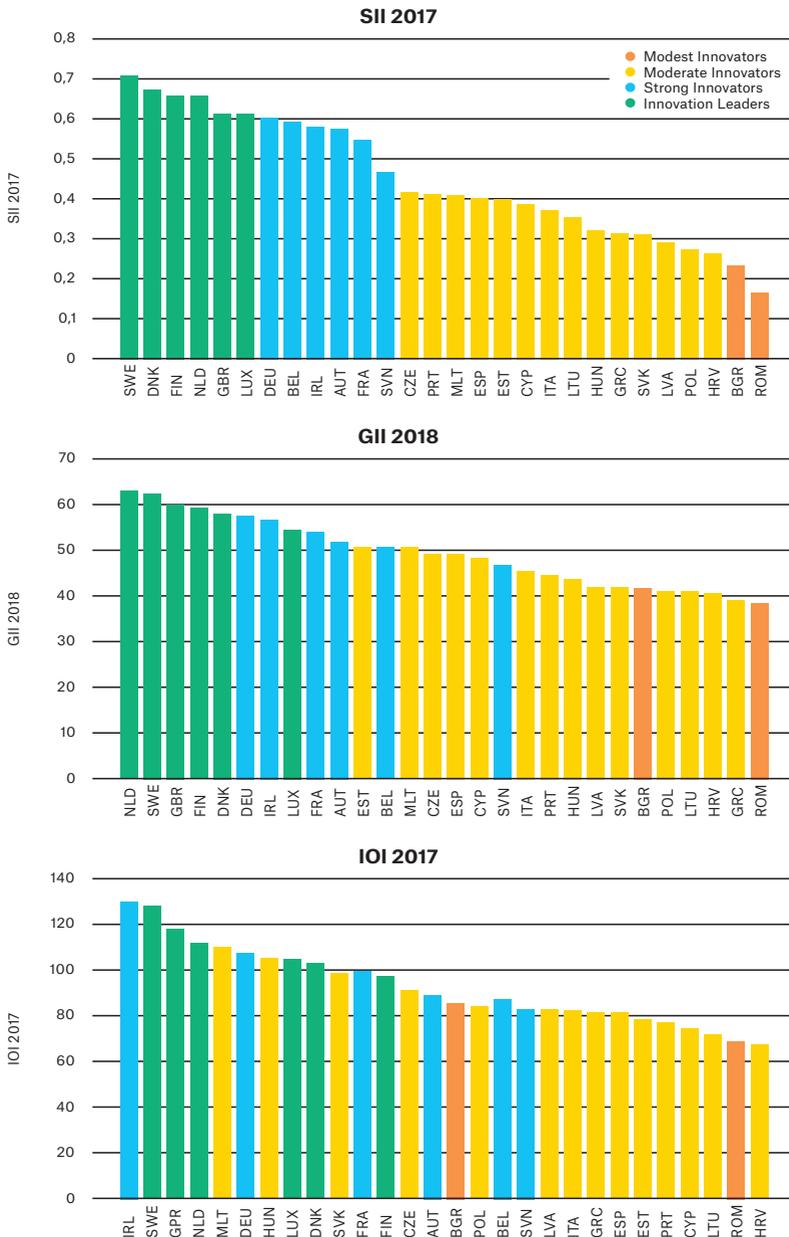
COMP = component; aims to capture international competitiveness in knowledge-intensive sectors, and is defined as the arithmetic average (with equal weights) of two indicators: GOOD and SERV

GOOD = the share of medium- and high-tech products in total exports; data for 2016

SERV = knowledge-intensive service exports as percentage of total exports; data for 2015

1.2.4 Comparison of innovation performance positions of the Czech Republic according to SII, GII, IOI

Figure 1.6: Comparison of positions within SII 2017, GII 2018 and IOI 2017



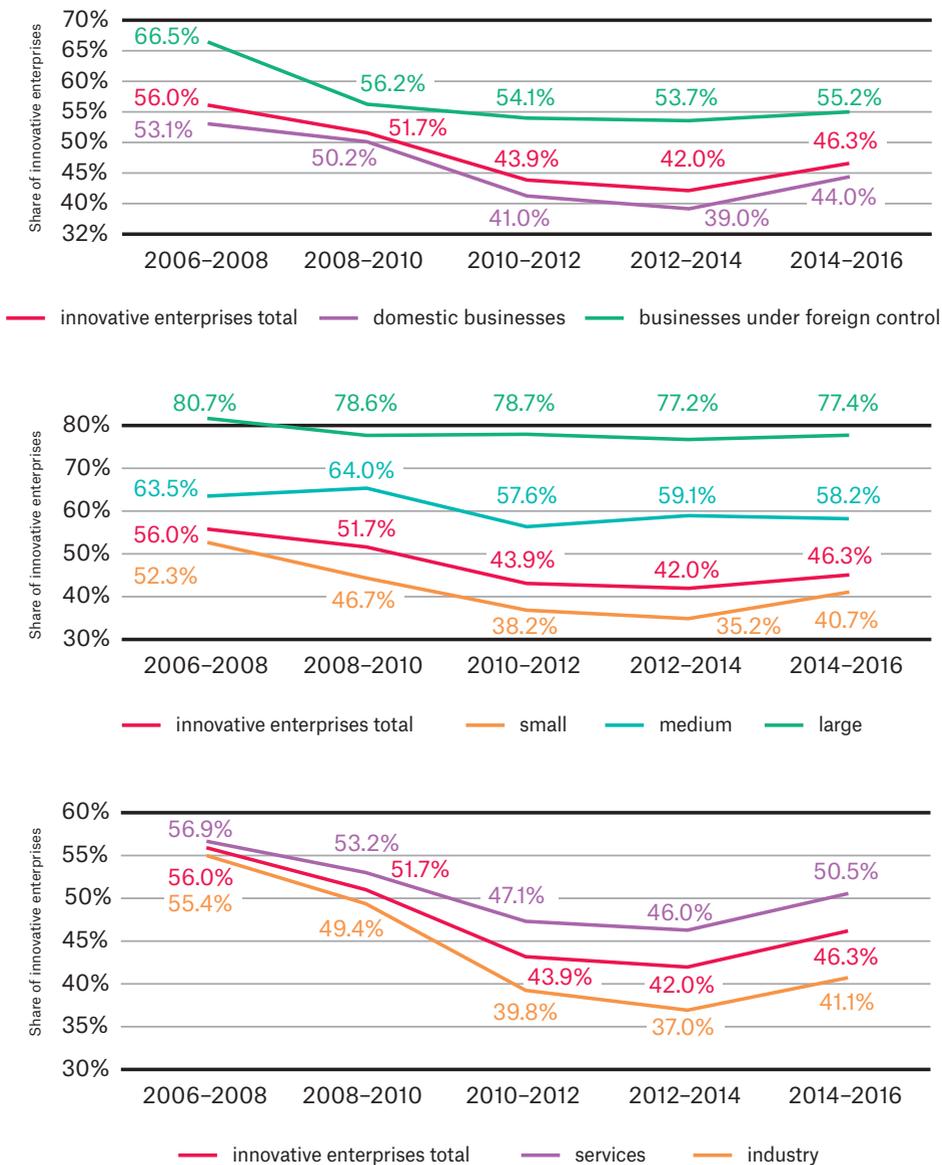
Source: own calculations based on EIS, 2018; GII report 2018; The Innovation Output Indicator 2017, Dániel Vértesy, JRC Technical Reports

Figure 1.6 shows the ranking of EU-28 countries within the composite indicators used — SII, GII, IOI. The colour coding of countries corresponds to the SII evaluation — Modest Innovators, Moderate Innovators, Strong Innovators and Innovation Leaders. Within SII 2017, the CR reaches 13th place. From the colour coding, the order of the countries in the case of GII 2018 is slightly different from that of SII 2017. The Czech Republic is in similar positions (14th place). The countries on the IOI 2017 are even more different compared to SII 2017, but the Czech Republic is ranked similarly in IOI 2017, in 13th place. The international comparison, which is based on the individual indicators from different points of view, shows the relatively good starting position of the Czech Republic in its ambition to become one of the innovation leaders. According to the SII we are the strongest Modest Innovator, where we are on a decent average position in the world ranking. But in the future, not only will the immediate situation be important, but also the dynamic of the changes that we will support.

2. Corporate innovation in the Czech Republic

Since 2002 the Czech Statistical Office has carried out statistical surveys on innovative business activities at regular two-yearly intervals. The most recent valid survey is TI 2016, which focuses on innovation activities for 2014–2016. The results can be compared to those in other European countries, as the methodology for them has a common basis in Eurostat methodology. Innovative enterprises are monitored for their technical and non-technical innovations. For companies with technical innovations, it may be the innovation of a product, a process or an ongoing or suspended innovation activity. In businesses with non-technical innovation, activities in the field of marketing or organisational innovation are reported.

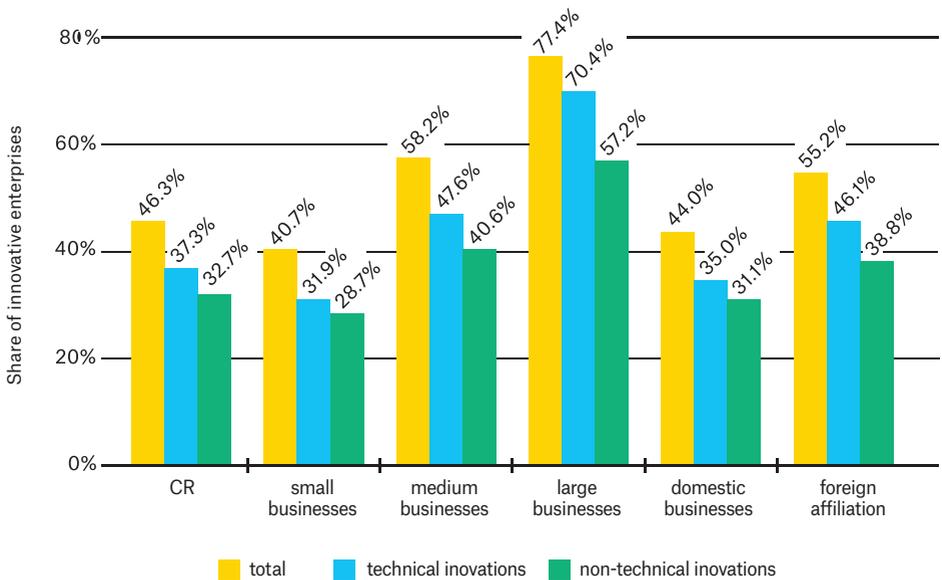
Fig. 1.7: Basic information on innovations in the Czech Republic by business category



Source: own calculations based on CZSO, Innovation activities of businesses in 2014-2016

The majority of innovating enterprises are foreign-controlled enterprises, which are mainly large industrial enterprises. At the same time, the share of foreign-controlled enterprises is high especially among medium and large firms, where foreign-controlled firms represent half to two-thirds. This implies their importance for the innovation performance of the Czech Republic and the necessity of cooperation of the public sector with this segment.

Fig. 1.8: Share of innovative enterprises by type of innovation (2014–2016)



Source: own calculations based on CZSO, Innovation activities of businesses in 2014–2016

Council for Research, Development and Innovation

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