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WORLD BANK GROUP

European Commission

CZECH REPUBLIC

ASSESSMENT OF THE SME POLICY MIX

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CZECH REPUBLIC

ASSESSMENT OF THE SME POLICY MIX

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ABBREVIATIONS AND ACRONYMS

BERD	Business Enterprise Expenditure on R&D
CAS	Czech Academy of Sciences
CEE	Central and Eastern Europe
CMZRB	Czech-Moravian Guarantee and Development Bank
COST	Cooperation in Science and Technology
CIS	Community Innovation Survey
CZSO	Czech Statistical Office
DESI	Digital Economy and Society Index
DG	Directorate-General
EGAP	Export Guarantee and Insurance Corporation
ERDF	European Regional Development Fund
ESIF	EU Structural Funds
EU	European Union
EUREKA	European Research Coordination Agency
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GVC	Global Value Chain
HR	Human Resource
I&E	Innovation and Entrepreneurship
ICT	Information and Communication Technology
IFR	International Federation of Robotics
IoT	Internet of Things
MEYS	Ministry of Education, Youth, and Sports
MFF	Multiannual Financial Framework for 2021-2027
MIT	Ministry of Industry and Trade
MLSA	Ministry of Labor and Social Affairs
NAPEE	National Action Plan of the Czech Republic for Energy Efficiency
OPEIC	Operational Programme Enterprise and Innovations for Competitiveness
PIAAC	Programme for International Assessment of Adult Competencies

PJ	Quadrillion joules
R&D	Research and Development
RDI	Research Development and Innovation
RES	Renewable Energy Sources
RIO	Research and Innovation Observatory
SBA	Small Business Act
SBS	Structural Business Survey
SITC	Standard International Trade Classification
SME	Small and Medium Enterprises
SRSP	Structural Reform Support Programme
STEM	Science, Technology, Engineering, and Mathematics
TACR	Technology Agency of the Czech Republic
TFP	Total Factor Productivity
VAT	Value Added Tax
WEF	World Economic Forum

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EXECUTIVE SUMMARY

This report provides an assessment of the policies devoted to supporting small and medium enterprises (SMEs) in the Czech Republic. It presents an original analysis of all national-level SME-related policy instruments, totaling 93 instruments operational from 2013 to 2017 and disbursing 108.5 billion CZK (4.71 billion USD), using an analytical framework that compares the SME *policy mix* to the *country needs* (see Annex 1 for framework and methodology). The analysis integrates three interrelated segments:

1. A **country needs assessment** to determine the national needs for SME policies. The needs assessment included a macro-level analysis of the Czech Republic's performance in productivity and trade; an analysis of national- and firm-level innovation performance; a firm-level analysis of productivity across firm sizes, sectors, and regions (leveraging original data from the Czech statistics office); and an analysis of market and institutional conditions that influence resource allocation and firm productivity.
2. A **policy mix analysis** to determine if the Czech Republic's SME policy mix matches the needs identified in the country needs assessment. The policy mix analysis included a review of relevant SME policy stakeholders, institutions, and governance; a review of national-level strategies; identification of the characteristics of SME policies instruments (administering agency, mechanism of support, beneficiaries, etc).; and a cluster analysis to evaluate the internal consistency of the policy mix and identify overlaps.
3. **Recommended areas for policy action** were developed using the needs assessment and policy mix analysis to improve the effectiveness of the policy mix and the business environment.

The following key findings emerged from the **country needs assessment**:

- **Czech Republic's productivity growth needs to increase further to reach German levels of productivity**. Despite recent increases in labor productivity, it currently stands at only 75 percent of Germany's level (The Conference Board, 2019). Productivity gaps are wide within the Czech economy. Productivity is higher for older firms, larger firms, foreign-owned companies and those headquartered in Prague (Davies, Iootty, and Zouhar 2019). This suggests that younger firms, SMEs and domestic firms have yet to catch up with their more productive counterparts.
- **The Czech economy shows high participation in global value chains and high levels of export sophistication**. These factors have contributed the Czech Republic's productivity growth over the last 20 years, but there is little potential for further productivity gains through additional GVC participation and export sophistication. The Czech Republic should look to other areas, such as R&D-driven startups, to boost productivity.

- **Firm-level productivity analysis suggests that there are allocative inefficiency issues across sectors**. The output growth of more productive firms was low or negative for both manufacturing and services, suggesting allocative inefficiencies such as barriers to firm entry and exit. Moreover, TFP growth is more likely to show a negative between-firm component (output growth of more productive firms) than a within-firm component (productivity improvements in the average firm), suggesting constraints to accumulating capital and competition barriers.
- **The Czech business environment performs well compared to its peers, but key issues remain that create barriers to resource allocation**. These issues include regulations related to bankruptcy and starting a business, as well as the availability of early-stage risk financing. These factors hinder the entry and exit of firms in the Czech economic and likely contribute to the resource allocation observed in the firm-level analysis.

The **policy mix analysis** found the following:

- **The SME policy mix covers the identified country needs and follow the stated objectives of the SME Support Strategy 2014-2020**. The Czech Republic has an extensive range of SME support instruments. However, given the breadth of instrument focus areas, there is a need for consolidation and improved prioritization of the policy mix. There are also gaps in certain areas, such as improving management capabilities and adoption of key I4.0 technologies (big data, automation, etc.) to catch up with more productive firms.
- **A cluster analysis of the SME policy mix reveals a lack of synergy between instruments across agencies and possible duplication of efforts within agencies**. There is an apparent lack of coordination between agencies and overlaps in the focus of agency instruments.
- **The resource misallocation across regions and sectors evident from the firm-level analysis could be exacerbated by the existing SME instrument mix**. Growing reliance on resources from EU regional development fund and compliance with associated institutional requirements may be tilting policy goals towards regional objectives to the detriment of overall productivity growth. Programs subsidizing operational expenditures of regional firms, in particular, do not contribute to increase firms' long-term growth likelihood and may be contributing to resource misallocation by postponing the adjustment of less productive units. Support to the adoption of digital technologies and to knowledge-intensive startups receive comparatively less support.

Recommendations. Based on the country needs assessment and the policy mix analysis, three key messages emerge:

Improvements to the institutional framework governing SME policies. The multiplicity of actors involved in supporting SMEs at the central government, regional, and municipal levels impair the cohesiveness of support policies. It will be important to simplify the governance framework for SMEs and consolidate instruments to improve the synergy and reduce

unnecessary duplication of instruments. While the SME policy mix is roughly aligned with the stated objectives articulated in the SME Support Strategy 2014-2020, there are gaps, such as improving management capabilities and adoption of key I4.0 technologies.

Adjustments to the policy mix. Greater priority should be given to programs that increase of the number of smaller firms investing in R&D and that promote the emergence of R&D-driven startups. The country is already integrated into global value chains and has attracted large amounts of FDI, so the potential for further productivity gains in these areas is limited. Supporting knowledge-intensive (R&D-driven) startups can help new clusters of products and services emerge (creating new markets) and expand exports in more knowledge-intensive sectors.

Easing constraints related to the operating business environment and competition policy. Eliminating regulatory restrictions to competition will be instrumental for enabling more productive firms to grow, and consequently boost aggregate productivity. Addressing bottlenecks to early-stage company growth, such as risk financing, will be key to promoting R&D-driven startups.

1. INTRODUCTION

Small and medium enterprises (SMEs) in the Czech Republic face challenges in improving productivity. For the country as a whole, increases in labor productivity during the past decades have not been sufficient to converge with more advanced peers.[1] SMEs face weak productivity outcomes compared to their larger counterparts: the largest firms were more than twice as productive as the smallest firms in 2016 (OECD 2018b). SMEs also tend to have weaker technological innovation capabilities and are less likely to integrate into GVCs through exporting. For example, less than one percent of micro firms export in the country, and this is the lowest performance among peer countries (for example, in Germany 26 percent of micro firms export) (OECD 2018b). Likewise, large firms outpace SMEs in the use of I4.0-related technologies, such as cloud computing and 3D printing (additive manufacturing). For example, Eurostat's ICT survey (2018) finds that 45 percent of large firms engage in cloud computing compared, to 26 percent of SMEs. Similarly, 17 percent of large firms use 3D printing compared to 4 percent among SMEs.

This assessment is intended to support a major government effort, the preparation of the Czech Republic SME Support Strategy 2021+ and Action Plan, which aims at improving SME productivity. The Ministry of Industry and Trade (MIT) is leading efforts to develop a new SME Strategy and Implementation Plan for the period 2021 – 2027 and has requested support from the European Commission under Regulation (EU) 2017/825 on the establishment of the Structural Reform Support Programme ("SRSP Regulation"). The request was analyzed by the European Commission in accordance with the criteria and principles referred to in Article 7(2) of the SRSP Regulation, following which the European Commission agreed to provide technical support to the Czech Republic, together with the World Bank, to conduct an analysis of the status of the SMEs Policy Mix and its alignment with the country needs. The findings and recommendations from this analytical work (Phase I of the project) will help guide the development of a national SME strategy and action plan that can help improve the productivity and competitiveness of domestic enterprises. The findings and policy directions outlined in this assessment are intended to highlight key policy areas in need of attention in the coming period. During the second phase of the project (ending in June 2020), the WB team will be assisting the MIT through providing peer review of the draft strategy and action plan with the intention of identifying concrete policy actions, reforms, and initiatives aligned with the objectives outlined for CR SMEs.

[1] For this report, Czech Republic is benchmarked to the following peers: Austria, Germany, Hungary, Poland and Slovak Republic. Germany, the Czech Republic's most economically advanced neighbor and Europe's leading economy, is used as the most frequent point of comparison, representing aspirational target levels of performance across many economic indicators.

The report is structured along three segments[2]. First, it provides a country needs assessment that analyzes the demand for productivity among SMEs by assessing and comparing key SME outcomes and analyzing local framework conditions. Second, it provides a thorough review of the SME governance structure and analyzes the coherence of the SME policy mix. The report concludes with identifying key policy directions for improving the SME policy environment in the Czech Republic.

[2] See Annex 1 for discussion on the framework and methodology followed.

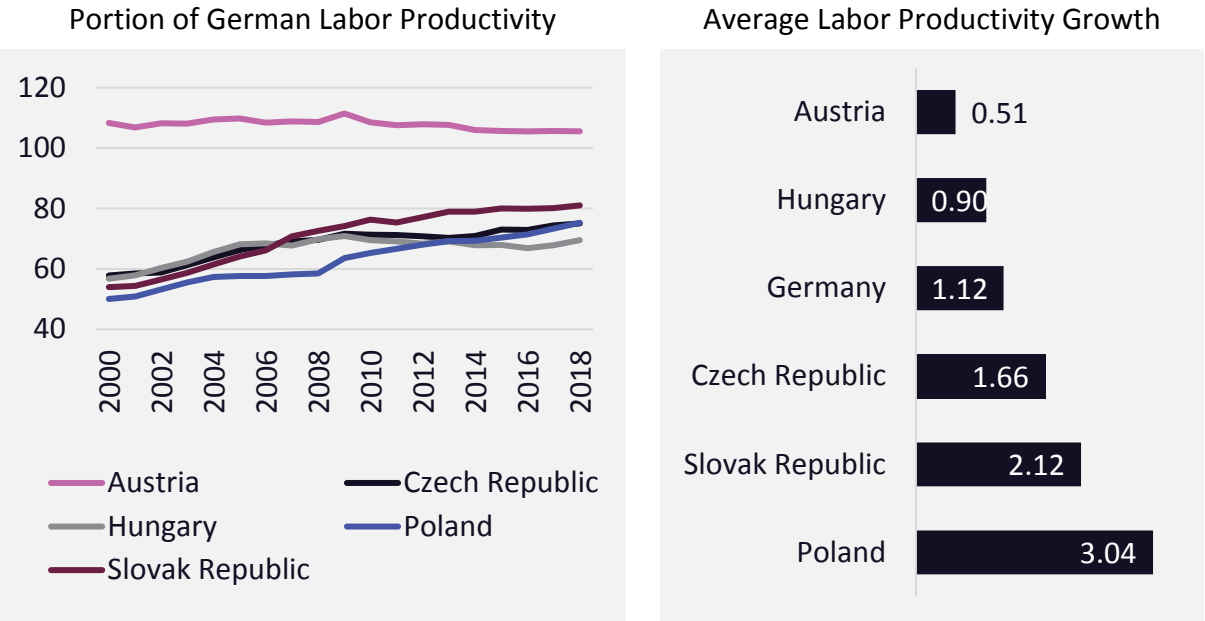
2. COUNTRY NEEDS ASSESSMENT

This section aims to identify the principal drivers of economic performance in the Czech Republic and to indicate where policies may particularly constrain or support SMEs. This includes analyses of 1) macroeconomic issues, including productivity and trade; 2) innovation, including investments in R&D and the adoption of technology; 3) productivity differences across firms; and 4) market and institutional factors that influence resource allocation and firm productivity, such as labor markets, the business environment, and competition policy.

2.1. Productivity and Trade Performances

Despite improvements in aggregate labor productivity in the Czech Republic, the country is not yet converging with German productivity levels. Labor productivity per worker in the Czech Republic grew from about 58 percent of Germany's level in 2000 to 75 percent by 2018. In comparison, the catch-up process was much faster for Slovak Republic, as productivity climbed from 54 percent of Germany's level in 2000 to 81 percent by 2018. Labor productivity increased by 1.7 percent a year from 2000 to 2018, compared to 3 percent in Poland and 2.1 percent in the Slovak Republic (Figure 1).

Figure 1. Labor productivity as a proportion of Germany's and average labor productivity growth (2010-2018)



Source: The Conference Board (2019). Total Economy Database.
Note: Labor productivity is defined as gross domestic product (GDP) per employed person in 2017 US$ (converted to 2017 price level with updated 2011 PPPs).

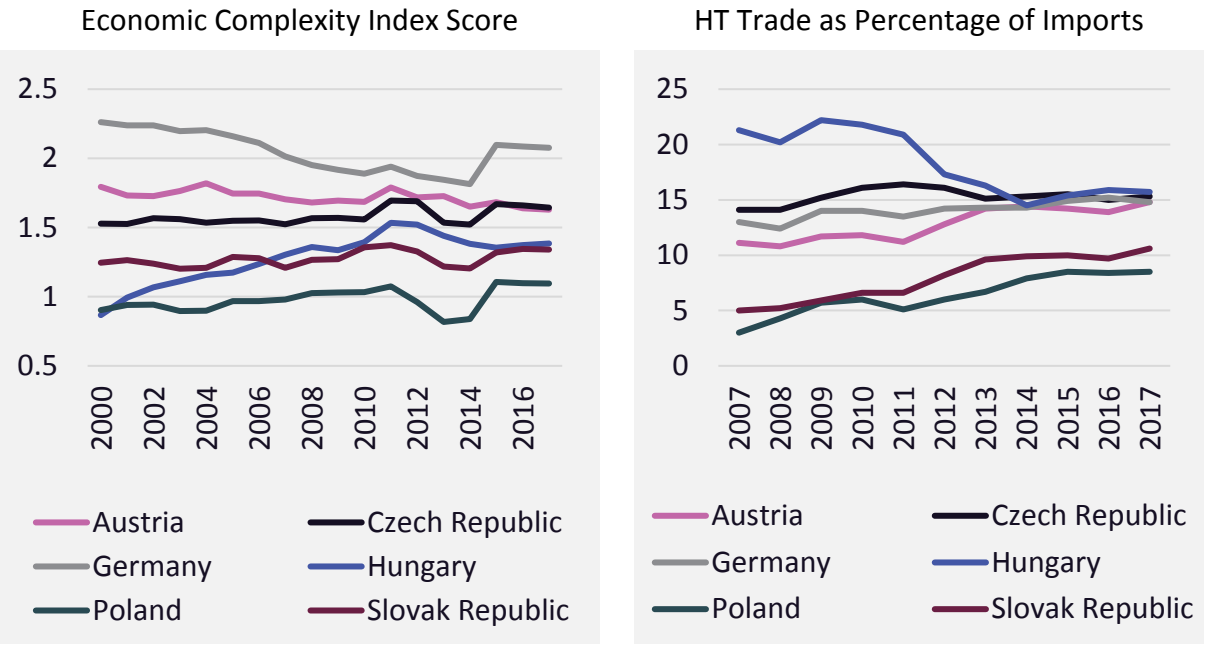
Labor productivity improvements in the Czech Republic are driven by capital deepening rather than improvements in total factor productivity (TFP). An IMF (2018) analysis of factor contributions to labor productivity in the Czech Republic shows that over the last twenty years, capital (particularly non-ICT) has been the largest contributor to labor productivity growth, attributable to concentration of growth in manufacturing and participation in the Germany-led car manufacturing value chains. In fact, the country's capital stock per worker is close to Germany's today. However, capital deepening has its limits, and large, sustained improvements in productivity will eventually require improvements in TFP. In this regard, Czech Republic's TFP was 60 percent of the level in Germany in 1997 and remained around 60 percent in 2014. Productivity gaps widened during this period in sectors such as food and accommodation, transport, construction, and agriculture, although this gap decreased in the manufacturing sector.[3] IMF (2018)'s analysis on the factors affecting TFP growth further shows that there are no signs of capital or labor misallocation across or within sectors, implying that how labor uses capital to transform inputs into outputs seems to be the problem. The analysis finds that the gap is driven by a lack of technology diffusion, as observed in wide and increasing productivity dispersions within sectors. In the manufacturing sector for example, the top 10th percentile firms are, on average, 2.5 times more productive than the bottom 10th percentile firms. Overall, lagging firms[4] (those in bottom 25th percentile of distribution) are holding back aggregate TFP. Their TFP growth has stalled compared to the top 25th percentile firms since 2009.

Czech Republic's exports show a high degree of economic complexity and of participation in European value chains (particularly Germany's manufacturing sectors). Czech Republic has one of the most complex exports mix among peers, performing below Germany but at par with Austria in 2017. High technology products represented about 15 percent of Czech Republic's exports during the last decade (Figure 2). Its US$ 164 billion exports in 2017 were dominated by key value chain sectors, namely electronics (computers, broadcasting equipment) and automotive products (cars, vehicle parts). The country is primarily operating within regional value chains, with about 75 percent of exports going to the European Union (EU) (mainly Germany and Central and Eastern Europe--Figure 3). This integration is made possible by geographic proximity to EU markets, lower labor costs (compared to Western European counterparts), and agglomeration economies (OECD July 2018). The high degree of economic complexity and participation in European value chains are both positive indicators for the Czech Republic's economic progress, but also mean that there are relatively few additional productivity gains to be made in these areas.

[3] In the manufacturing sector, Czech TFP was less than 60 percent of Germany's in 1997 and about 70 percent by 2014 (IMF 2018).

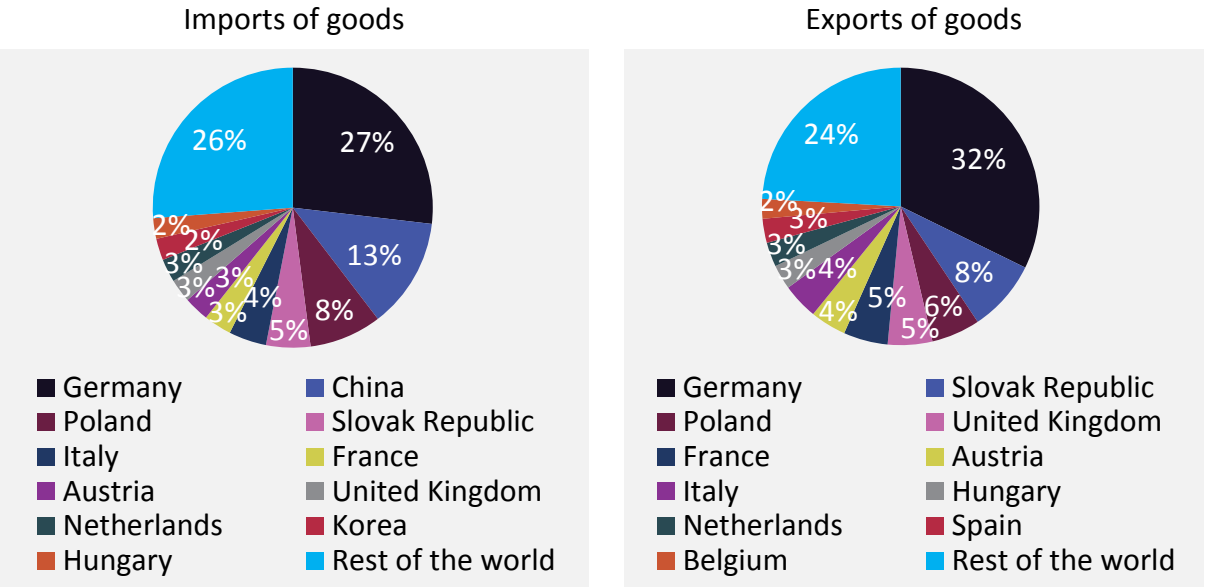
[4] According to the IMF (2018) analysis, lagging firms tend to be smaller, younger, and more indebted.

Figure 2. Economic Complexity Index[5], 2000-2017 and high-tech trade as percentage of exports, 2007-2017



Source: MIT—The Observatory of Economic Complexity (left) and Eurostat (right).
Note: High technology products, according to SITC Rev.4, include the following products: Aerospace, Computers-office machines, Electronics-telecommunications, Pharmacy, Scientific instruments, Electrical machinery, Chemistry, Non-electrical machinery, Armament.

Figure 3. Czech Republic's main trading partners (2016, %)

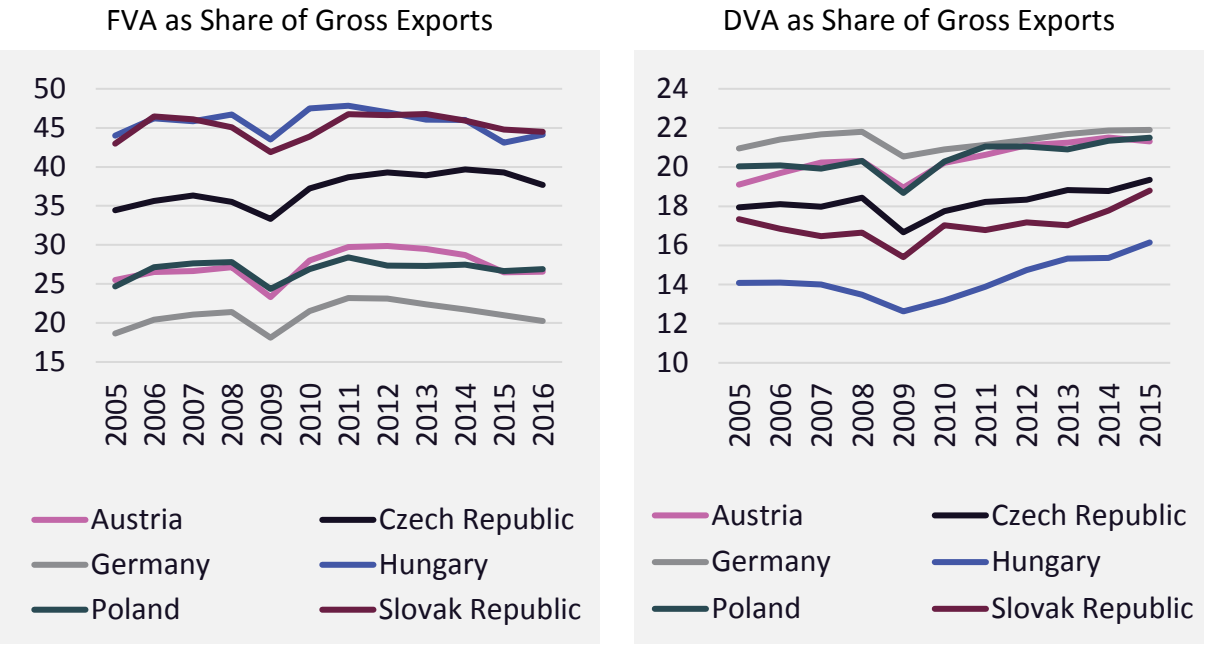


Source: OECD (July 2018) Czech Republic Economic Surveys.

[5] The Economic Complexity Index measures the knowledge intensity of an economy by considering the knowledge intensity of the products it exports. For additional information, please see: https://oec.world/en/resources/methodology/

Exports also reflect a high degree of participation in GVCs—Czech exporters are integrated primarily as buyers of foreign inputs, and to a lesser extent as sellers of inputs for further downstream processing. As a buyer of foreign inputs for further exports, the foreign value added embodied in Czech Republic's exports stood at 38 percent in 2016, somewhat below the level in Hungary and Slovak Republic (about 45 percent apiece). As can be seen in the composition of export and import destinations in Figure 3, this shows that exports are primarily re-exports of imported intermediate inputs and ICT products (OECD July 2018). As a seller of inputs for further downstream processing, Czech Republic's domestic value added in exports of third countries was about 19 percent in 2015, although this forward participation is weaker than in Germany, Poland and Austria (Figure 4). Overall, participation in GVCs supported improvements in labor productivity, although participation is dominated by foreign-owned firms, concentrated in regional value chains, and reflects the firms' downstream position in GVCs (close to the final consumer). Given the downstream position and despite relatively high GVC integration, participation tends to be in the lower value-added and less technology/knowledge-intensive sectors (e.g., mass assembly in the car manufacturing sector) (OECD July 2018).

Figure 4. Foreign value added (FVA)[6] and domestic value added (DVA)[7] embodied in foreign exports, as a share of gross exports



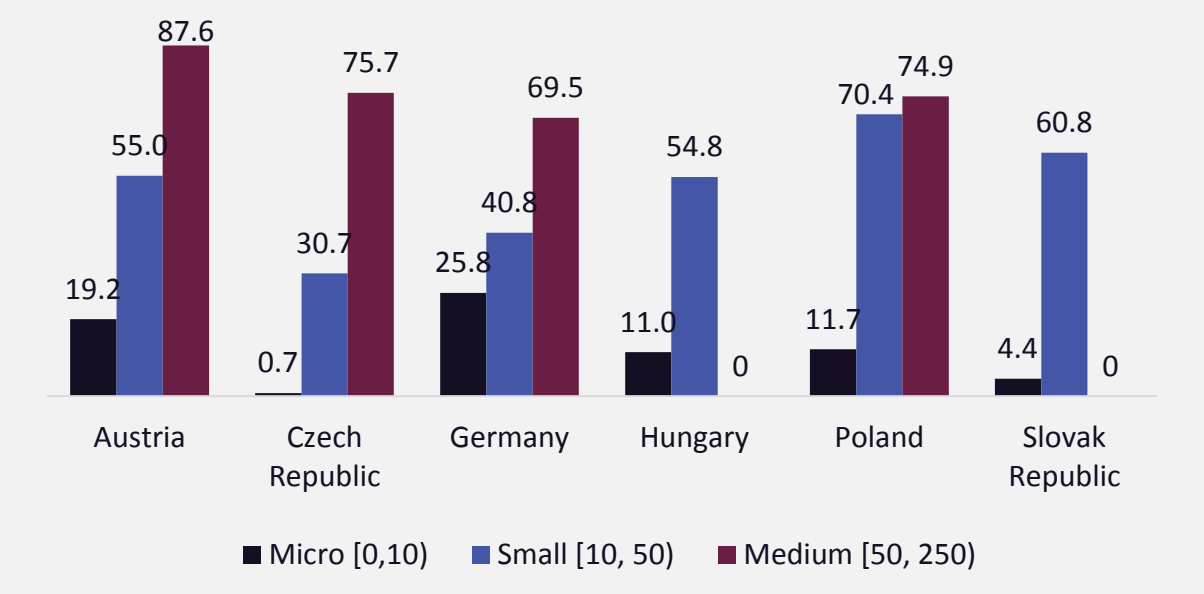
Source: OECD TiVA database.

[6] Foreign value added in gross exports is an estimation of the value added of inputs that were imported in order to produce intermediate or final goods/services to be exported.

[7] Domestic value added in gross exports is an estimation of value added in producing goods and services for export.

Yet, Czech exports are dominated by larger firms. Whereas 75 percent of medium-sized firms export in the Czech Republic, less than one percent of micro firms do. Moreover, the share of micro firms that export is lowest among peer countries (Figure 5).

Figure 5. Share of exporting firms in 2016, by size



Source: OECD (2018).

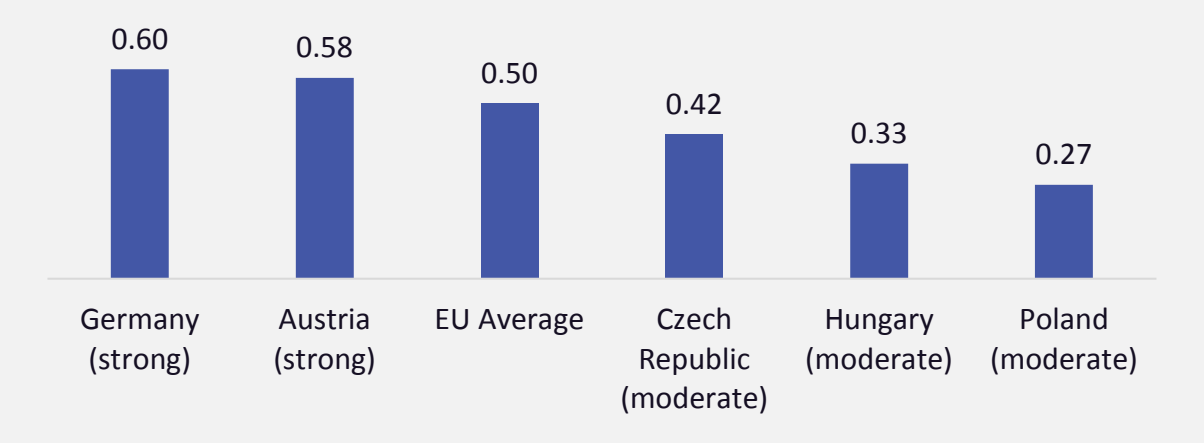
2.2. Innovation Performance

Despite the role of innovation as a channel towards improving productivity, Czech Republic is considered a 'moderate' innovator, and innovation is mostly done by large firms. The European Innovation Scoreboard 2018 finds that Czech Republic's performance is lower than the average for the EU and ranks better than only Hungary and Poland (Figure 6). Research-related weaknesses include low publication citations and public-private co-publications, and innovation performance weaknesses include limited SME innovativeness, knowledge-intensive services exports and venture capital spending (European Commission 2018a). Also, this 'moderate' innovation performance is driven primarily by large firms; there is significantly poorer innovation performance among SMEs (Figure 7). For example, the share of innovative SMEs (in terms of product, process, marketing, or organizational innovation) is a mere 19 percent compared to 49 percent among Czech large firms. However, Czech SMEs outperform SMEs in Poland, Hungary, and Slovakia in this regard.

There are regional disparities in terms of innovation performance within the country. The Regional Innovation Scoreboard 2018 finds that whereas Prague is considered to be a 'strong' innovator, other regions, such as Central Bohemia, Southwest region, and Northwest region, face declining innovation performance and are 'moderate' innovators. For example,

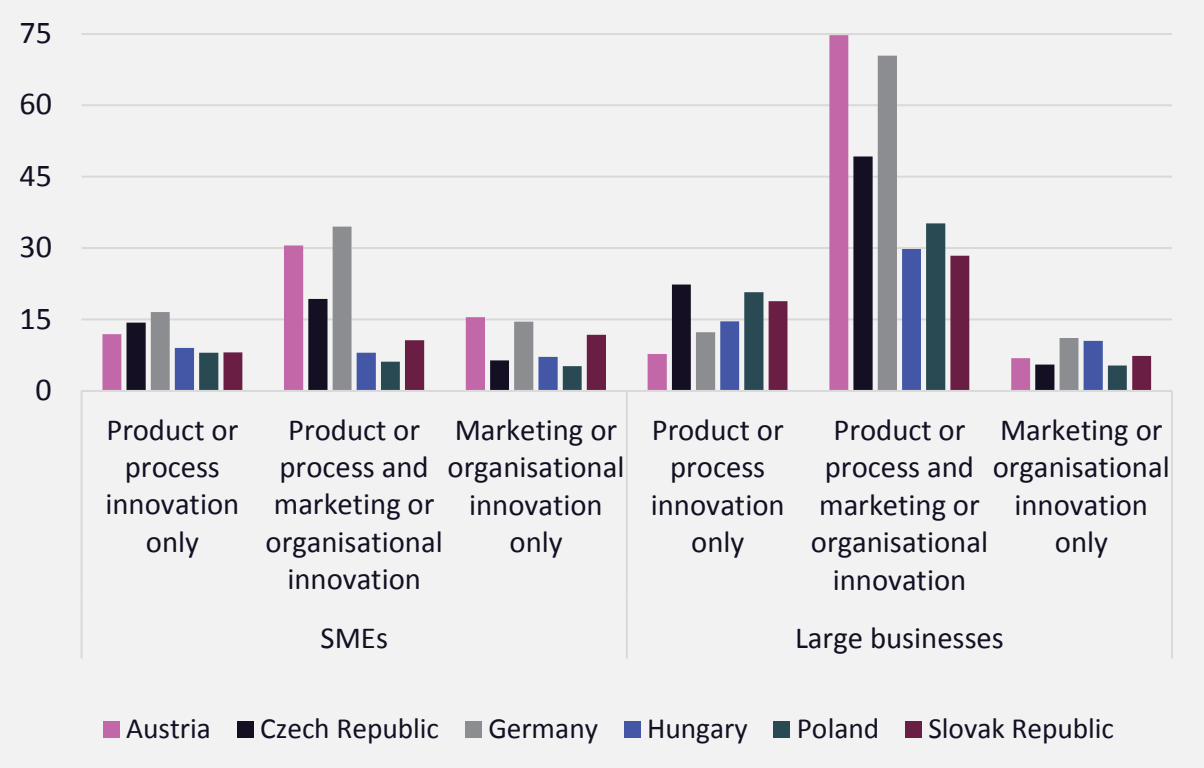
Northwest region's R&D spending in the public sector (.09 percent of GDP) is less than a third of the level in the next-worst region (Northeast region, at 0.32 percent of GDP). Overall performance as a 'moderate' innovator may be due to lack of a coherent strategy for public R&D investment towards improving research performance and boosting industry-academia cooperation (European Commission DG Research & Innovation 2019).

Figure 6. Summary innovation index, 2017



Source: European Innovation Scoreboard 2018.

Figure 7. Innovation types, by business size, 2012/2014



Source: OECD Science, Technology and Industry Scoreboard (2017).

Innovation performance among Czech SMEs either stagnated or weakened between 2010 and 2017. Firms tend to combine different forms of innovation strategies, such as introducing product or process innovations along with introducing new marketing methods (OECD 2017). Along with a considerable gap in these innovations between SMEs and large firms (Figure 7), performance in these different types of innovations by SMEs have either slowed or decreased over time in the Czech Republic. For example, the share of SMEs that introduced product or process innovations remained at about 31 percent from 2012 to 2017. Also, marketing and organizational innovations among Czech SMEs are decreasing, although the country still leads Poland, Slovakia and Hungary (Figure 8).

Box 1. Firm-Level Innovations

OECD defines four categories of firm-level innovation:

- **Product innovation**: the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.
- **Process innovation**: the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
- **Marketing innovation**: the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- **Organizational innovation**: the implementation of a new organizational method in the firm's business practices, workplace organization or external relations.

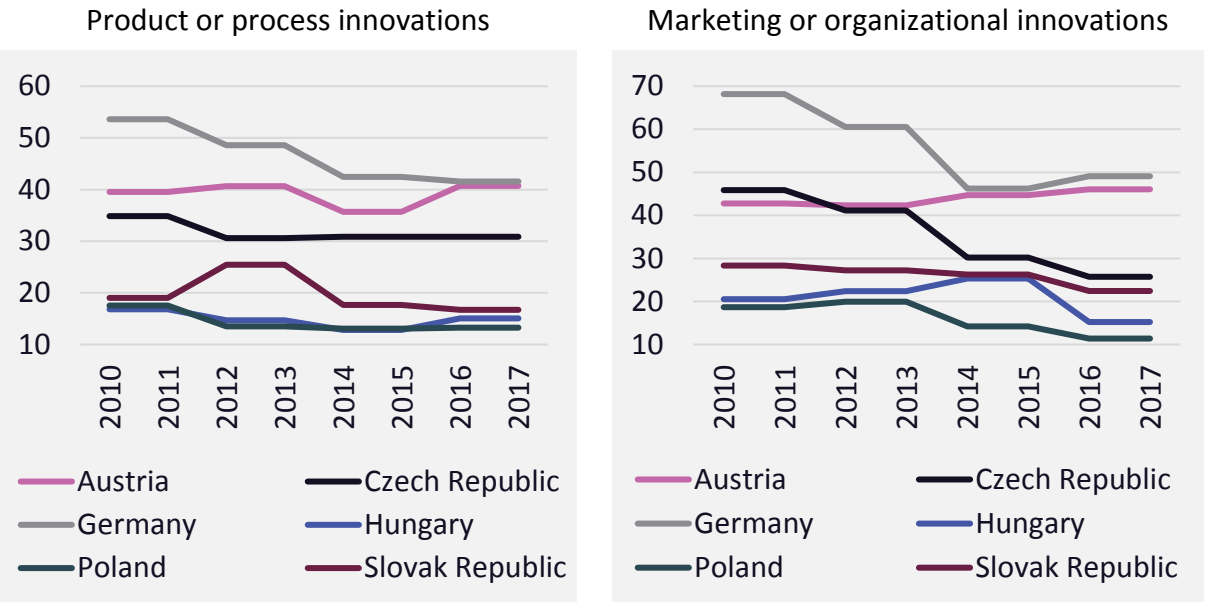
For additional information, please see: https://www.oecd.org/berlin/44120491.pdf

Czech investment in R&D has surpassed the Europe 2020 target[8] of one percent of GDP, although it lags the EU-28 target of three percent. In 2017, Czech Republic's gross domestic expenditure in R&D (GERD) reached 1.79 percent of GDP. While this figure is above the country's Europe 2020 target of one percent, the set target is lower than those set by country peers. On average, EU-28 countries have a set target of three percent. Also, only 39 percent of R&D investments are financed by the private sector, while all peers rely more on business-

[8] Europe 2020 targets are adopted as part of Europe 2020 strategy which seeks to improve EU competitiveness and productivity. One of the areas where the EU has adopted targets is R&D. For more information: https://ec.europa.eu/eurostat/web/europe-2020-indicators#targetText=It%20emphasises%20smart%2C%20sustainable%20and,Employment

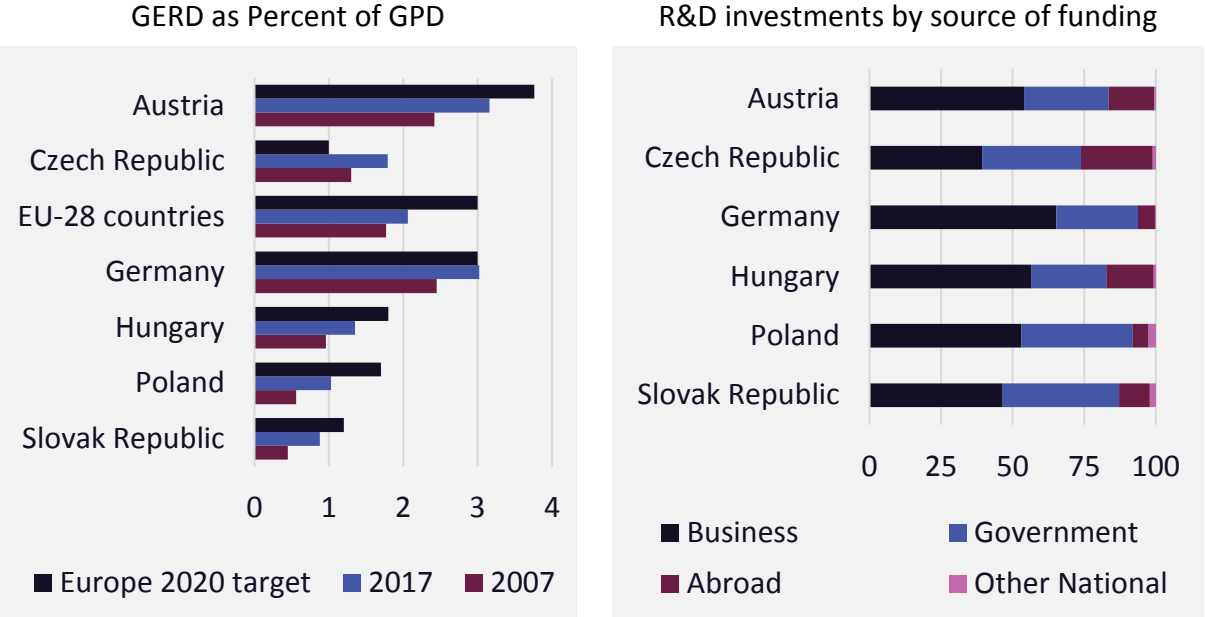
financed R&D (such as Germany at 65 percent, with only about 29 percent spending coming from the government) (Figure 9). This suggests that it would be useful to explore how to increase innovation investments by businesses.

Figure 8. SMEs introducing product or process innovations and SMEs introducing marketing or organizational innovations, as percentage of SMEs



Source: European Innovation Scoreboard (2018).

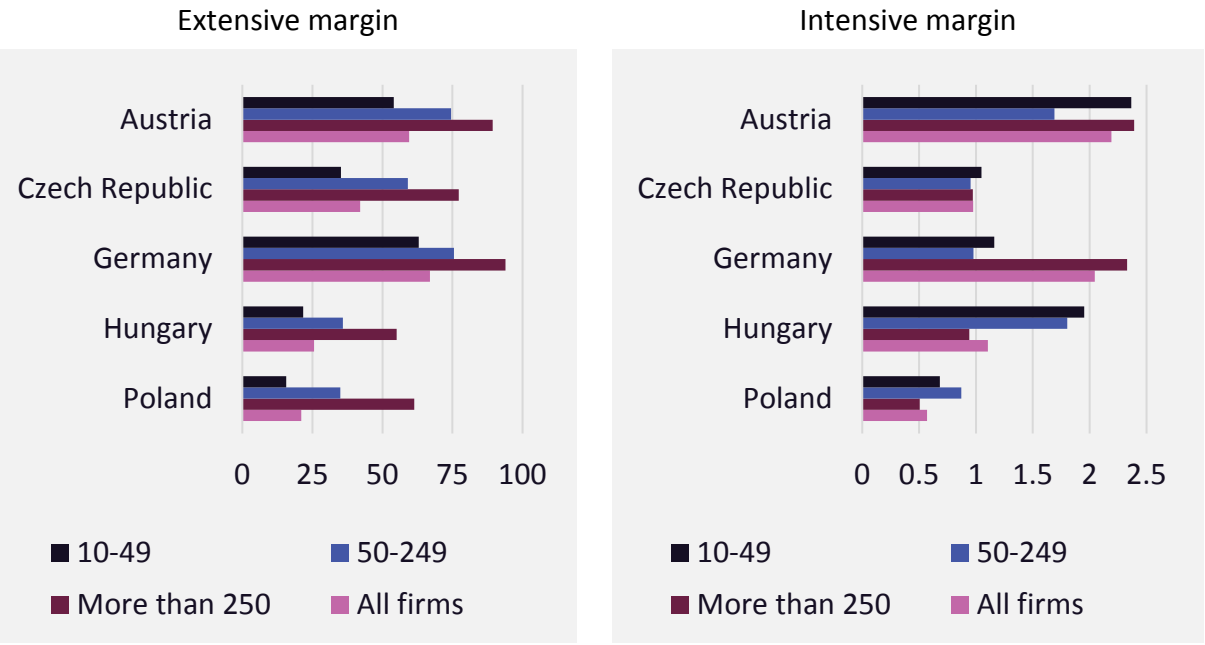
Figure 9. GERD (% GDP) in 2017 and R&D investments by source of funding in 2016/2017



Source: Eurostat and OECD Science, Technology and R&D Statistics.
Note: Data sources for right graph—2016 (Germany, Hungary, Poland, Slovakia) and 2017 (Austria, Czech Republic).

The share of SMEs investing in R&D is low, although R&D intensity among SMEs is at par with that of large firms (Figure 10). Only 35 percent of small firms and 59 percent of medium firms spend on R&D (compared to 77 percent of large firms), indicating that large firms in the Czech Republic still account for the bulk of R&D activity. However, SMEs that invest in R&D spend a similar amount as larger firms (about one percent of turnover). Overall, Czech firms involved in R&D spend less, and a smaller share of firms spend anything on R&D, than in Austria and Germany. BERD expenditures by Czech firms are primarily used for experimental development, rather than applied/industrial research, although some firms have created medium/high-tech research and innovation facilities (European Commission DG Research & Innovation 2019).

Figure 10. R&D extensive margin and intensive margin



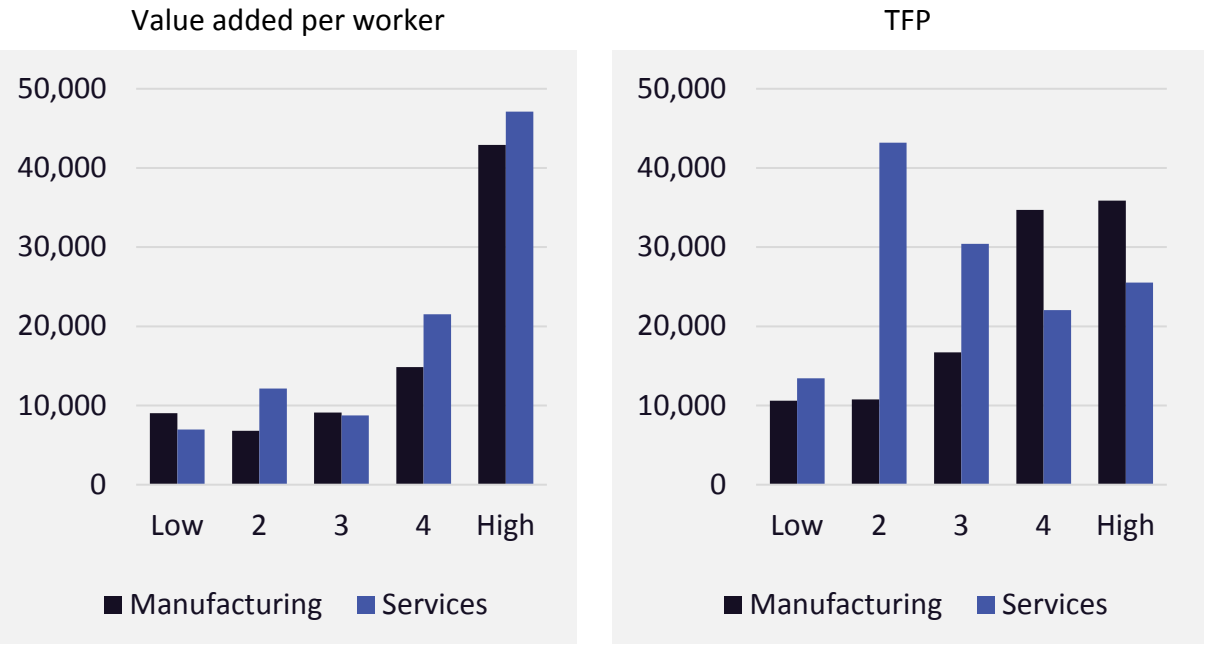
Source: Eurostat CIS (2014).
Note: Numbers along x-axis refer to number of employees.

Firm-level analysis shows there is a positive correlation between R&D and productivity (Figure 11). Results presented in Davies, Iootty, and Zouhar (2019) shows that more productive firms spend more on R&D. A firm in the top 20 percent of the productivity distribution spends 2-3 times as much on R&D than the median firm. For the services sector, however, the relationship is less clear when using TFP as the productivity measure. In addition, firm-level regressions presented in the same study show that a one percent increase in R&D expenses is related to a 4.3 percent increase in TFP[9]. Results also show that different types of R&D have different impacts on TFP growth: a one percent increase in external R&D expenses is related to a 1.5 percent increase in TFP, while an increase in internal R&D

[9] This relationship is not necessarily causal, due to potential reverse causality and omitted factors.

spending and acquisition of equipment/software improve TFP by much less: 0.9 percent and 0.2 percent respectively.[10]

Figure 11. R&D expenditure by productivity quintile: value added per worker and TFP



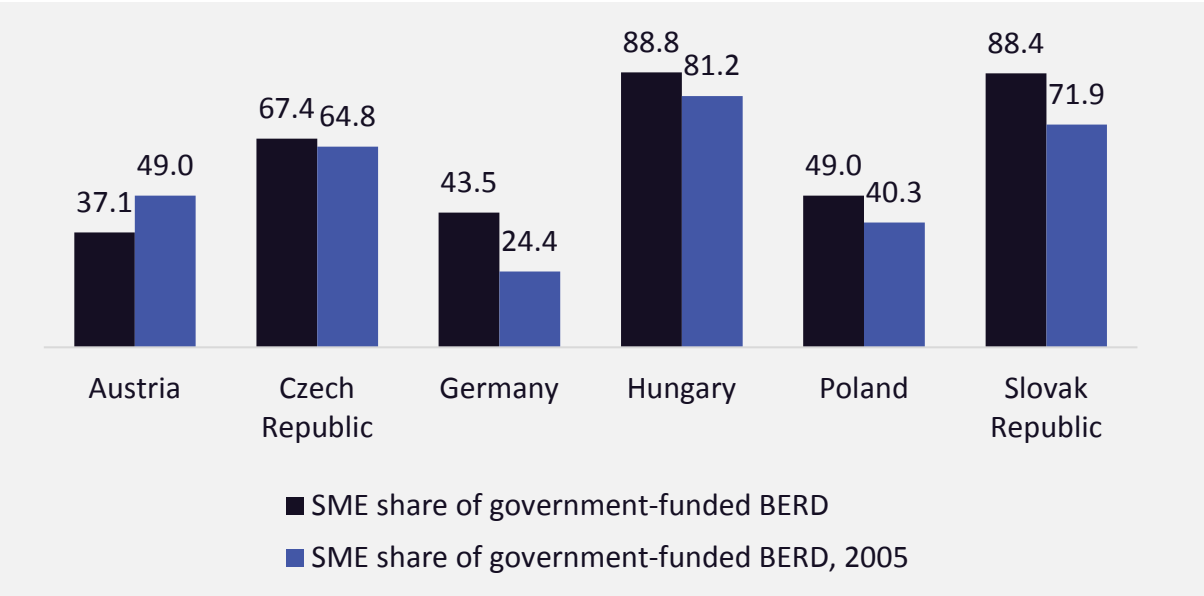
Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey and CIS datasets.

However, there is evidence that returns to R&D[11] differ between SMEs and large firms, which suggests either that the innovation ecosystem does not provide firms with the right mix of support, or that firms of different sizes have distinct capabilities to use and benefit from the system. Results presented by Davies, Iootty, and Zouhar (2019) show that larger firms have higher returns to R&D spending than SMEs (between 1.5 and 2 times higher) and these differential returns explain about 60 percent of productivity differences between large and small firms.[12] Differences in returns to R&D across firm sizes can be an indication that innovation enabling factors, under the existent innovation ecosystem, do not provide firms with the right mix of support. The Czech Republic ranks 30th out of 126 countries in 2018 in terms of innovation enabling factors[13], as measured by the Global Innovation Indicator dataset, compared to Germany (17th), Austria (20th) and Poland (38th). On the other hand, the

[10] Calculations based on CIS (CZSO).
[11] Returns to R&D are in this analysis measured by the (partial) correlation between R&D expenses and productivity, measuring the relationship between productivity and firm characteristics. The firm-level analysis shows that this relationship is stronger for larger firms.
[12] This is based on Oaxaca-Blinder decomposition using value added per worker as productivity measure. The estimate goes up to 94 percent when using TFP as productivity measure. For more details, see Davies, Iootty and Zouhar (2019).
[13] Innovation input captures the set of innovation enabling factors as: institutions; human capital and research; infrastructure; market sophistication; and business sophistication.

Czech Republic government also plays a significant role in financing R&D in the business sector: SMEs receive a significant amount (65 percent) of government R&D funding, and this average did not change between 2005 and 2015 (Figure 12). Therefore, differential returns to R&D investments, despite significant government support, may also be because firms of different sizes have distinct capabilities to use and benefit from the system.

Figure 12. Government support for business R&D, 2005 and 2015



Source: OECD STI Scoreboard (2017).
Note: Government-funded BERD is R&D performed by businesses linked to direct government funding (including grants and payments for R&D contracts for procurement, but not R&D tax incentives, repayable loans or equity investments).

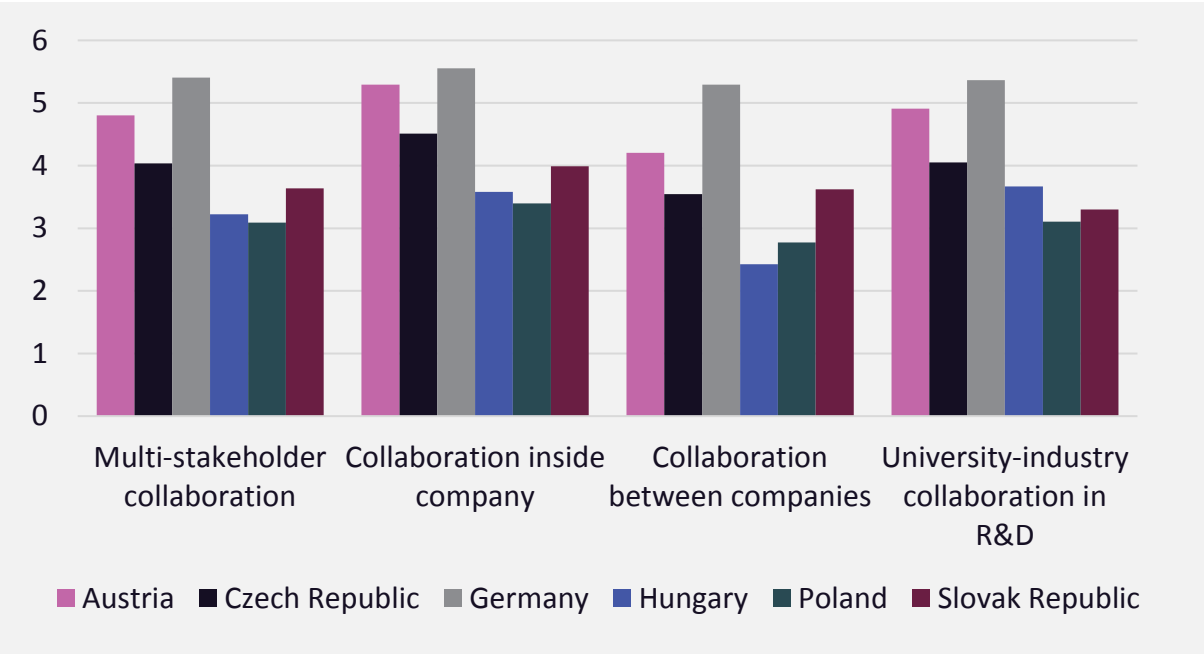
Professional, scientific and technical activities by SMEs increased sharply from 2013 to 2017, although large firms experienced even more growth. Between 2013 and 2017, SME value added in this sector grew 21 percent and SME employment increased eight percent. In comparison, among large firms in this sector, value added increased by 46 percent and employment by 50 percent. Regardless of firm size, growth in professional, scientific and technical activities can be attributed to targeted support for R&D and innovation collaboration as well as demand for scientific and technical services from the automotive industry (European Commission 2018b).

Knowledge collaboration serves as another channel to boost the supply of knowledge by facilitating knowledge transfer and technology diffusion between stakeholders. Davies, Iootty, and Zouhar (2019) show that the pay-off of external R&D (in terms of higher TFP) is larger compared to the payoff from internal R&D (see above), indicating the role of outside knowledge and collaboration in boosting firm growth.[14] Overall multi-stakeholder

[14] External R&D refers to contracted-out R&D, whereas internal R&D refers to R&D conducted in-house.

collaboration in the Czech Republic is stronger than in Slovak Republic, Hungary, and Poland but weaker than in advanced economy peers such as Germany and Austria. Czech Republic has achieved some improvements in terms of collaboration between companies and between industry and academia (Figure 13). Nevertheless, only about 10 percent of SMEs have engaged in collaboration with other firms in recent years, 10 percentage points lower than in Austria, for example (Figure 14). Moreover, collaboration between business and academia tends to be more ad-hoc rather than systematic, reflecting lack of integration of industry needs in academic research and activities; this is true even in fields which Czech Republic specializes in, such as engineering sciences, medical sciences and life sciences (European Commission DG Research & Innovation 2019).

Figure 13. Collaboration as an innovation capability

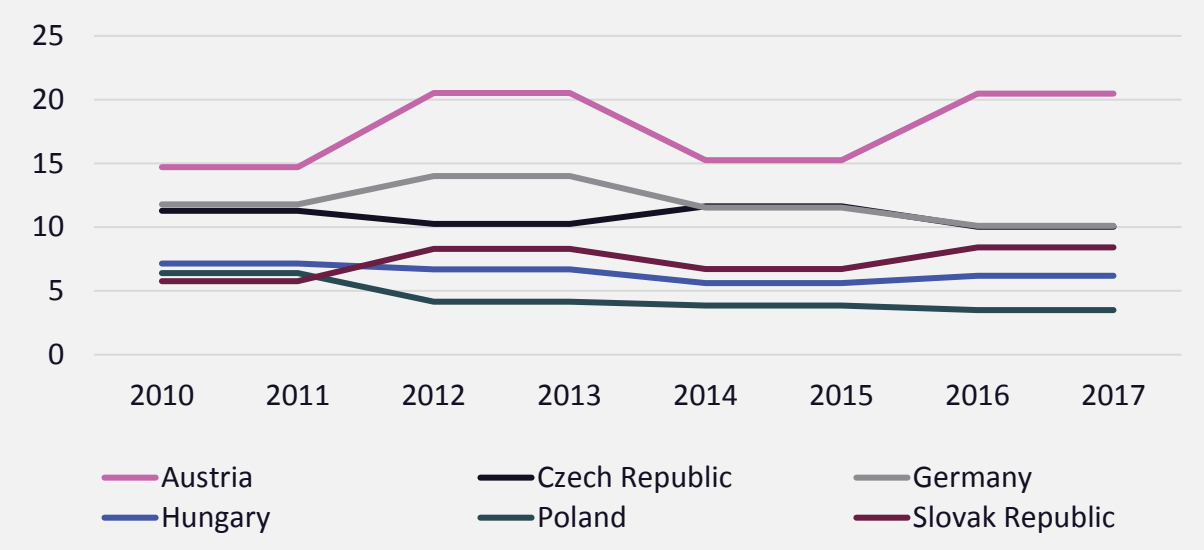


Source: World Economic Forum (2018) Global Competitiveness Index.
Note: Indicators are based on WEF Expert Opinion Survey. Multi-stakeholder collaboration represents the average score of the questions: (Collaboration inside company) In your country, to what extent do people collaborate and share ideas within a company? [1 = not at all; 7 = to a great extent]; (Collaboration between companies) In your country, to what extent do companies collaborate in sharing ideas and innovating? [1 = not at all; 7 = to a great extent]; (University-industry collaboration in R&D) In your country, to what extent do business and universities collaborate on R&D? [1 = do not collaborate at all; 7 = collaborate extensively]

Productivity depends not only on how innovative existing enterprises are, but also whether new entrepreneurial firms are being created. Entrepreneurial outcomes in the Czech Republic are improving modestly. About four new businesses were created per 1,000 people in the working age population in 2016, the second-highest rate among the five comparator countries (Figure 15). The growing number of new businesses reflects a generally positive

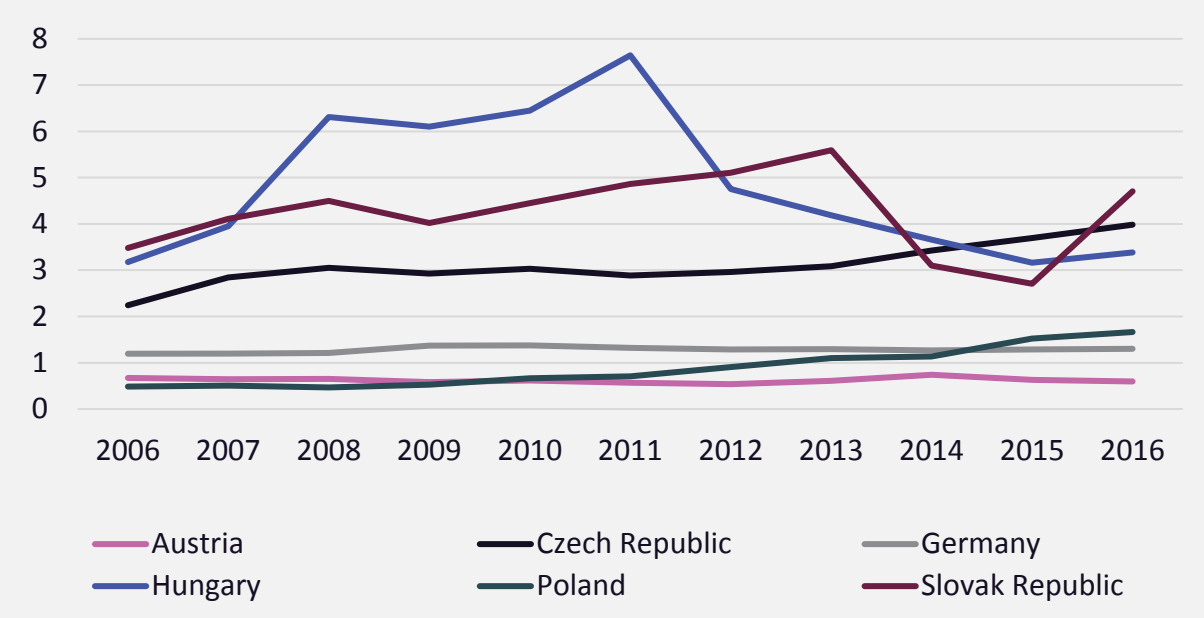
investment climate in the country (European Commission 2018b). However, not all of these new businesses will become high-growth enterprises[15].

Figure 14. Innovative SMEs collaborating with others, % of SMEs



Source: European Innovation Scoreboard (2018).

Figure 15. New business density (New Business Registrations per 1,000 People)

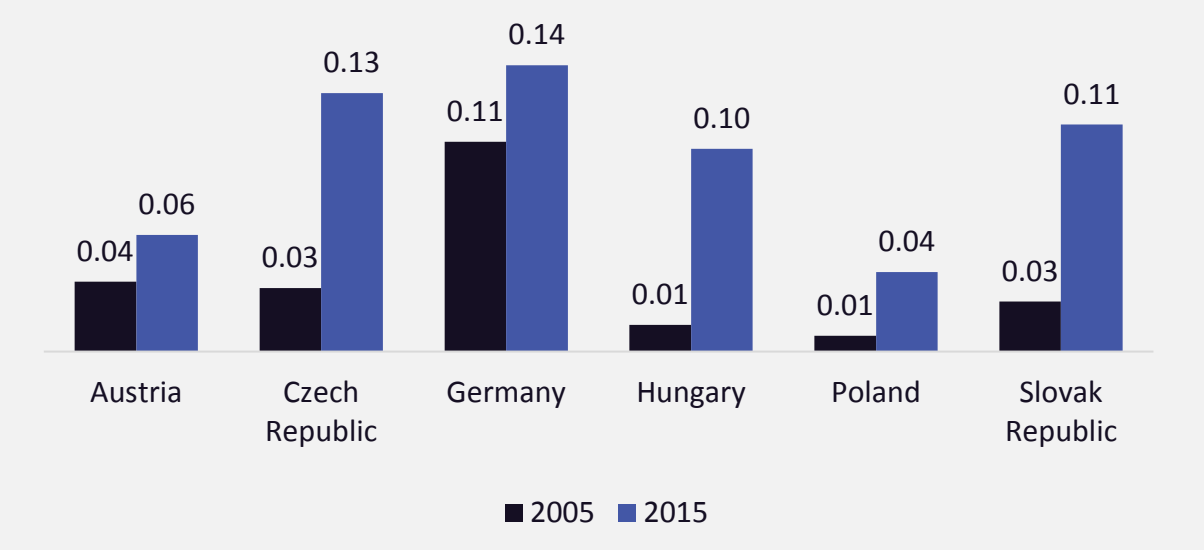


Source: World Bank (2016).
Note: New business density refers to new registrations per 1,000 people ages 15-64.

[15] About 1 in 10 firms in the Czech Republic are high-growth (i.e., employment growth of 10 percent or more), and they tend to be more prevalent in the manufacturing (31 percent) wholesale and retail trade (20 percent), and transportation and storage sector (10 percent).

Disruptive technologies such as industrial robots[16] have been transforming production processes and methods, and the deployment of such technologies has been increasing, including in the Czech Republic. Technologies are spearheading the integration of physical (analog) and digital production and consumption processes in the Industry 4.0 (I4.0) revolution (IZA 2019). Key I4.0 technologies include robotics, the internet of things (IoT), digital platforms, artificial intelligence, automation and big data, among others. For example, Germany leads peer countries in terms of intensive use of robots (measured as the ratio of industrial robot stock to manufacturing value added), followed by the Czech Republic. Like many peers, robot intensity in the Czech Republic quadrupled between 2005 and 2015 (Figure 16). Overall, a relatively high and increasing robot intensity in the Czech Republic supports its ability to leverage automation of production processes over time.

Figure 16. Robot intensity: industrial robot stock over manufacturing value added, million USD, current values



Source: OECD Science, Technology and Industry Scoreboard (2017) using International Federation of Robotics (IFR) data.

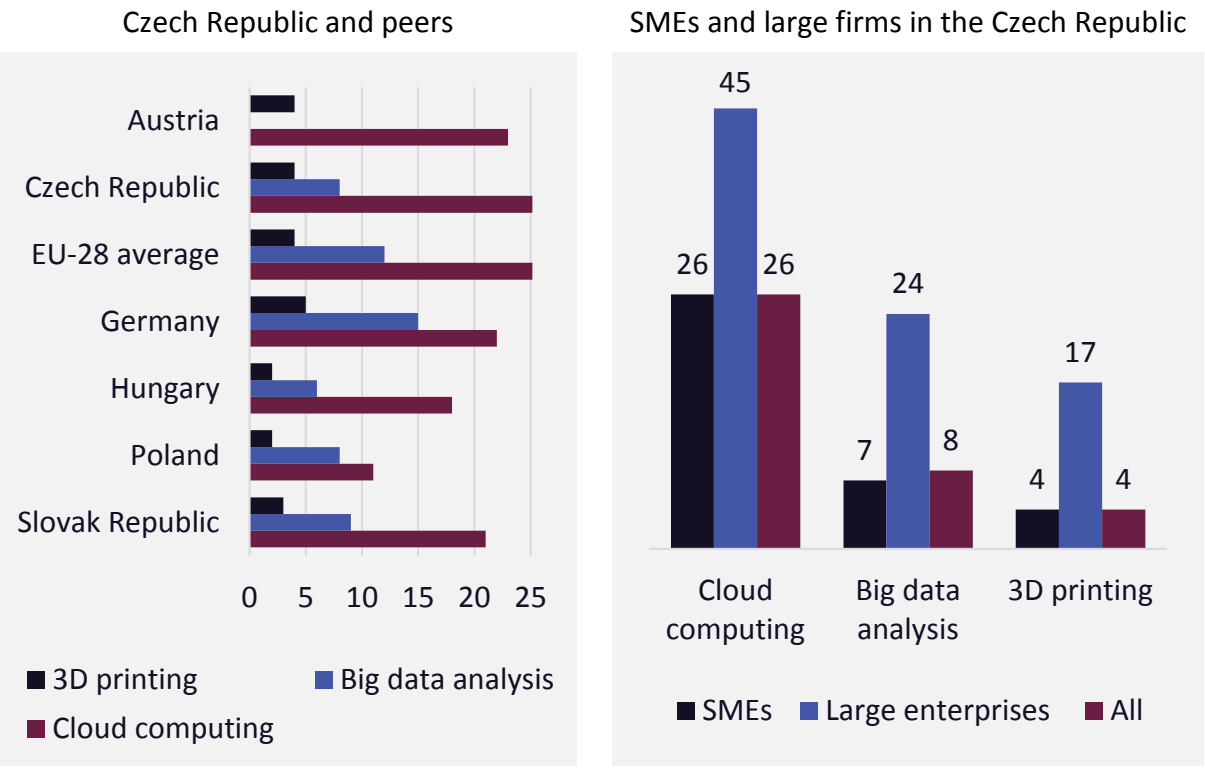
I4.0 technological competencies are even more important in the medium-to-long term for the Czech Republic. Considering demographic changes and the emigration of workers (leading to labor shortages) and thus the likelihood of wage increases (IMF 2018), automation is a potential response to labor supply reductions over time. Further, these competencies could allow the country to benefit from circular economy (shared economy) or peer-to-peer based business models, especially when such competencies are absorbed and diffused among

[16] ISO 8373:2012 defines an industrial robot as an "automatically controlled, reprogrammable, multipurpose manipulator, programmable on three or more axes, which can be either fixed in place or mobile for use in industrial automation applications". See: https://www.iso.org/obp/ui/#iso:std:iso:8373:ed-2:v1:en.

SMEs. Moreover, being I4.0-ready[17] means that Czech Republic can reap the benefits of having one of the largest manufacturing sectors in the region, and leverage I4.0 technologies as a means to further strengthen manufacturing competitiveness and thus not lose out through possible reshoring and offshoring of production (IZA 2019).

Yet, Czech firms' adoption rates of I4.0 technologies differ, depending on the type of technology and firm size. Eurostat's ICT usage in enterprises survey considers three types of technologies, namely cloud computing, big data, and 3D printing. Results show that Czech firms' use of cloud computing services and 3D printing is at par with the EU-28 average and is highest among peers. That is, 26 percent of Czech firms use cloud computing services over the internet compared to Austria (23 percent) and Germany (22 percent). However, Czech firms rank below the EU-28 average in terms of the use of big data analysis among its enterprises. That is, only eight percent of Czech enterprises conducted big data analysis (from any data source) in 2018, compared to the EU-28 average of 12 percent. Among Czech firms, the strong performance in the use of disruptive technologies is attributable to large firms, which outpace SMEs in the use of digital technologies (Figure 17).

Figure 17. Use of digital technologies in enterprises, Czech Republic and peers and between SMEs and large firms in the Czech Republic (% of firms)

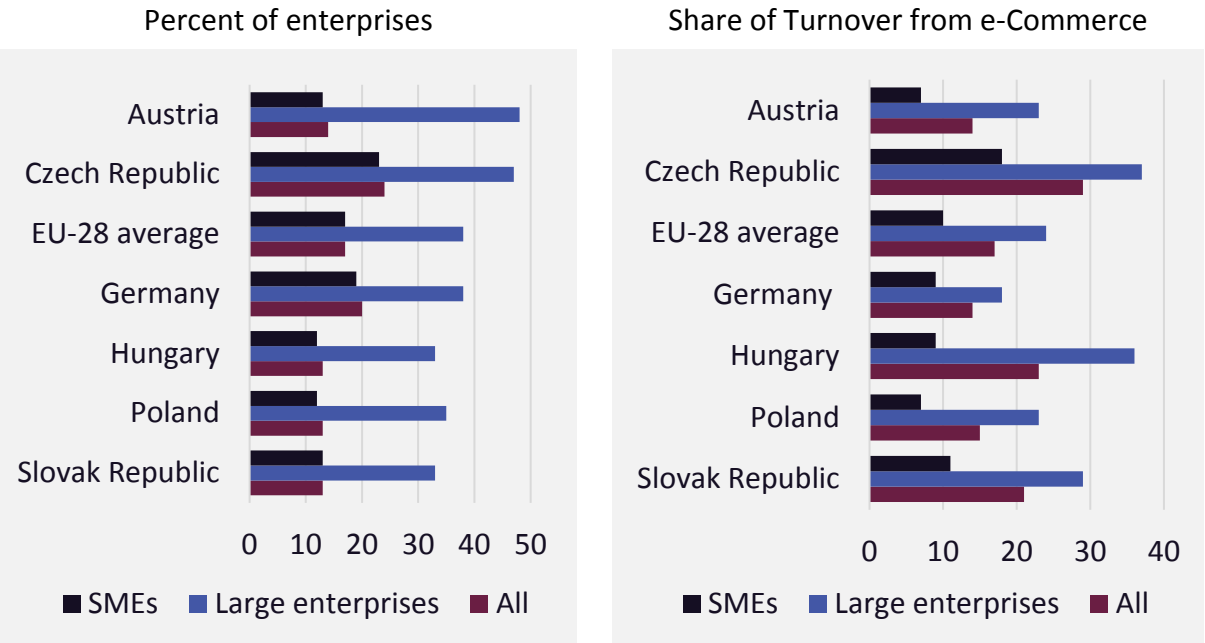


Source: Eurostat ICT survey (2018).

[17] IZA (2019) measured I4.0 readiness in terms of technological, entrepreneurial/innovative and governance competencies. Czech Republic ranks top in the list of being I4.0 ready and in individual competencies, particularly technological competencies. Other countries found to be I4.0 ready include Lithuania, Hungary and Slovenia, whereas Bulgaria, Slovakia, Romania and Poland are found to be least I4.0 ready.

Czech Republic excels the use of digital platforms, such as e-commerce, although its large firms use e-commerce more extensively than SMEs. 23 percent of Czech SMEs sell online, compared to a 17 percent average for EU-28 SMEs. Almost half of Czech large firms are engaged in e-commerce, and this is about 10 percentage points higher than the EU-28 large firms' average. Czech firms' sales receipts through e-commerce averaged 29 percent in 2018, higher than all other peers and the EU-28 average (Figure 18). Overall results indicate the strength of the use of ICT among firms, although differences across firms in the Czech Republic are large.

Figure 18. Percentage of enterprises selling online (at least 1% of turnover) and share of enterprises' total turnover from e-commerce

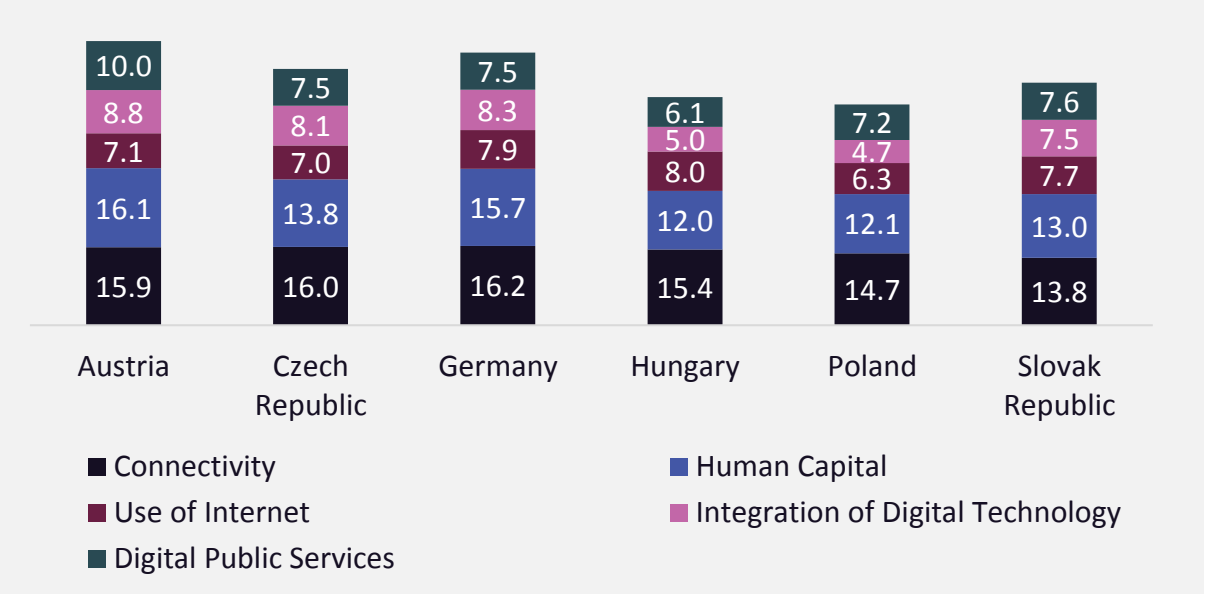


Source: Eurostat (2018).

Nationwide digital economy performance in the Czech Republic ranks higher than peers, such as Slovakia, Poland and Hungary (Figure 19). The Digital Economy and Society Index (DESI) measures the digital policy mix in EU countries in terms of five dimensions, namely connectivity, human capital, use of internet, integration of digital technology, and digital public services. Czech Republic's strengths lie in dimensions such as connectivity (i.e., deployment and quality of broadband infrastructure such as 4G technologies) and integration of digital technology (i.e., use of e-commerce and business digitization towards business efficiency). Weaknesses seem to lie in basic and especially advanced digital skills (e.g., share of internet users, having ICT skills, and STEM graduates—see below) as well as digital public services (i.e., digitization of public services in eGovernment and eHealth), especially when compared to Austria. Looking at the dynamics of select digitization indicators over time

(especially over the last decade) shows that Czech Republic has improved in terms of increasing the proportion of households with access to broadband, the proportion of daily internet users, the proportion of people using e-commerce and the proportion of population interacting electronically with the government (see Annex 2 for these convergence scatterplots).

Figure 19. Digital Economy and Society Index, 2018



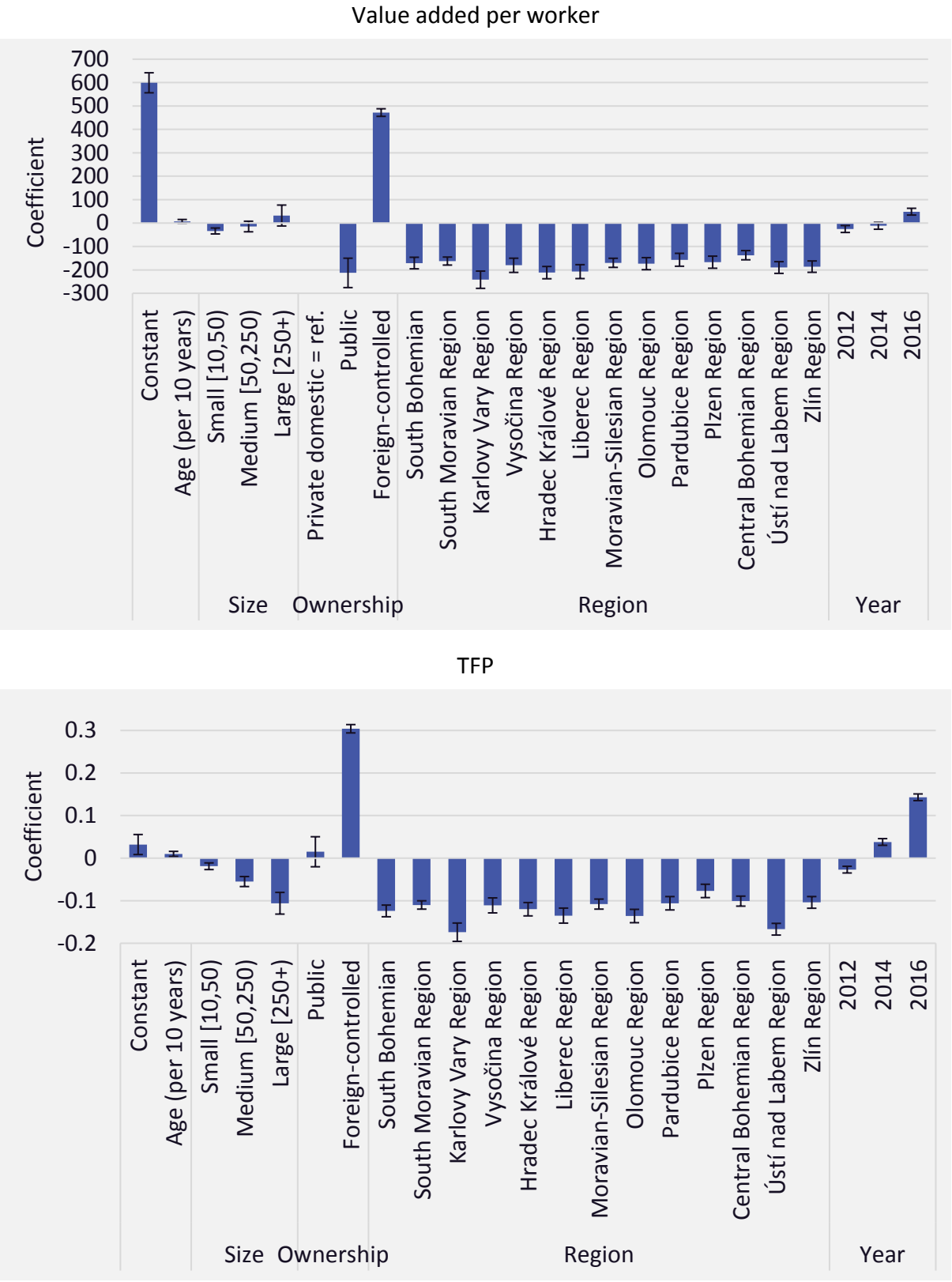
Source: European Commission.
Note: Numbers pertain to the scores of each sub-indices.

2.3. Firm-Level Productivity Dynamics

Within the Czech Republic economy, productivity gaps can be seen across sectors and firm types. Recent empirical evidence provided by Davies, Iootty, and Zouhar (2019) show that productivity is higher for older firms, larger firms, foreign-owned companies and those headquartered in Prague (see Figure 20).[18] The result for foreign-owned companies is particularly relevant, given their importance in terms of value added and employment generation. The foreign-domestic productivity gap (both in terms of labor productivity and TFP) indicates limited foreign spillovers of knowledge and technology to the local economy.

[18] Note however that larger firms are not necessarily more productive than micro firms when using TFP despite that they are more productive in terms of value added per worker. Given that TFP corrects for capital usage, this implies that large firms have more access to capital but do not necessarily use capital efficiently.

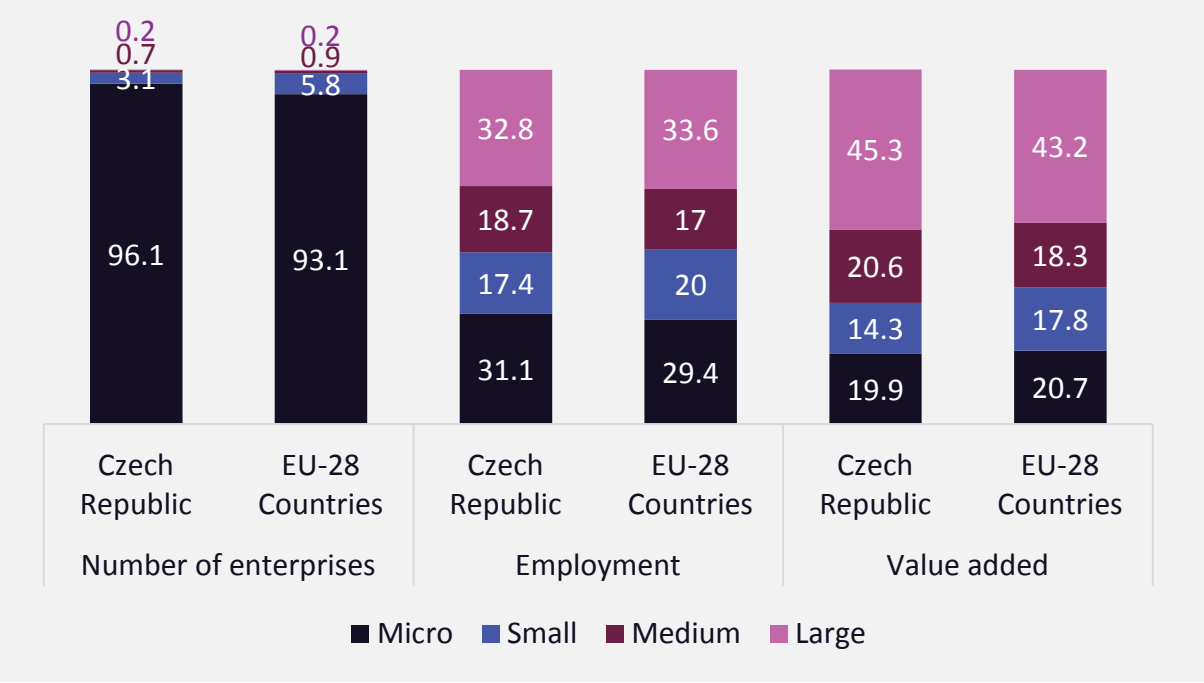
Figure 20. Average differences in value added per worker and TFP between groups



Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey data (CZSO).
Note: Brackets indicate confidence intervals [at 95%]. Size reference - Micro [0,10). Ownership reference - Private domestic. Region reference – Prague. Year reference – 2010.

Productivity and value added in the Czech Republic is still concentrated among multinationals and large firms, despite the fact that most enterprises are micro firms. 96 percent of Czech enterprises are micro firms, slightly higher than the average EU-28 proportion of 93 percent (Figure 21). Even though micro firms represent the majority of enterprises, their contribution is more modest than that of small and medium firms. Taken together, micro and SMEs employ close to 67 percent of the total number of employees (with a growth rate of 1.8 percent in 2013-2017) and contribute 55 percent of total value added (with a growth rate of 22 percent in 2013-2017, similar to large firms) (European Commission 2018b). Still, Czech micro and SMEs are smaller than EU-28 averages: they employ 2.4 people compared to 3.9 in the EU, and have value added per worker of around EUR 22,800 compared to the EUR 43,900 average in the EU (European Commission 2018b). Large firms account for 33 percent of employment and 45 percent of value-added. Large firms tend to be foreign invested companies or publicly owned enterprises in the services sector (European Commission 2018a).

Figure 21. Business demography in the Czech Republic, 2017

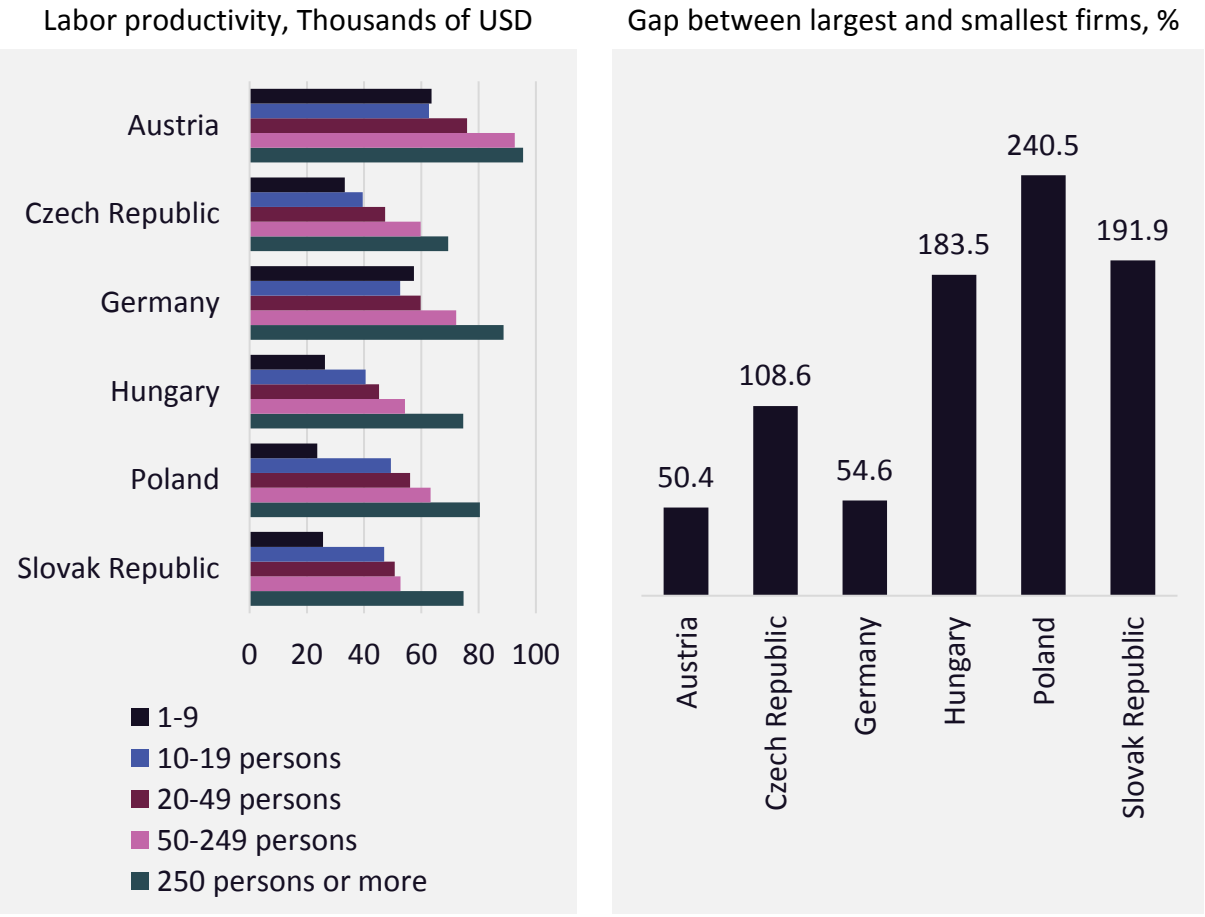


Source: EC (2018a). 2018 SBA Fact Sheet.

Smaller firms in the Czech Republic have lower value added per worker compared to larger firms. This is similar to peer countries. Still the gap between the largest and smallest firms tends to be wide compared to advanced economy peers such as Austria and Germany. Whereas these countries' largest firms tend to be 50 percent more productive than the smallest firms, the largest firms in the Czech Republic were more than twice as productive as its smallest firms in 2016 (Figure 22). The story of weak productivity among SMEs can be

linked in part to the high incidence of self-employment in the country (higher than EU-28 average); self-employed workers' productivity can be hindered by lack of scale economies and limited ability to access domestic and foreign markets, among other factors (Fall and Lewis 2017).

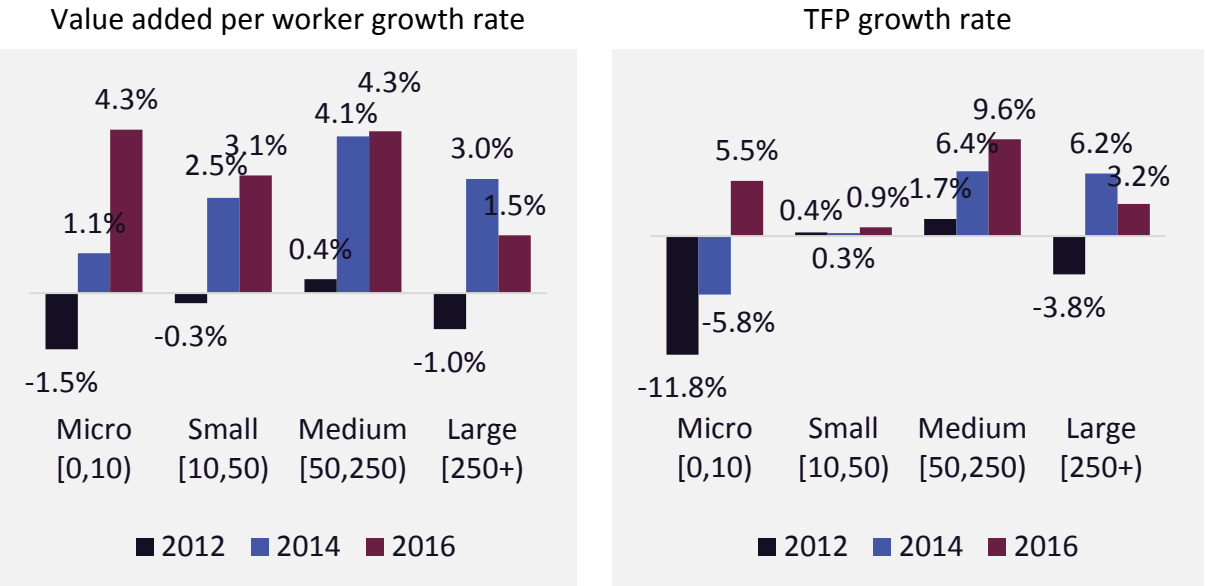
Figure 22. Labor productivity by firm size in 2016 and gap between largest (250+ workers) and smallest firms (1-9 workers)



Source: OECD (2018).
Note: Value added per person employed, thousands of USD, current PPPs.

Productivity increased for almost all size groups of firms between 2010 and 2016. Growth in productivity was highest for medium-sized enterprises, whether measured by value added per worker or by TFP. Micro firms experienced a sharp decline in TFP over this period, albeit some rise in value added per worker. Small firms achieved some increase in value added per worker, but TFP growth was flat. Large firms have seen a recent slowdown of productivity, while for other firms, productivity growth has been increasing. (Figure 23)

Figure 23. Trends in value added per worker and TFP from 2010–2016

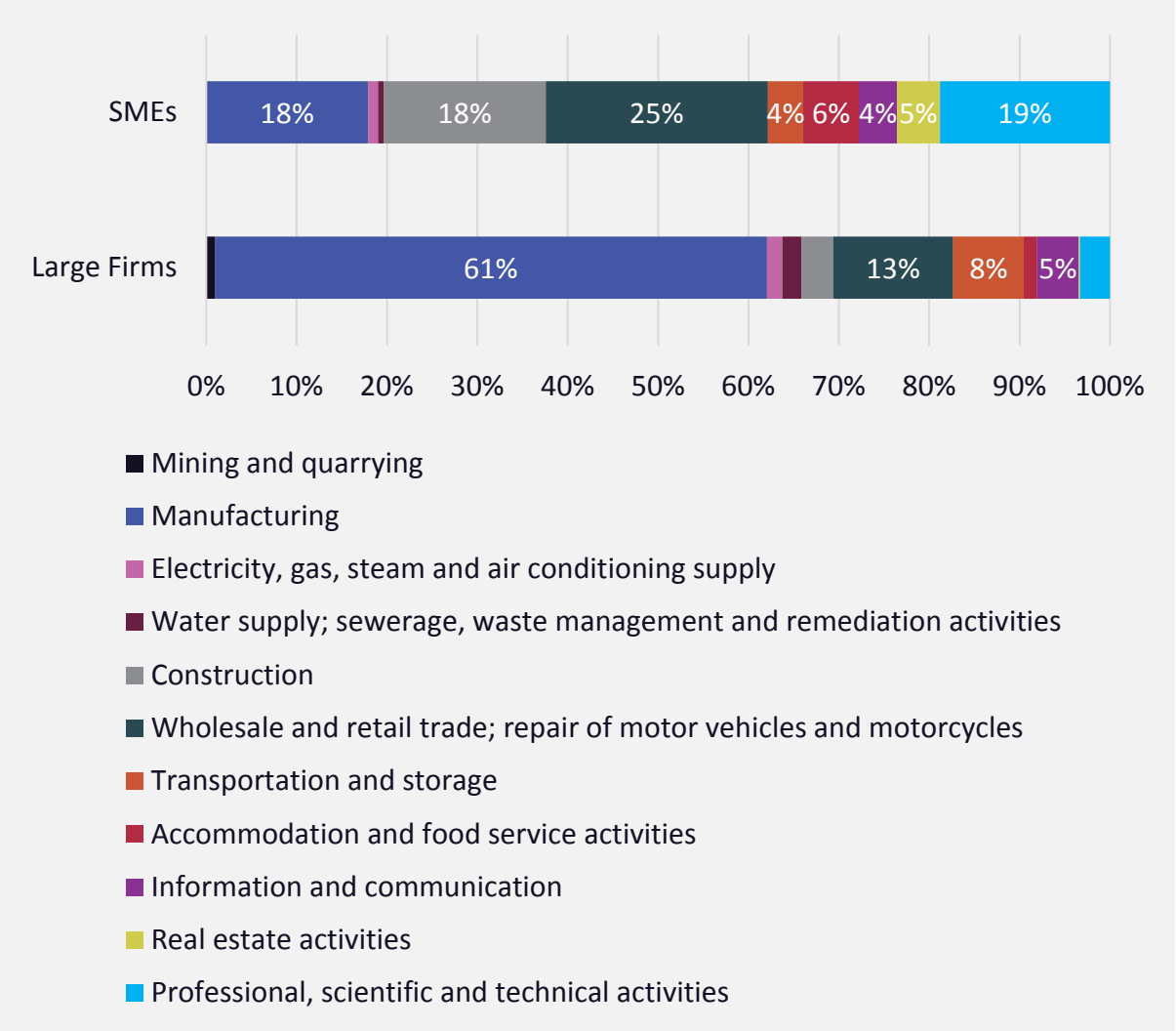


Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey data (CZSO).

Large firms tend to be concentrated in the manufacturing sector, whereas the distribution of activity among SMEs is more dispersed. 61 percent of large firms are in the manufacturing sector. In comparison, only 18 percent of SMEs are in the manufacturing sector, and 24 percent are in the wholesale and retail trade sector (Figure 24). Nevertheless, the manufacturing sector is the largest sector among SMEs in terms of value added and employment, accounting for 28 percent of each (this is about 10 percentage points higher than the average for EU-28 countries) (European Commission 2018b).

Value added, but not employment, increased in manufacturing SMEs between 2013 and 2017. Large manufacturing firms experienced even higher growth rates in terms of value added and employment. Value added in manufacturing SMEs rose by 19.5 percent from 2013-2017, but employment stagnated. Growth among large manufacturing firms was more robust, with 35.7 percent value added growth and 11.6 percent employment growth during the same period. Overall growth in the manufacturing sector is linked to local and international consumer demand in the motor vehicle industry, benefiting both SMEs and large car manufacturers in the supply chain. However, because the motor vehicle industry is dominated by large firms, this helps explain weaker growth among SMEs compared to large firms in the overall manufacturing sector. Also, lack of employment growth among SMEs is due to shortages of both skilled and unskilled workers, particularly as large firms can offer more attractive pay and benefits than can the SMEs. (European Commission 2018b)

Figure 24. Distribution by type of activity in SMEs and large firms



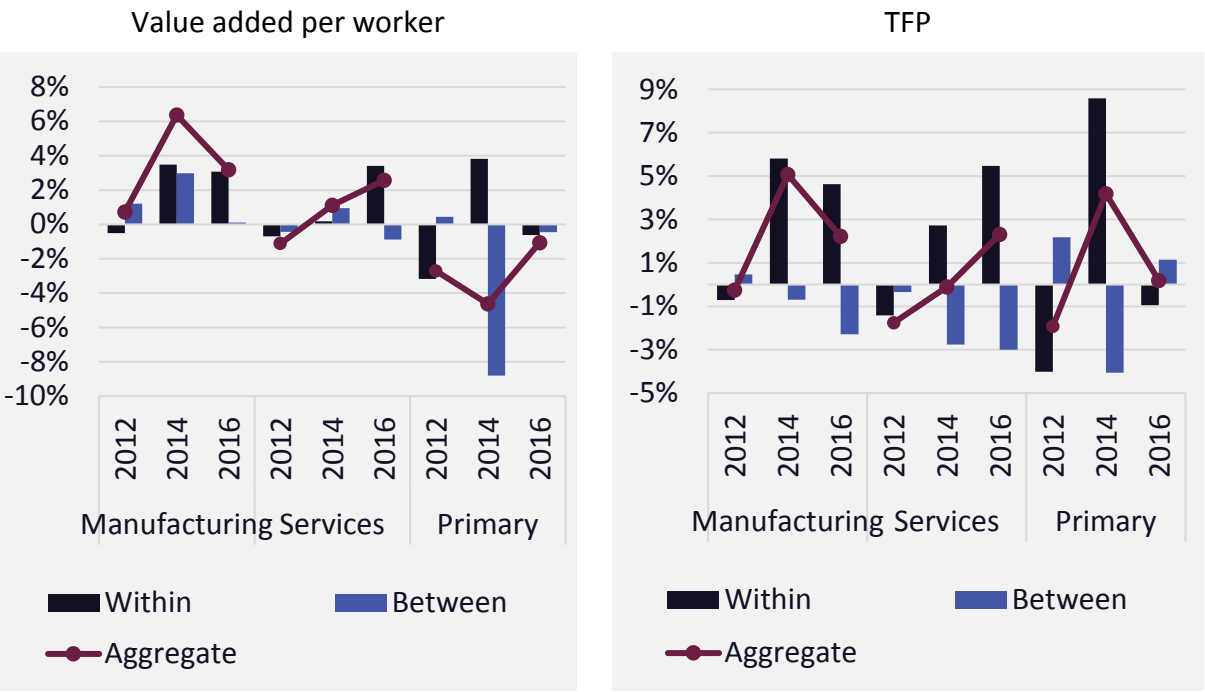
Source: Eurostat.

Productivity growth can be mechanically decomposed into two components: within-firm and between-firm. Average productivity can increase by productivity improvements in the average firm (within component) and through the output growth of more productive firms (between component). The former is typically related to individual firms becoming more productive due to increasing internal capabilities, which includes innovation capacity, managerial practices, workforce skills and technology-absorption capacity. In 2012-2016 the within component was mostly positive, for both manufacturing and services industries, regardless of whether productivity is measured by labor productivity or TFP.[19] This result suggests an across the board increase of firms' production efficiency. The between component is related to the reallocation of production resources and economic activity

[19] This productivity growth decomposition exercise is taken from Davies, Iootty, and Zouhar (2019), and relies on Structural Business Survey firm-level data.

towards most productive firms. This component was low or negative, implying allocative inefficiencies in both manufacturing and services from 2014-2016. Moreover, the growth decomposition for TFP frequently shows a negative between component, suggesting constraints to accumulating capital and competition barriers (Figure 25).

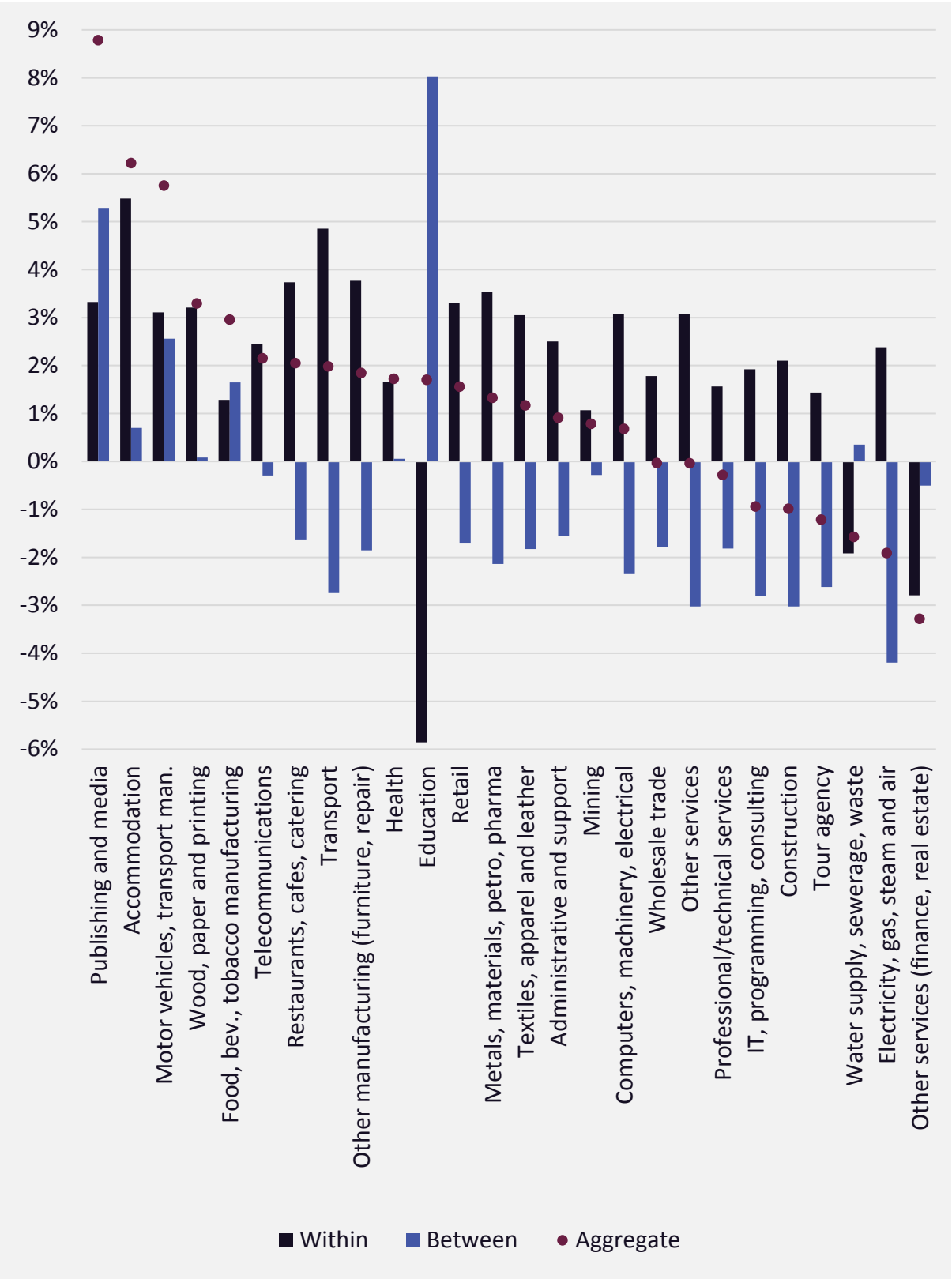
Figure 25. Components of productivity growth: value added per worker and TFP



Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey data.

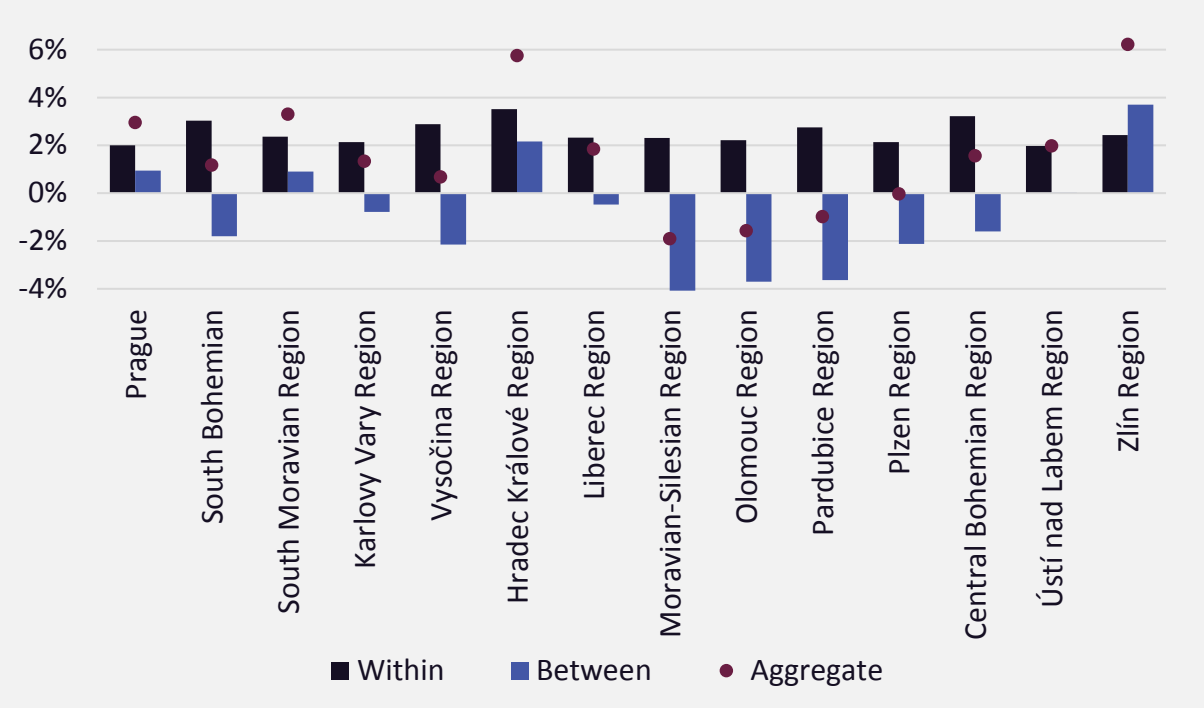
Resource misallocation appears prevalent in many services sectors and across regions. At the 2-digit sector level, most service sectors – especially the professional/technical services, IT, construction, utilities and financial services - experienced a reduced or negative productivity growth and a negative performance of the between component (Figure 26), which suggests that allocative efficiency might be problematic in these sectors. This result points to a particularly worrisome trend since negative productivity performance of services sectors is likely to have a negative impact on manufacturing industries that buy services inputs. When performing the productivity growth decomposition exercise at the regional level, Davies, Iootty, and Zouhar (2019) find evidence that resource misallocation seems to drive regional productivity differences (Figure 27). Results show a positive growth in the western regions (with the exception of Plzeň and Vysočina), but negative growth in the east, and most of the productivity decreases are related to more productive firms growing less than less productive firms (a negative "between" component).

Figure 26. TFP growth decomposition by 2-digit sector, 2010-2016



Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey dataset.

Figure 27. TFP growth decomposition by region, 2010-2016



Source: Davies, Iootty, and Zouhar (2019); calculations based on Structural Business Survey dataset.
Note: Geographical indicators are based on the location of the headquarters, not plant locations

2.4. Market and Institutional Factors

Ensuring productivity growth through innovation and entrepreneurship among SMEs necessitates a range of market and institutional factors, including an enabling business environment, available capital, and a skilled workforce. Overall, the Czech business environment (as measured in the Ease of Doing Business Survey) compares well with many of its peers in 2019; the overall doing business ranking stood at 35. However, Czech Republic scores poorly on some indicators. For example, Czech Republic ranks 115th out of 190 countries in starting a business,[20] contract enforcement is costly,[21] and the rollout of e-government services has been slow (European Commission 2018b). While the business environment has shown improvement, the availability of risk financing, an important dimension of resource allocation for startups remains underdeveloped.

Whereas the Czech Republic has in the past scored poorly in "second chance"[22] for entrepreneurs, it has improved and now performs in line with the EU average.[23] The time

[20] It involves 8 procedures and 24.5 days to incorporate a business, compared to Hungary with 6 procedures and 7 days.
[21] In fact, Czech Republic ranked worst in enforcing contracts among peers.
[22] 'Second chance' ensures that honest entrepreneurs who have gone bankrupt get a second chance quickly.
[23] European Commission (2017) Czech Republic 2017 SBA Fact Sheet.

needed to resolve insolvency fell from 6.5 years in 2008 to 2.1 years in 2019 (compared to 4 years in Slovak Republic, albeit resolution requires only about one year in Austria and Germany). However, the costs associated with insolvency remain high, at 17 percent of the debtor's estate compared to 8 percent in Germany and 10 percent in Austria, and only better than Slovak Republic (18 percent). Some of the issues connected with second chance include: ineffective measures to facilitate business transfers due to generational change, lack of equal treatment for honest bankrupt entrepreneurs, lack of 'fast-track' procedures to enable entrepreneurs to move on quickly from bankruptcy processes, and lack of early warning mechanisms to potentially avert bankruptcy (European Commission 2018b).

The performance on Doing Business indicators varies by region.[24] In fact, Czech Republic showed larger subnational differences than Croatia, Portugal and Slovakia (World Bank 2018). For example, Doing Business is easier in larger cities (Prague, Brno) than in smaller cities. Overall, Prague leads all other secondary cities in performance across regulatory areas, suggesting scope for secondary cities to learn from good practices found in the capital city. A summary of specific areas of differences in Doing Business include the following:

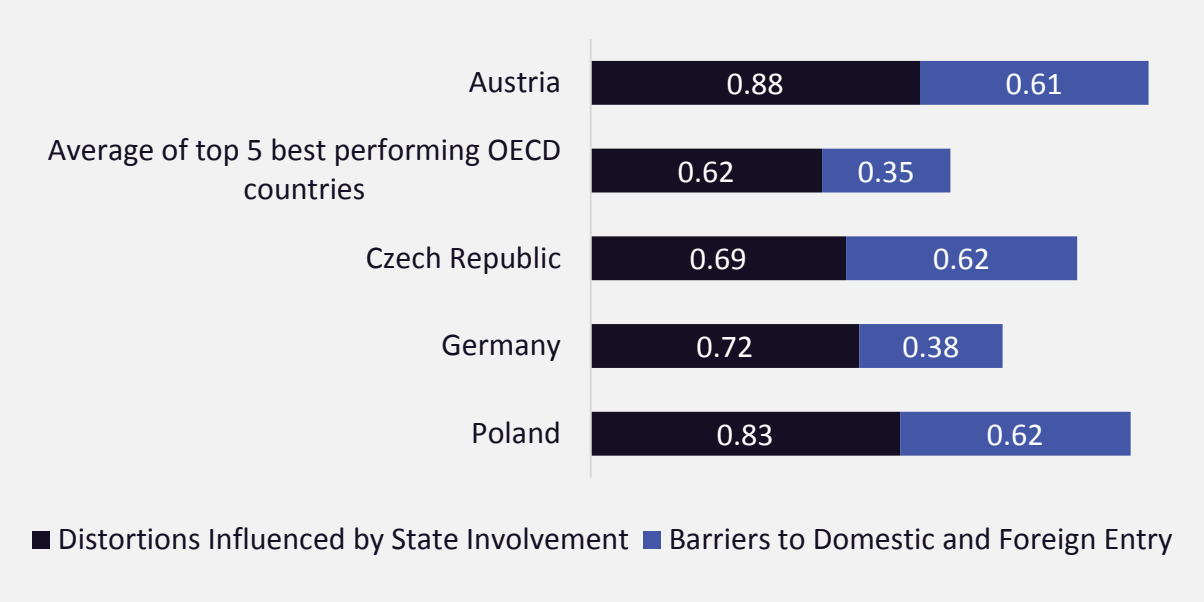
- Prague ranks first in 'getting electricity' and 'enforcing contracts', while Brno ranks first in 'dealing with construction permits' and Ostrava leads in 'registering property'. Strong performance in these key regulatory areas among large cities indicates the importance of economies of scale and investing in administrative modernization to improve regulatory efficiency and quality.
- Among cities, the largest variation is in 'getting electricity'. Differences in performance are primarily due to differences in the type of connection needed, e.g., for a new warehouse. In all Czech cities (except for Brno and Prague), a warehouse typically connects to a medium-voltage network and necessitates a process involving higher time and cost than the EU average; up-front costs reach as high as 283.2 percent of income per capita (in Ostrava). The long process (e.g., about eight months in Usti nad Labem) can be due to the time spent obtaining multiple municipal permits. In comparison, warehouses in Brno and Prague are more likely to connect to a low-voltage network. This process can be completed in two months, at a cost of 25.9 percent of income per capita.
- In terms of starting a business, variations in time is large among Czech cities. This variation is driven by the time required to register with tax authorities. While income tax registration usually takes 1-5 days in most cities, time for value added tax (VAT) registration differs. For example, applicant-firms can wait from 10 days in Olomouc and Usti nad Labem to 18 days in Prague (which also has the highest application volume).

Barriers against competition are an additional obstacle to efficient resource allocation in the Czech Republic. The fact that more productive firms are not being able to grow in the Czech Republic might be explained by restrictions to competition imposed by product market

[24] The seven Czech cities considered include Brno, Liberec, Olomouc, Ostrava, Plzen, Prague, Usti nad Labem.

regulations. In principle, governments intervene in product markets through regulatory policies, often motivated by legitimate reasons, as to address typical market failures such as asymmetric information, externalities, and monopoly conditions. However, if poorly designed, these product market regulations may affect the degree of competition between firms which in turn limit firm's incentives to maximize efficiency, innovate, and increase productivity. Against this backdrop, the Product Market Regulation (PMR) data – collected by OECD - allows for a high-level assessment of the restrictiveness of the regulatory framework that affects competition conditions in a sample country (see Box 2). Recent data published by the OECD – for 2018 - shows that product market regulations are more restrictive to competition in the Czech Republic than in Germany or when compared to the average of the top 5 OECD countries. However, the country performs better than Austria and Poland (Figure 28).

Figure 28. Economy-wide product market regulation: restrictiveness to competition (higher scores, more restrictions to competition)



Source: OECD PMR database (http://www.oecd.org/economy/reform/indicators-of-product-market-regulation/)
Note: Higher scores reflect more restrictive regulation or a regulatory framework least conducive to competition; OECD top 5 are UK, Denmark, Spain, Germany, Norway; OECD = Organization for Economic Co-operation and Development.

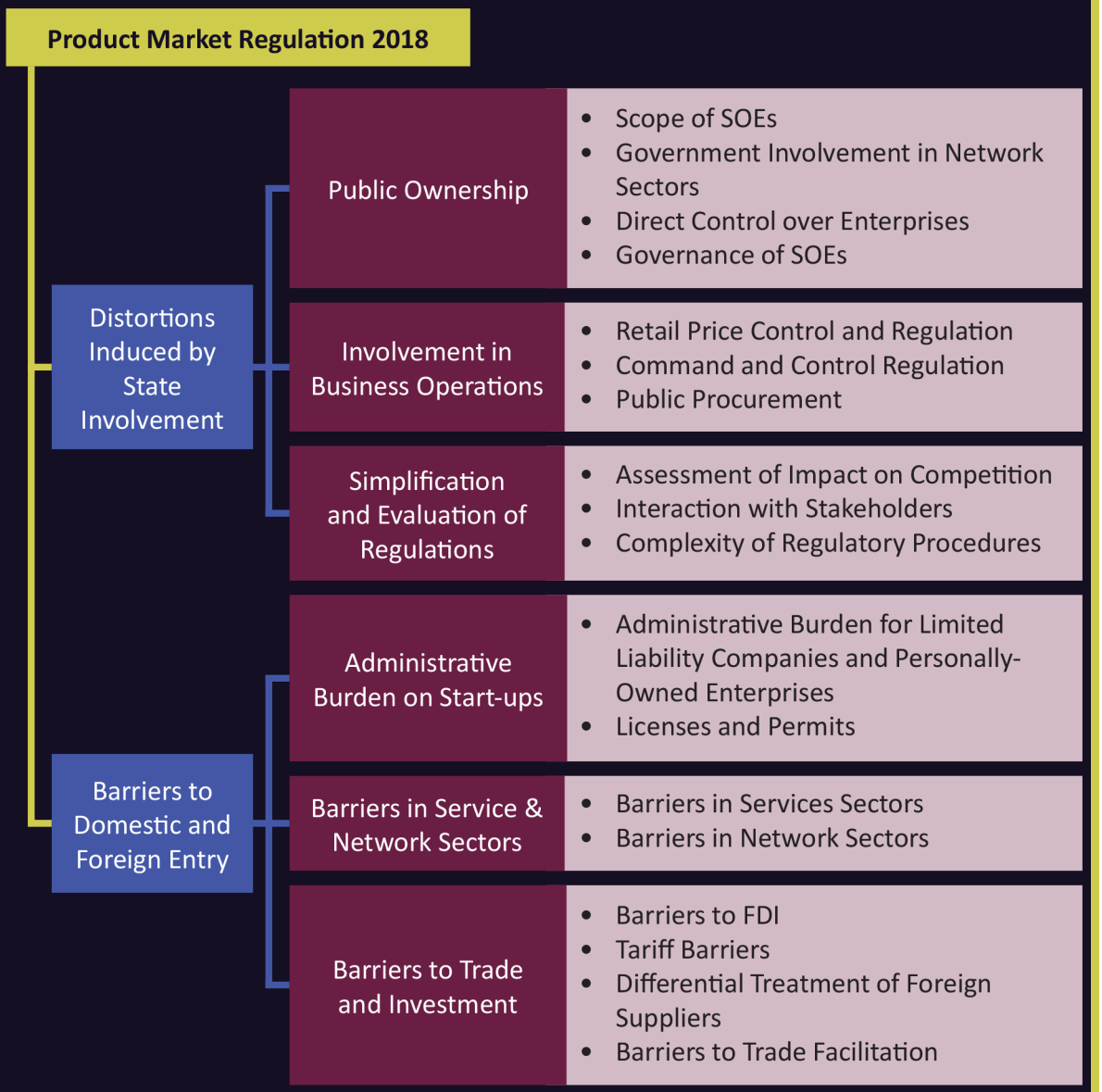
Box 2. The PMR framework

Product Market Regulation (PMR) indicators form a comprehensive and internationally-comparable set of indicators. The PMR measures the degree to which policies promote or inhibit competition in areas of the product market where competition is viable. PMR data

captures: i) laws and regulations at the national level; ii) laws, regulations and market outcomes in key sectors (telecommunications; electricity; gas; rail, road, maritime and air transport; retail; professional services); and iii) economy-wide policies (e.g., price controls, antitrust exemptions, quality standards).

The PMR tool is composed of two sub-indicators – "distortions induced by State involvement" and "barriers to domestic and foreign entry" - with various intermediate and low-level indicators as detailed in the figure below. Higher scores reflect more restrictive regulation or a regulatory framework least conducive to competition.

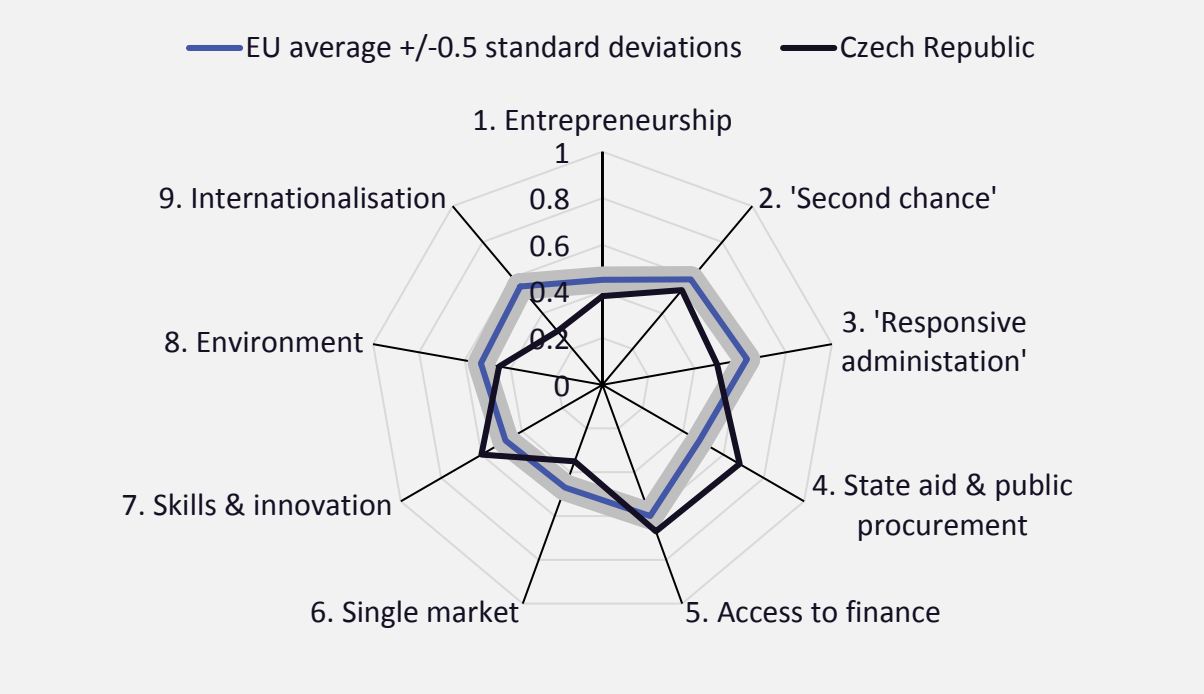
Structure of economy-wide PMR 2018



Source: https://www.oecd.org/economy/reform/indicators-of-product-market-regulation/

The extent to which product market regulations are restrictive to competition in the Czech Republic is equally driven by distortions induced by State involvement and barriers to domestic and foreign entry. The 2018 PMR data shows that distortions related to State involvement in the economy account for 52.5% of the overall PMR score for the Czech Republic, while barriers to domestic and foreign entry respond for the remaining 47.5%. Moving one layer further, public ownership (particularly governance of SOE) is the main driver to explain the overall burden related with State presence in the economy, while administrative burdens on startups (particularly licenses and permits) emerges as the key subcomponent underpinning the restrictions associated with barriers to domestic and foreign entry.

Figure 29. SBA scores for Czech Republic, 2018



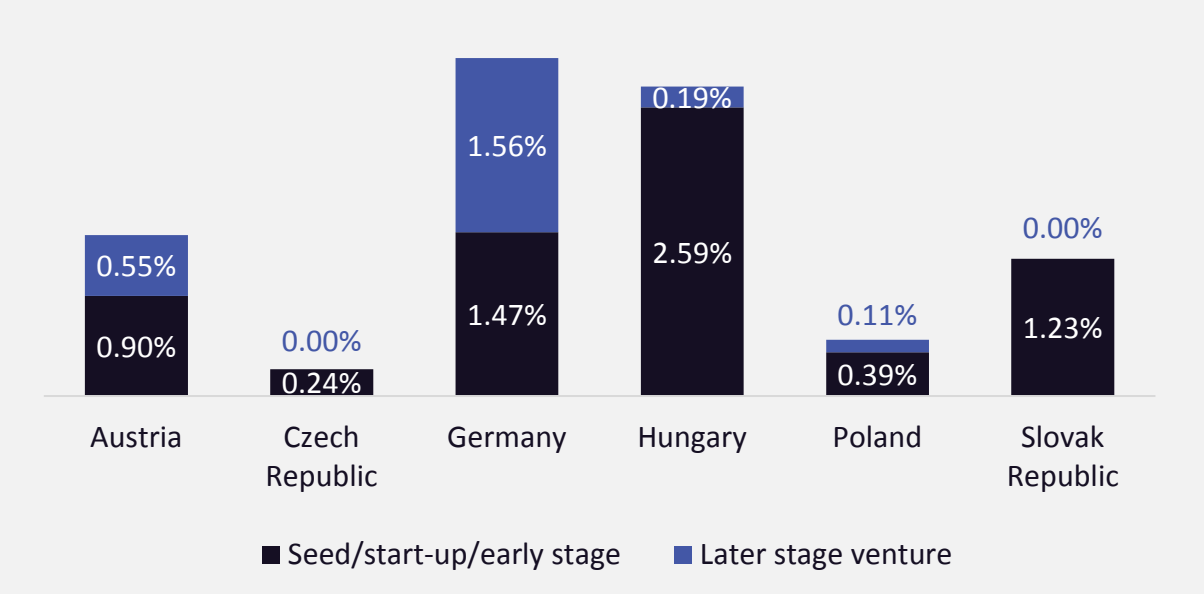
Source: European Commission (2018b).

An assessment focused on the maturity of SME policies in aligning with Small Business Act (SBA) principles shows key policy strengths and weaknesses in the Czech Republic. SBA strengths, which are better than the EU average, include access to finance, skills and innovation, and state aid and public procurement. The country however ranks below the EU average in entrepreneurship, responsive administration, single market and internationalization (Figure 29). As a result, Czech Republic's overall score is at par with the EU average. European Commission (2018b) attributes this performance to consistency in implementing the SBA principles, such as the adoption of 13 policies that address half of the policy issues under the SBA. These policies include the use of the European Social Fund to fund digital skills training for SMEs, and supporting research, development and innovation

among SMEs. Weak performance, particularly in entrepreneurship, is linked to SBA recommendations that are unaddressed, such as the lack of support targeting women, youths, and the unemployed. Weaknesses in the responsiveness of public administration to SME needs are linked to complex administrative requirements for doing business. Finally, internationalization of SMEs is Czech Republic's weakest SBA principle, as the country has among the lowest percentage of SMEs in the EU with extra-EU goods imports and exports (European Commission 2018b).

Despite strong performance in conventional bank financing, risk financing for innovation remains an area that requires improvement. European Commission (2018b) attributes this relatively strong performance of access to bank finance for SMEs to high liquidity (i.e., willingness of Czech banks to lend to SMEs), low rates of rejected loan applications (third lowest among all EU countries), as well as decreasing borrowing costs for small loans relative to large loans. However, the availability of risk financing, an important dimension of resource allocation (especially for new firms/startups and innovative companies) remains underdeveloped. For example, venture capital as a percentage of GDP is lowest among peers (Figure 30).

Figure 30. VC investment as percentage of GDP

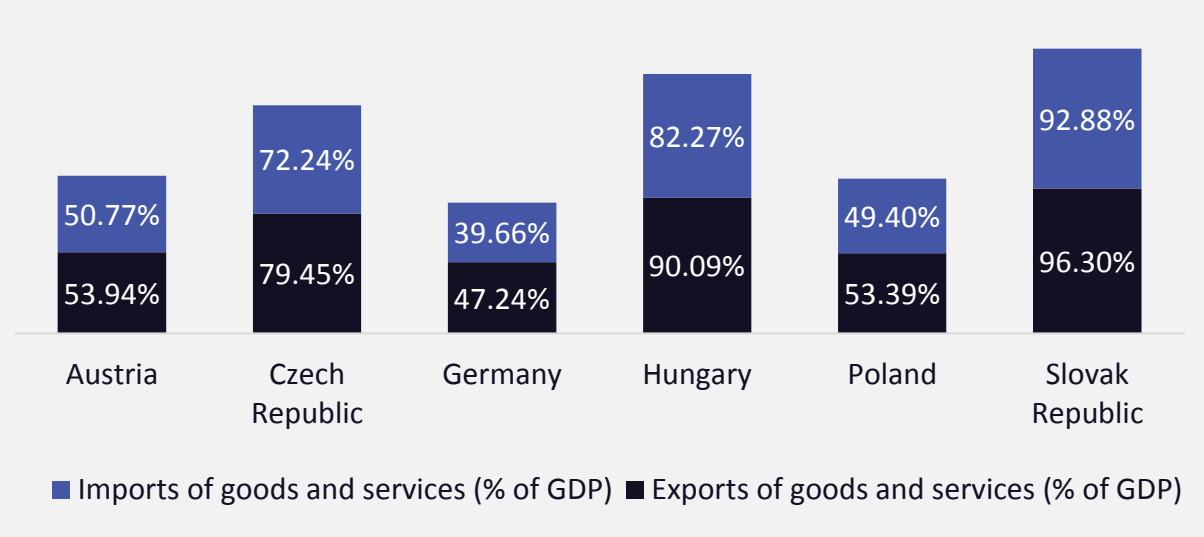


Source: OECD (2016).

Czech Republic's open trade regime encourages efficient production and knowledge transfers. Exports and imports of goods and services were larger as a share of GDP in 2017 than in Austria, Poland and Germany, with the bulk of trade carried out with other EU countries (Figure 31). Access to imports among firms is an important channel for technology transfer and thus affects firm capabilities for I&E (Figure 4, above, indicates that Czech Republic has a relatively high foreign value added in exports, which showcases the importance

of imports for export). Czech firms' access to imports is supported by the very low time and cost involved in importing and exporting, since document and border compliance for trade with Czech Republic's EU neighbors and main trading partners is essentially null (World Bank Doing Business 2019). However, as documented in the section on trade above, SMEs have enjoyed only limited benefits from the degree of openness of the Czech economy, as only a small share of SMEs participates in either exporting or importing (refer to Figure 5). Thus, SMEs have not reaped the potential benefits of trade openness in expanding I&E activities. Given that micro firms and SMEs comprise the largest share of enterprises, Czech enterprises' role as an indirect exporter with partner countries is likewise muted, given a relatively weak domestic value added embodied in the exports of partner countries (refer to Figure 4).

Figure 31. Trade openness: Exports and imports as share of GDP in 2017



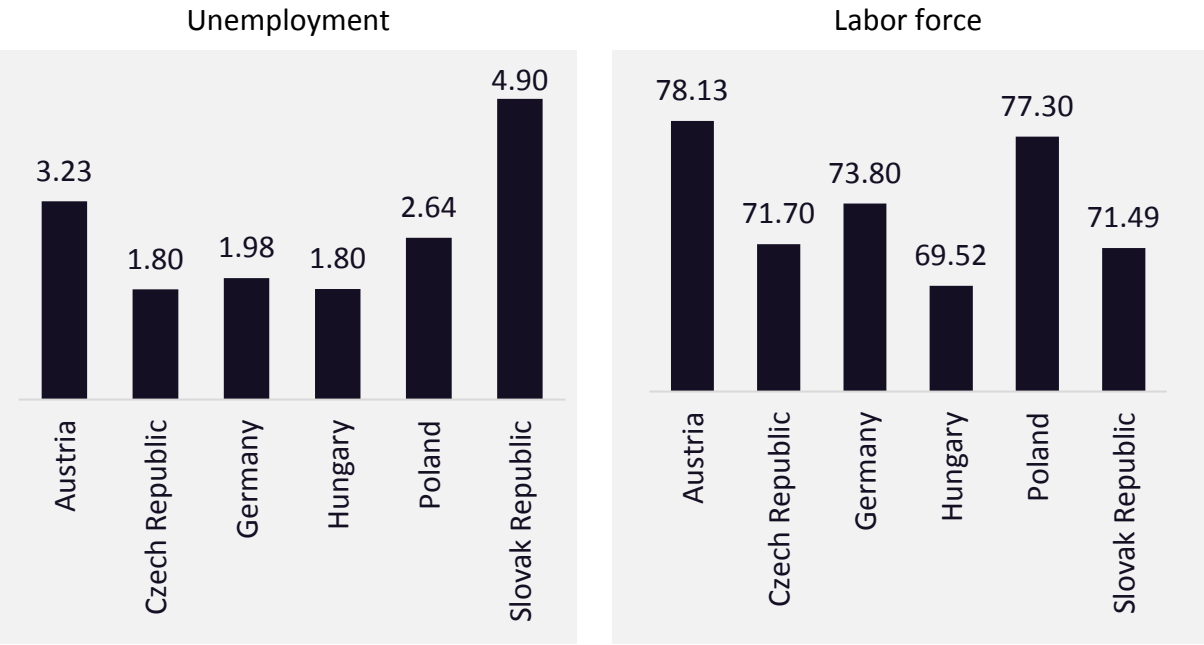
Source: World Bank WDI.

Foreign direct investment (FDI) inflow is another channel to transfer knowledge and technology from foreign to domestic enterprises through spillover effects. While Czech Republic has received substantial FDI to fuel integration into GVCs and contribute to the economy, spillovers to the local economy are limited. During the last 20 years, huge FDI inflows (attracted by low labor costs) have been key for integration of Czech Republic into GVCs, particularly EU value chains (OECD July 2018). Today, foreign firms account for about one-third of jobs generated in the country, as well as two-thirds of manufacturing value-added and 90 percent of the automotive industry's value-added. Foreign firms also have higher labor productivity and turnover per worker. Yet, there is limited spillover to the local economy: the difference in labor productivity between foreign and domestic firms has not fallen since 2008. A substantial number of domestic firms still generate low value-added products and services in GVCs (European Commission DG Research & Innovation 2019). Technology transfer from FDI (as a channel for productivity spillovers) is likewise weak: only 16 percent of Czech manufacturing firms used technology licensed from foreign companies in

2013, compared to 21 percent in Poland and 35 percent in Slovak Republic (WBES 2013). Moreover, as the technologies developed under I4.0 are likely to increase multinationals' ability to profitably re-shore production, reliance on FDI inflows may not be sustainable (IZA 2019).

Czech Republic had very low unemployment rates during the recent economic boom, but firms complain about the lack of skills. The unemployment rate was 2.2 percent in 2018, the lowest in the EU (in 2018, unemployment among EU-28 countries averaged 6.8 percent). Among those with advanced education, the unemployment rate was even lower (1.8 percent), the lowest rate among peers (Figure 32). Labor shortages are increasingly becoming a constraint on growth, with increasing job vacancies and reported difficulties in recruiting workers (OECD July 2018). Part of the reason is a small pool of qualified workers—the share of people with advanced education in the workforce in the Czech Republic (72 percent) is lower than in peers such as Austria, Poland and Germany, for example (Figure 32). Moreover, the stock of R&D personnel of about 3,600 per million people is lower than in Austria (which is on the frontier at over 4,900). Also, 54.7 percent of R&D personnel are in business enterprises in the Czech Republic, lower than in Austria at over 70 percent (OECD 2017b). And, as pointed out above, SMEs face difficulties in competing with large firms for the best workers.

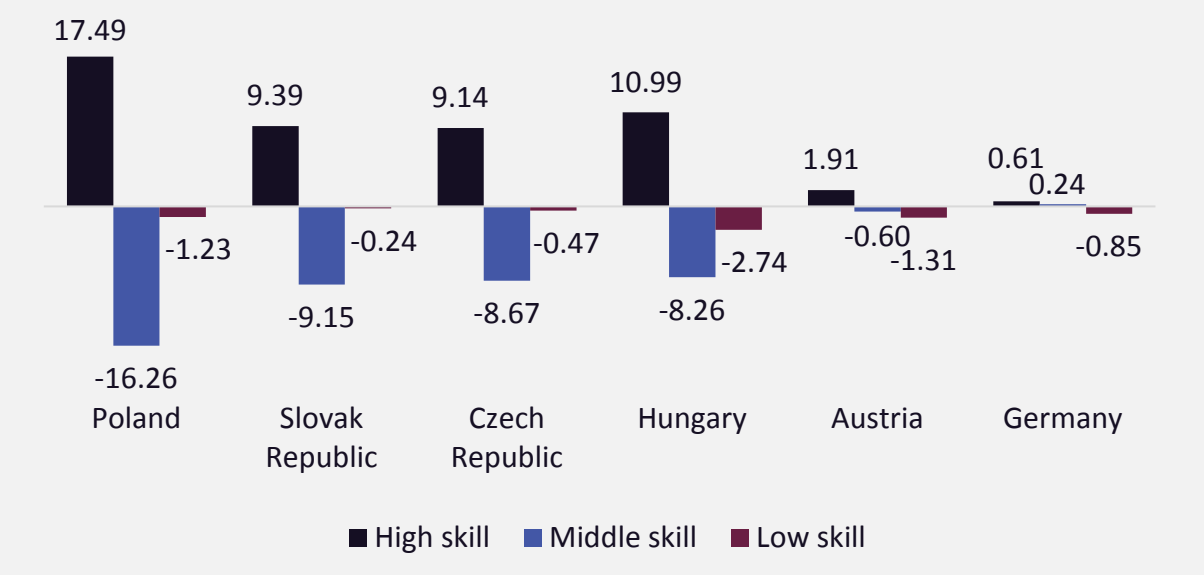
Figure 32. Unemployment rate for workers with advanced education and labor force with advanced education in 2017, %



Source: World Development Indicators.
Note: The unemployment rate for workers with advanced education is expressed as a percentage of the total labor force with advanced education (left). The labor force with advanced education is expressed as a percentage of the total working-age population with advanced education (right).

Another reason that lack of skills may constrain growth is a significant mismatch in skills between workers and business needs. These skills mismatches contribute to a relatively low level of labor productivity in the Czech Republic when compared to advanced economies (OECD July 2018)[25]. Using Programme for International Assessment of Adult Competencies' Survey of Adult Skills (PIAAC) data, Montt (2015) highlights the prevalence of mismatches between workers' fields of study and occupations across 22 participating countries. This mismatch is relatively high in the Czech Republic (38 percent of workers are in occupations that differ from their fields of study), higher than in Austria (28 percent) and Germany (26 percent), although comparable to Poland (41 percent) and Slovak Republic (38 percent). Despite this skills mismatch, there is no systematic assessment of labor market needs (European Commission 2018b).

Figure 33. Projected change in shares of total employment, percentage points, 2015-2025



Source: European Centre for the Development of Vocational Training (2017), Forecasting skill demand and supply, as cited in OECD (2018b).

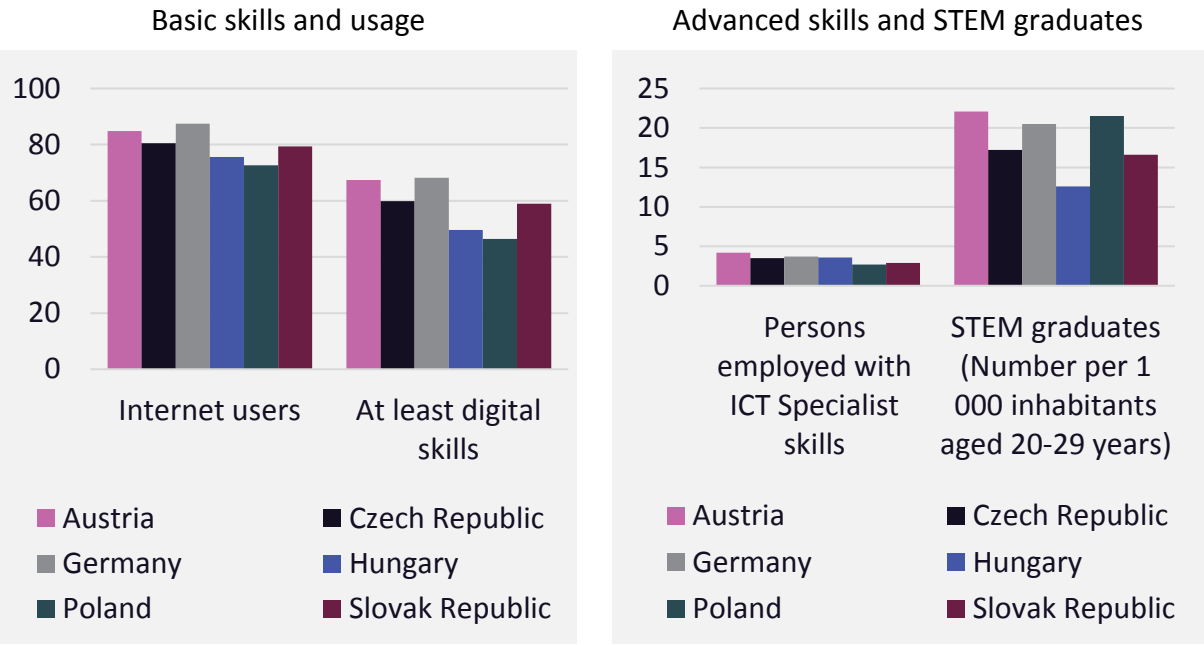
The gap skilled labor may grow—in recent years, Czech labor demand has shifted towards higher skilled employment and this is expected to continue. OECD (July 2018) highlights that employment has shifted from medium-skilled towards high-skilled jobs since the 1990s under the backdrop of an expansion of services and rising GVC participation in the manufacturing sector. Changes in the industrial structure, especially the increase in automotive production and in mechanical and electrical engineering, were reflected in the rising share of high- and medium-high technology manufacturing enterprises, to 15 percent of manufacturing enterprises by 2014, comparable to the EU-28 average of 12 percent and Germany's 18

[25] Other reasons include weak translation of R&D into commercialized innovation products and process as well as the sizable low-skilled intensive manufacturing sector.

percent (Eurostat). Expansion is likewise expected in manufacturing, IT and business services, and thus demand for highly skilled workers is likely to increase. The share of high-skilled employment in total employment is expected to increase by 9.1 percentage points between 2015 and 2025 in the Czech Republic (Figure 33). Given trends shaping I4.0 (e.g., higher demand for skilled labor), this makes it imperative for the Czech labor market to be better prepared to leverage automation and other I4.0 technologies.

Digital skills development and the sustainable supply of digitally skilled labor are critical for taking advantage of the I4.0 revolution.[26]. Yet, Czech Republic ranks low in investments in advanced digital skills. Competencies in both basic and advanced digital skills enable faster technology adoption and diffusion. DESI measures the human capital dimension of the digital economy based on basic skills, internet use, advanced skills and development. In 2017, 81 percent of people in the Czech Republic were internet users (equal to the EU-28 average), and 60 percent had at least basic digital skills (slightly higher than EU-28 average of 57 percent). In terms of advanced skills, 3.5 percent of employed workers were ICT specialists (slightly lower than EU-28 average of 3.7 percent and lower than Austria at 4.2 percent). The number of STEM graduates per 1000 inhabitants aged 20-29 years is 17.2, lower than EU-28 average of 19.1 and lower than Austria at 22.1. Overall, advanced digital skills are particularly weak in the Czech Republic compared to advanced economy peers (Figure 34).

Figure 34. Basic skills and usage and advanced skills and STEM graduates



Source: DESI (2018).

[26] For further discussion on this, see Aridi, Anwar; Querejazu, Daniel Enrique. 2019. Manufacturing a Startup: a case study of Industry 4.0 development in the Czech Republic. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/498571562044573589/Manufacturing-a-Startup-a-case-study-of-Industry-4-0-development-in-the-Czech-Republic.

Demographic trends in the Czech Republic are likewise shaping the stock of labor. The working age population is expected to decrease six percent by 2030 and 21 percent by 2050. Currently, higher labor force participation rates have offset the decline in the working age population (IMF 2018). Yet, status quo measures are insufficient to limit labor shortages. For one, participation rates have not reached EU maximum levels for young women (IMF 2018). That is, available skills of women are not maximized in the labor market—about 60 percent of graduates in mathematics and natural sciences are female, but a significant portion of these skillsets are unused: one-third of female STEM college graduates aged 25-34 described themselves as being inactive in 2016 (OECD July 2018). Weak female labor participation rates may be due in part to long parental leave rules, a preference for home care instead of formal childcare, and lack of policies that enable the re-entry of women into labor market (e.g., job flexibility) (OECD July 2018). Other factors affecting female labor force participation includes the gender pay gap (second highest in the EU), lack of public childcare, and a high relative tax rate on second earner income[27] (IMF 2018). For the latter, IMF (2018) estimates that reducing the relative tax rate on second earners via removal of the non-working spouse tax credit would increase female labor force participation by 6 percentage points.

While Czech management practices are stronger than CEE peers, catchup is needed to reach the managerial performance of select high-income countries, especially among SMEs. This analysis is based on Fall and Lewis (2017), which considers an array of measures related to managerial practices and quality. Weaknesses in management among Czech firms include areas such as reliance on professional management and willingness to delegate authority, for example. Within firms in the Czech Republic, large firms tend to have better managerial quality than SMEs (proxied by mean literacy proficiency scores of managers). Further, managers in Czech large firms even have better management performance than CEE and high-income peers using this measure (Figure 35).

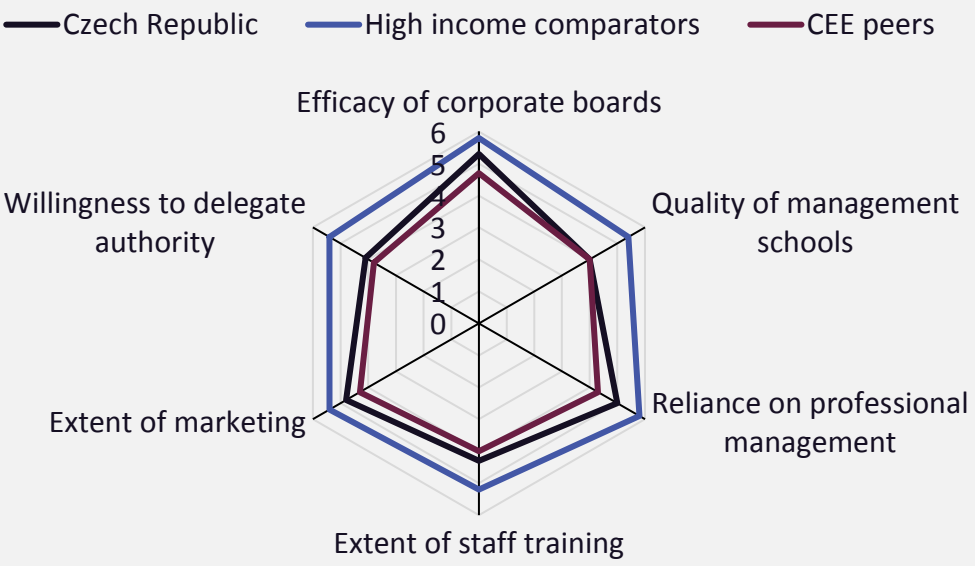
Investments in management competencies can improve productivity growth. For example, Bloom et al. (2015) show that managerial quality is correlated with firm growth in India. Also, Adalet McGowan and Andrews (2015) find that boosting managerial quality to the level of the OECD frontier (Finland) would increase OECD countries' labor productivity by about 2 percent and reduce the probability of skill mismatch by about 5 percent. One channel is the ability of better-managed firms to promote adoption and diffusion of best-practice knowledge and to hire and retain talented workers. Using adoption of international quality certifications as a measure of management quality shows Czech Republic possesses more registered ISO 9001[28] certificates per capita than any of its peer countries in 2017 (Figure 36).

[27] This is defined as the tax rate of the second earner divided by tax rate of the first earner in a childless household.

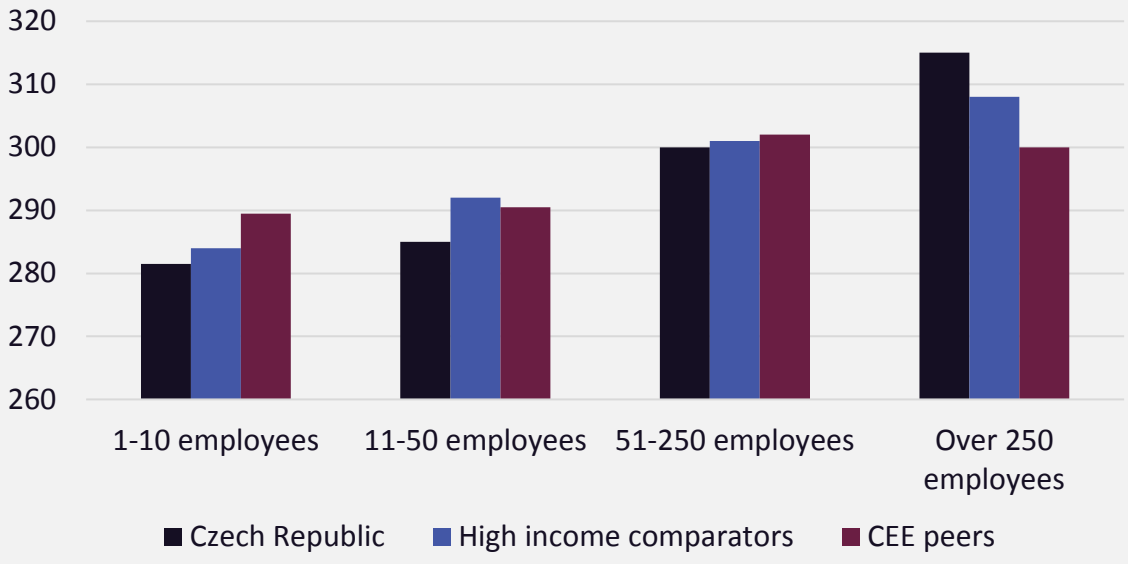
[28] ISO 9001 is an international standard that specifies requirements for a quality management system. Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements.

Figure 35. Indicators of management quality and practices and average literacy proficiency scores of managers

Management quality and practices, 2015, scores range from 1 (lowest) to 7 (highest)

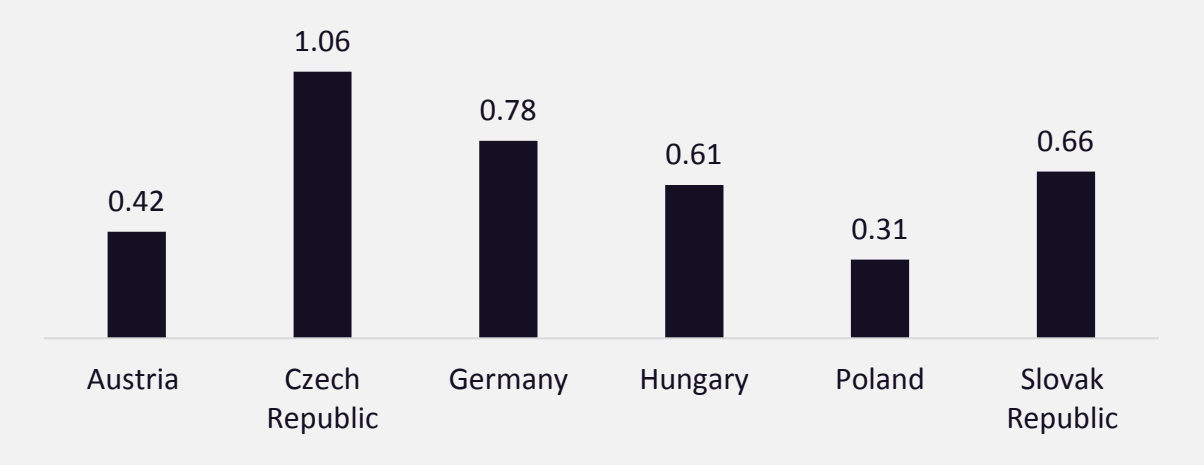


Average literacy proficiency scores of managers by size of firm



Source: Fall and Lewis (2017).
Note: For management quality graph high income comparators are Austria, Belgium, Denmark and Sweden; CEE peers are Estonia, Hungary, Poland, the Slovak Republic and Slovenia; "Reliance on professional management" takes the highest value (7) when senior managers are professional managers who obtained their position based on merit and qualifications and the lowest value (1) when senior management are mostly family and friends; Calculations based on World Economic Forum (2015), The Global Competitiveness Index Historical Dataset 2005-2015. For average literacy of managers graph CEE peers are Estonia, Poland and the Slovak Republic; high income comparators are Austria, Belgium, Denmark and Sweden. Averages for country groupings are unweighted; OECD calculations based on the Survey of Adult Skills (PIAAC) (2012).

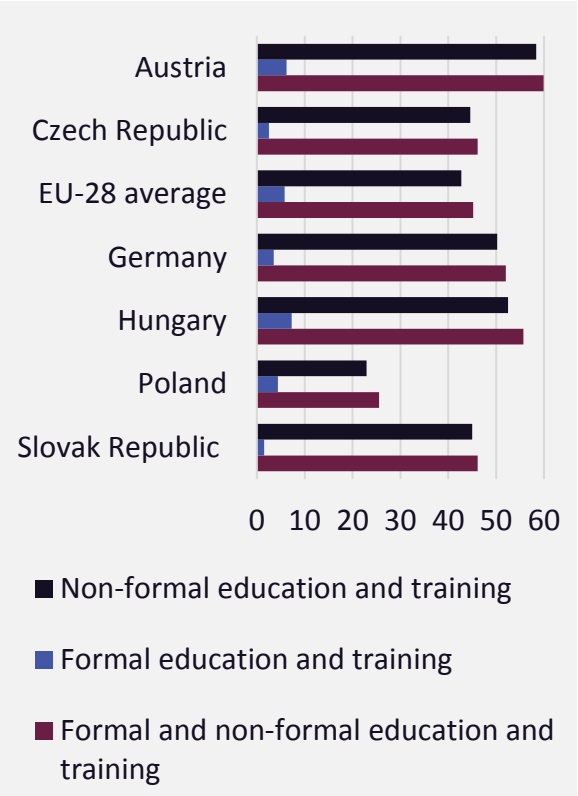
Figure 36. Number of registered ISO 9001 certificates per 1000 population in 2017



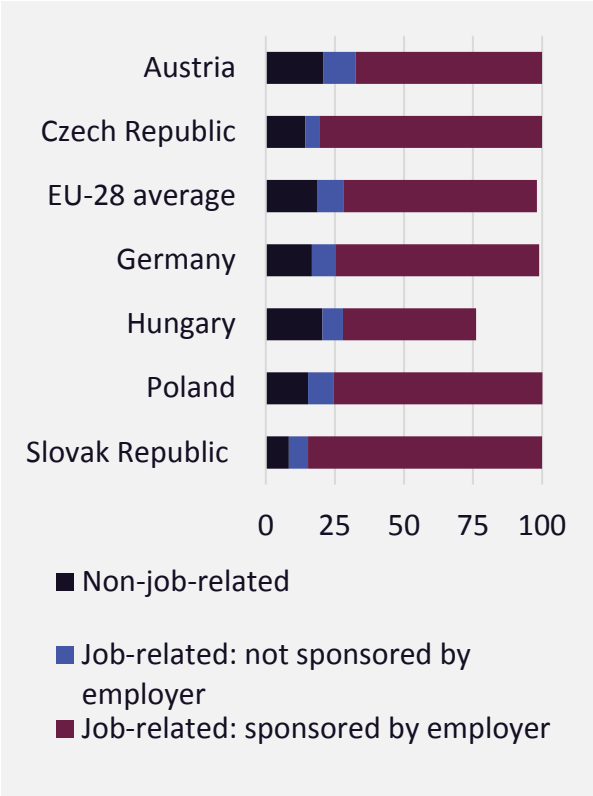
Source: ISO Survey of Management System Standard Certifications and World Bank WDI.

Figure 37. Participation rate in education and training (last 12 months) by type and distribution of non-formal education and training activities by type

Participation rate in education and training by type



Distribution of non-formal education and training activities by type



Source: Eurostat Adult Learning Statistics (2016).
Note: Participation rate in education and training is expressed in terms of the percentage of adults aged 25–64. Distribution of non-formal education and training activities is expressed as the percentage share of all non-formal learning activities of adults aged 25–64.

Investments in worker training can also contribute to productivity improvements, and such investments are high in the Czech Republic. Competent workers help firms meet changing business needs, address business issues, and help firms improve efficiency through innovative solutions. In the Czech Republic, 46 percent of individuals are engaged in lifelong learning (measured as those who participated in formal and non-formal education and training in the past 12 months). This is at par with the EU-28 average (45 percent), but lower than in Austria (60 percent) and Hungary (56 percent). Eighty-one percent of participants engaged in non-formal learning activities received support from employers. In fact, Czech Republic has the second highest participation rate in terms of on-the-job training, after Slovakia (85 percent) and higher than the EU-28 average (70 percent) (Figure 37).

2.5. Key Findings

This broad diagnosis of the innovation and entrepreneurship capabilities of the Czech economy reveal several key messages:

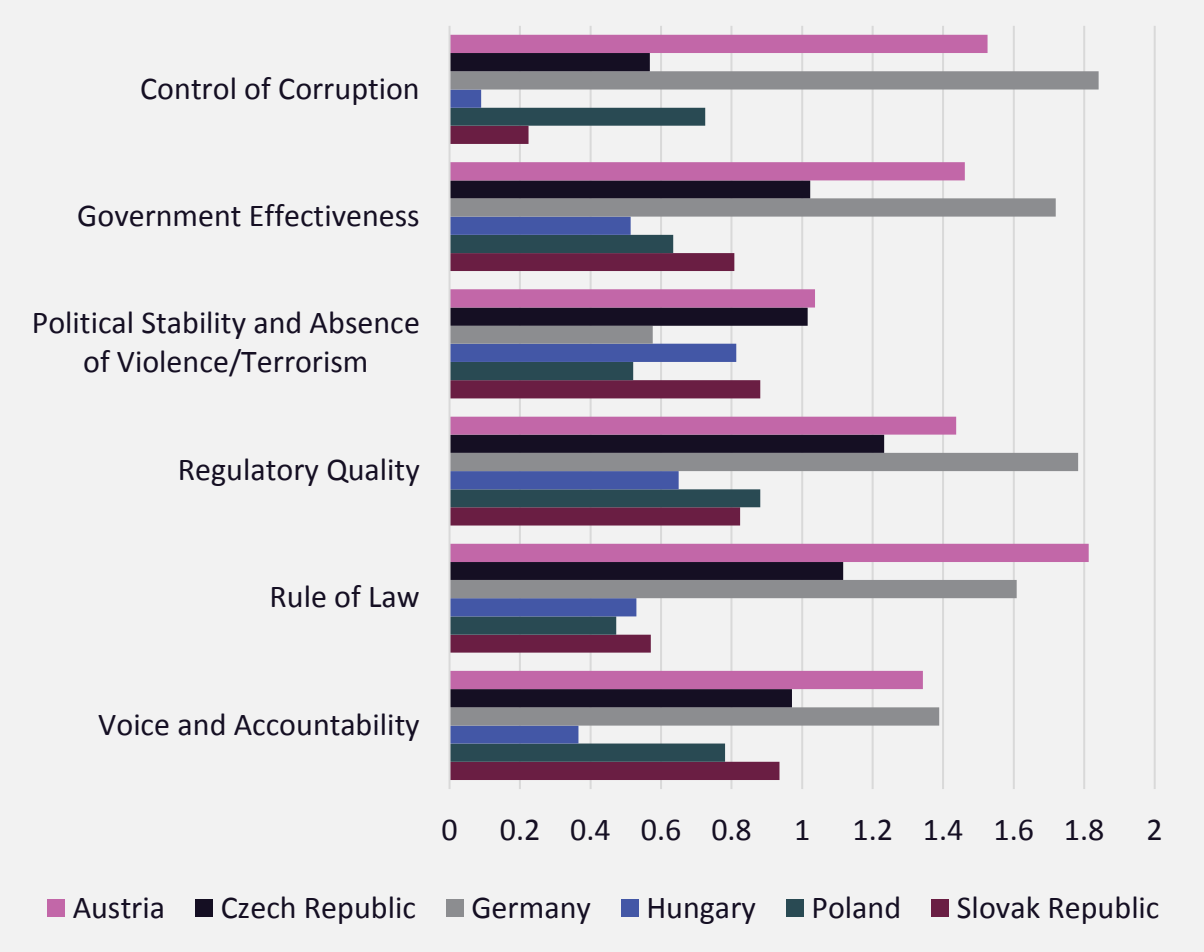
- Despite improvements in productivity in the past two decades, Czech Republic has yet to converge with more advanced peers such as Germany and Austria. Productivity improvements are likewise limited to large and foreign firms, particularly those located in the manufacturing sector. Productivity improvements are driven by capital deepening rather than TFP improvements, which are crucial in the long run.
- SMEs enjoyed value added growth from 2013 to 2017, but employment levels stagnated. Lack of employment growth is linked to labor shortages, as SMEs have to compete with large firms that are able to attract more talent through better pay and benefits. Overall, large firms enjoyed higher value added and employment growth rates during the same period.
- While exports show a high degree of economic complexity due to participation in key GVCs sectors (i.e., automotive, electronics), the country's GVCs participation is concentrated in the EU and primarily as a buyer of foreign inputs for re-exports rather than as a seller of inputs for further downstream processing. This indicates the importance of re-orienting GVC participation towards higher value-added production as well as diversifying exports outside EU markets. Further, SMEs participation in GVCs could be improved, given the currently low share of SMEs trading via exporting or importing and the low share of SMEs with extra-EU goods imports or exports.
- Czech Republic continues to rank as a moderate innovator. Innovation in terms of product, process, marketing and organizational innovation as well as R&D investments, however, is skewed towards larger firms, foreign firms, and those located in Prague (the capital). In general, SMEs have experienced either stagnation or declining innovation performance in recent years.

- SMEs are at a disadvantage when it comes to competencies in key innovation inputs such as technology adoption. While the country tends to perform strongly in terms of technological capabilities such as robot intensity, use of cloud computing, 3D printing, and e-commerce, SMEs lag large firms in these key I4.0 technologies.
- Overall, the country exemplifies strong investments in other innovation inputs, particularly in workers' on-the-job training, but not in improving management capabilities. Moreover, SMEs perform worse in managerial quality compared to large counterparts. Further, the country as a whole lags in advanced digital skills (e.g., skills in ICT and STEM), indicating the importance of increasing investments in this particular area. Firms complain about a lack of skills, while economic activity is expected to shift further towards higher skilled employment given I4.0. Investments in collaboration among SMEs is likewise relatively weak, indicating the need to improve collaboration to boost transfer and diffusion of knowledge.
- Business environment competencies in the Doing Business survey are generally strong, but there are some areas of weaknesses such as in starting a business, enforcing contracts, second chances (resolving bankruptcies), as well as removing competition barriers. Implementation of e-government services (with the hope of reducing administrative burdens and responding to SME needs) has likewise been limited. There is heterogeneity at the subnational level, indicating scope for smaller cities to learn from larger cities such as Prague (best performer) in easing regulatory burdens.
- Czech Republic's strong performance in access to conventional bank financing is offset by an underdeveloped risk financing environment. Yet, risk financing (especially for new firms/startups and innovative companies) is an important dimension of resource allocation processes.
- Apart from SMEs, some segments of the economy have likewise not benefited from recent productivity improvements. Women, youths and the unemployed have been left behind in participating in the economy. Against the backdrop of skills shortages, this indicates the importance of entrepreneurship in crowding-in these segments of the population.
- Given current trends in I4.0 and an aging population, productivity growth especially among SMEs will be crucial for long-term development.

3. SME POLICY FRAMEWORK

The governance framework for SMEs in the Czech Republic is complex and, in some aspects, weakened by fragmentation and overlap. Several central government ministries or agencies have a role in determining policies towards SMEs, and regional and municipal authorities may also participate in governance, depending on the region. This section describes the various institutions involved in SME policies at the central and regional level. It follows by providing an original analysis of the SME-support instruments used at the national level (93 instruments between 2013 and 2017, collecting 149 variables per instrument) and identifies key issues of concern. The section concludes with a formal cluster analysis of the instrument mix, which indicates a lack of coordination between agencies involved in supporting SMEs and overlaps in the focus of agency instruments.

Figure 38. World Governance Indicators in 2017



Source: World Bank (2017).
Note: Estimates give the country's score in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.

3.1. SME Institutions and Governance

Czech Republic ranks best in governance among former command economies but is behind advanced peers such as Austria and Germany (Figure 38). According to the World Governance Indicators, strong performance in governance dimensions include (i) control of corruption, (ii) quality of public services, civil service, and policy formulation and implementation (government effectiveness), (iii) political stability, (iv) government capacity to formulate and implement regulations that promote private sector development (regulatory quality), and (v) ability of citizens to participate in selecting their government (voice and accountability). This performance correlates well with Czech Republic's relatively good general Doing Business ranking, indicating that both the investment climate and current government competencies are enabling the development of the private sector. Nevertheless, further strengthening such competencies is needed to catch up with its advanced peers.

3.1.1. Government Stakeholders Responsible for SME Policies

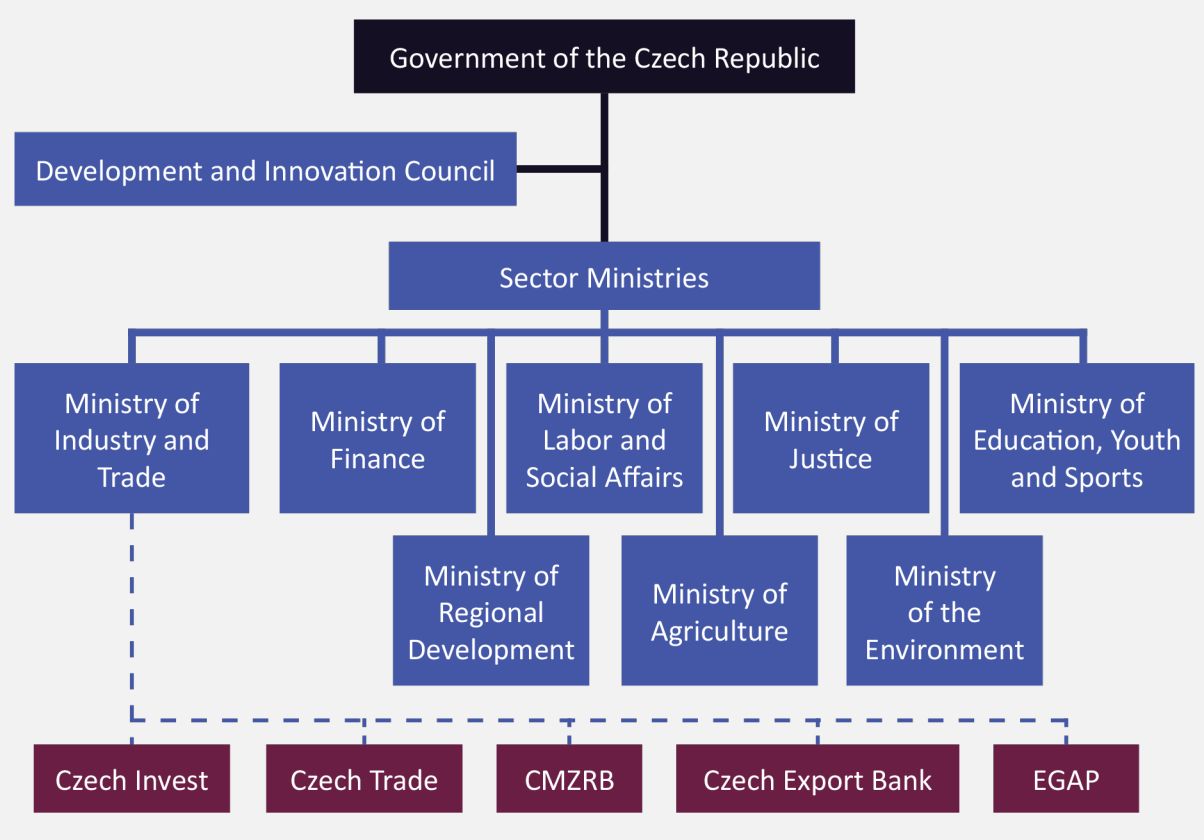
The SME governance system is spread across a number of ministries. At the state-level, the MIT coordinates SME policies, but the implementation of business support tools is fragmented among a wide range of ministries and other national institutions that oversee various SME-related issues.[29] This reflects the historical fragmentation of ministries according to sectors (e.g., industry, agriculture, education, etc.) in the Czech Republic and the associated fragmentation of agenda, tasks and financial support. MIT is the central government body for industrial policy, energy policy, trade policy in the context of the EU single market, as well as pro-export policy, business support and investment in manufacturing and industrial research and technology development, including the use of European funds in this area. The Ministry of Education, Youth, and Sports (MEYS) coordinates scientific research policies and international cooperation in research activities, such as supporting organizations in accessing the European Cooperation in Science and Technology (COST), European Research Coordination Agency (EUREKA), and H2020 projects.

Besides MIT, other ministries are responsible for related agendas, such as promoting social entrepreneurship (Ministry for Regional Development), training in companies (Ministry of Labour and Social Affairs) and more (e.g., Ministry of Agriculture). Another important agency is the Technology Agency of the Czech Republic (TACR), which encourages long-term cultivation of the innovation ecosystem and supports domestic and international cooperation and linkages among companies and universities, and targets technology transfer and

[29] For example, TACR is primarily the go-to agency for innovation activities, and MIT through CzechTrade tackles exports. This said, fragmentation across topics is not uncommon in other countries, which also tend to segment ministries/agencies in a similar manner. However, fragmentation in terms of lack of coordination across ministries/agencies in implementation of activities is a more serious concern. Czech Republic seems to face both types of fragmentation.

commercialization. The Research, Development and Innovation Council, a professional and advisory body, seeks to moderate and coordinate the activities of the main actors and stakeholders in the Czech research, development and innovation (R&D&I) system, among other initiatives. In recent months, this Council has developed a strategic framework for research, development and innovation (also called the Innovation Strategy of the Czech Republic 2019–2030), which aims to move the Czech Republic among Europe's most innovative countries. In addition to ministries and a technology agency, several state institutions have different competencies to support entrepreneurship at the national level (e.g., CzechInvest, CzechTrade, Czech-Moravian Guarantee and Development Bank, Czech Export Bank, etc.—Figure 39)

Figure 39. Current SME governance structure



Source: Own illustration.

To increase coordination among of the all actors involved (ministries, agencies, research organizations, institutions and banks), the Ministry of Industry and Trade has aimed to redesign horizontal cooperation through a system of assistance for all phases of the business cycle, ranging from innovation and development support. This system is intended to especially focus on supporting firms that produce and export higher value-added goods and services and participate in global value chains.

3.1.2. Other SME Actors and Stakeholders

Despite the existence of fragmentation and barriers at the national level, regional authorities (i.e., regional and city self-governments) have significantly strengthened their role in promoting and cultivating the business and innovation environment. Still, differences in performance persist,[30] and some regions, such as South Moravia, have managed to scale up bottom-up initiatives.[31] The following institutions constitute the backbone of the regional innovation system in most regions:

- The **regional authority** is the main institution of regional self-government that seeks to shape and coordinate innovation policy in regions. It oversees a significant budget and a sizable administrative body.
- **City town offices** come second in terms of financial resources and administrative powers and play an important coordinating role with the regional authority.
- **Regional innovation centers** are key intermediary institutions established in the majority of the regions. These centers manage a variety of projects supporting business innovation (e.g., South Moravia Innovation Centre - JIC).[32] The role of university-affiliated intermediaries (such as Centres for International Mobility, Regional Development Agencies or technology transfer centers) differs among regions. However, these generally lack effectiveness and play a limited role in the development of innovative businesses and the transfer of knowledge to enterprises.

Finally, coordination between regions (i.e., NUTS III regions have their own self-government systems) and state-level entities (e.g., MIT) is indirect and could be improved. While regions depend on transfers from the national government to implement national strategies, they have their local priorities and agendas which should be taken into account.

European institutions provide substantial support for SMEs in the Czech Republic, and reliance on EU funding is considerable. In general, there are three main sources of funding for SMEs. First, a sizeable amount of financial resources for SMEs comes from the EU structural funds (ESIF). Further, EU programmes directly managed by the European Commission (e.g., Horizon 2020) also provide money. Finally, SMEs are supported through national programmes. SMEs' reliance on external financial sources, primarily from Europe, is substantial and growing. Given the level of economic progress in the Czech Republic, the volume of EU-funded direct subsidies is expected to decline within a few years. This indicates

[30] CR Regional innovation systems suffer from several shortcomings – they are institutionally and organizationally thin and suffer from knowledge and cognitive lock-in (Blažek and Csank 2016).
[31] Blažek et al (2013), Květoň and Blažek (2018)
[32] The role played by these innovation centers have been increasing overtime. For example, JIC provides a range of services to actors of the regional innovation system and prepares and implements projects financed by the State, structural funds of the EU and JIC's own activity.

possible existential problems for companies that do not prepare for a decline in business support.

3.2. Policy Aspirations, Agenda, and Programmatic Rationale

The fragmentation of responsibilities related to SMEs among ministries has influenced the development of a large number of strategies in the Czech Republic. There is often no obvious hierarchy among strategies (i.e., no indication whether one strategy is outweighs or governs another). In most cases, ministries provide comments on strategies developed by other ministries following the intersectoral comment procedure, and most are discussed in working groups comprised of representatives of various institutions. Because strategies are not legally binding, their benefits may be limited in the long run. Strategies related to SME support include the Small and Medium Enterprises Support Strategy 2014 – 2020, Concept for the Support of SMEs, Regional Development Strategy of the Czech Republic, Export Strategy, International Competitiveness Strategy, National Reform Programme, State Energy Concept, Strategic Framework of Sustainable Development of the Czech Republic, among others. A summary of these strategies is provided in Annex 4.

Czech Republic strategies generally lack measurable goals and suffer from implementation issues. Further, the implementation part of strategies are often complex, implementation tends to lack strong political support, and commitments from key actors are often missing. Thus, strategies are unlikely to have much of an impact. Moreover, many strategies have an excessive emphasis on the analytical component of the strategy, with little room devoted to elaborating how a strategy can be implemented. Finally, a fundamental and frequent mistake is failure to link the implementation part with the institutions' budget and time frame. Therefore, options for implementation are limited.

Nevertheless, Czech Republic's SME Support Strategy 2014-2020 appears focused on addressing key SME bottlenecks. The Czech Republic government developed SME Strategy 2014-2020 as a comprehensive strategy for enterprise development funded by the state budget, Operational Programme Enterprise and Innovations for Competitiveness (OPEIC) under the EU cohesion policy, and EU programs financed directly from EU budget and implemented by the European Commission. This SME Strategy identified the following priority areas:

- Enhancement of the business environment
- Development of consultancy services and education for business
- Development of enterprises based on support for R&D and innovation
- SME internalization support

- Sustainable energy management and development of energy innovations[33,34]

Based on the above priority areas, there are specific SME policy areas that are left unaddressed by the Strategy. Some challenges revealed by the country needs analysis that are currently unaddressed in the SME Strategy 2014-2020 warrant closer scrutiny for subsequent iteration of the country's SME strategy.

- **Business environment:** There remains issues related to second chances, particularly in reducing insolvency procedures and costs for entrepreneurs. Specifically, these issues include: ineffective measures to facilitate business transfers due to generational change, lack of equal treatment for honest bankrupt entrepreneurs, lack of 'fast-track' procedures to enable entrepreneurs to move on faster from bankruptcy processes, and lack of early warning mechanisms to potentially avert bankruptcy (European Commission 2018b).
- **Access to finance (risk financing):** Despite availability of bank financing programs (debt side), there is a lack of non-bank financing sources on both debt and equity side (e.g., venture capital, business angel financing).
- **Human capital for I4.0:** Improving I4.0-related skills (e.g., advanced digital skills and managerial skills) is a missed opportunity in SME Strategy 2014-2020.
- **Collaboration in innovation:** Industry-university collaboration remains weak, thus limiting knowledge transfers between knowledge providers and businesses, especially SMEs. Moreover, technological and knowledge spillovers from FDI remain limited.
- **SME internationalization:** Exports and GVC participation remain oriented towards regional value chains, perhaps missing opportunities for integration beyond the EU single market. SMEs have not significantly benefited from trade integration, given the low share of GVC-oriented SMEs.

The goals of various SME-related strategies are not closely aligned with SME policy needs for productivity growth in some areas, such as boosting human capital (e.g., managerial competencies) and I4.0 technology adoption and diffusion (Table 1). Goals mentioned in strategies do not systematically cover key SME productivity areas, particularly the need to improve management practices. Although the Industry 4.0 initiative emphasizes business R&D, there is a lack of emphasis on adoption and diffusion of I4.0 technologies. Yet given Czech Republic's level of development as a 'moderate' innovator, coping with I4.0 trends will require both invention through R&D, as well as technology adoption. Thus, some policy needs are not addressed by strategies to foster productivity growth and cope with emerging structural trends. Nevertheless, strategies and policy needs to support productivity growth are closely aligned in some areas. For example, the Export Strategy of the Czech Republic

[33] Examples of support measures include modernization of existing facilities, use of waste energy in industrial processes, energy efficiency improvements through introduction of combined heat and power generation. How this priority area is correlated to country needs and current policy mix is not a focus of this report.
[34] An analysis of energy and energy efficiency in the Czech Republic can be found in Annex 6.

2012-2020 highlights the importance of diversifying exports outside the EU as well as value chain upgrading among exporters as key priority areas.

Table 1. Linking objectives of current strategies and policy mapping

Relevant Strategy	Responsible Institution	Specific goals (as mentioned in the strategy) related to the objective
Research excellence		
Innovation strategy 2019-2030	The Government Council for Research, Development and Innovation (CRDI)	• To increase R&D spending • To support protection of intellectual property • To support the most prospective centres of research infrastructure
Technology transfer and science-industry collaboration		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	• To assist in the search for business partners and technology cooperation partners in the identification and anticipation of new trends and tendencies of development • To support cooperation between small and medium-sized enterprises and higher education institutions
Business R&D		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	To boost competitiveness including an increase in private expenditure on research, development and innovation
Industry 4.0 Initiative	The Ministry of Industry and Trade	• To strengthen applied research funding • To establish clear research priorities as a coordinating role for the state • To increase society-wide preparedness to implement Industry 4.0 oriented research • To raise awareness of the optimal use of the intellectual property system
Strategic Framework Czech Republic 2030	Office of the Government of the Czech Republic, Department of Sustainable Development	• To support the shift of the economy towards higher positions in the international division of labour and the international value chain • To support innovative enterprise activity, based mainly on the results of domestic R&D and cooperation between the academic and business sectors

Relevant Strategy	Responsible Institution	Specific goals (as mentioned in the strategy) related to the objective
OPEIC 2014–2020	The Ministry of Industry and Trade	• To raise the number of businesses capable of extending the technological boundaries of their industry • To develop entrepreneurship and lower-order innovation
Technology adoption/diffusion		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	• To reduce energy and material requirements in the business of SMEs • To reduce the energy requirements per unit of output while keeping the long-term stability and availability of energy to the business sector • To reduce the dependence of the Czech economy on imports of energy commodities, reduce the consumption of primary fossil energy sources, and support entrepreneurs in using renewable energy sources (RES) • To boost the competitiveness of SMEs through supporting the development of progressive ICT improvements in enterprises
OPEIC 2014–2020	The Ministry of Industry and Trade	• To shift towards an energy-efficient, low-carbon economy, mainly through improving the energy efficiency of the business sector • To facilitate the development of entrepreneurship, services and access to government services by means of high-speed Internet access
Digital Czech Republic 2013 – 2020	Ministry of Industry and Trade, the Ministry of Labor and Social Affairs, the Ministry of Culture and the Czech Telecommunication Office	• To strengthen the digital economy with an emphasis on self-regulatory mechanisms • To support the development of high-speed access networks to the Internet • To increase ICT accessibility for all, regardless of location, social status or disability, and promote lifelong learning to enhance digital literacy
Management practices		
n/a	n/a	n/a

Relevant Strategy	Responsible Institution	Specific goals (as mentioned in the strategy) related to the objective
Access to finance		
National Reform Programme 2018	Office of the Government of the Czech Republic	To provide targeted support for SMEs in three priority areas: fostering of a business environment, direct SME support, and improvements in the use of financial resources and labour resources
Export promotion		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	• To provide information about foreign markets, the application of technologies to those markets, the possibilities of export funding and insurance, the services provided by the export support network and the Enterprise Europe Network • To support participation in specialized trade fairs and exhibitions abroad, incoming missions, foreign trade missions in the presence of Czech political representatives and other specialised networking activities abroad
2012-2020 Export Strategy of the Czech Republic	The Ministry of Industry and Trade	• To diversify exports to countries outside the EU • To shift Czech exporters to higher value-added segments and industries in the value chains • To make maximum use of the positive synergies arising from the different pro-export activities of the state and the savings generated by the complementarity of the activities, an efficient coordination and cooperation of all stakeholders
Skills formation		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	To enhance the business environment, the development of consultancy services and education for business
Entrepreneurship		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	To reinforce of the position of SMEs in the Czech economy and improve the competitiveness of SMEs in the European and global context

Relevant Strategy	Responsible Institution	Specific goals (as mentioned in the strategy) related to the objective
Innovation strategy 2019-2030	The Ministry of Industry and Trade	To support Czech companies, spin-offs and start-ups, both for academic research and for the natural needs of businesses
Improving business regulatory environment		
National Reform Programme 2018	Office of the Government of the Czech Republic	To provide targeted support for SMEs in three priority areas: improving the business environment, direct SME support, and improvements in the use of financial resources and labour resources
Linkages between domestic and foreign firms		
SME Support Strategy 2014-2020	The Ministry of Industry and Trade	To assist in the search for business partners and technology cooperation partners, and in the identification and anticipation of new trends and tendencies of development

Source: Authors' elaboration.

3.3. Characteristics of the SME and Entrepreneurship Policy Mix

The Czech Republic has introduced various instruments to support a wide variety of SME activities. This section analyzes instruments managed at the national level in terms of the source of funds, the kinds of instruments used, their main goals, and the types of firms and sectors targeted. The objective is to provide an overview of the instruments, analyze their cohesiveness, and identify issues of concern. The section outlines the major characteristics of the instruments, followed by a cluster analysis that groups the instruments according to various criteria. The cluster analysis indicates a lack of coordination between agencies involved in supporting SMEs and overlaps in the focus of agency instruments.

The SME and entrepreneurship portfolio mapping exercise provides the basis for evaluating the coherence between SME policy needs and the composition of the portfolio of support instruments. The mapping covers instruments that were operational during the 2013 to 2017 period and that were managed at the national level (national instruments with a regional focus also are included). Based on the following criteria for including SME support instruments, a total of 93 instruments are mapped:

- Instruments that directly support SMEs, whether in part or in whole (through at least one component) and use public budget (i.e. from government or international development agencies);
- Instruments that indirectly support SMEs through public inputs (e.g., provision of access to information services);
- Instruments that support creation and survival of new ventures and entrepreneurship (e.g., supporting potential entrepreneurs via incubators/accelerators housed in public universities, social entrepreneurship);
- Instruments that support applied research or research launched with a commercial orientation and/or for promoting business innovation (in cases where instruments focus on science, technology, and innovation).

The policy mix assessment required the creation of a matrix containing detailed information about each SME support instrument included in the scope of the analysis. A total of 149 variables were collected per instrument along 18 categories:

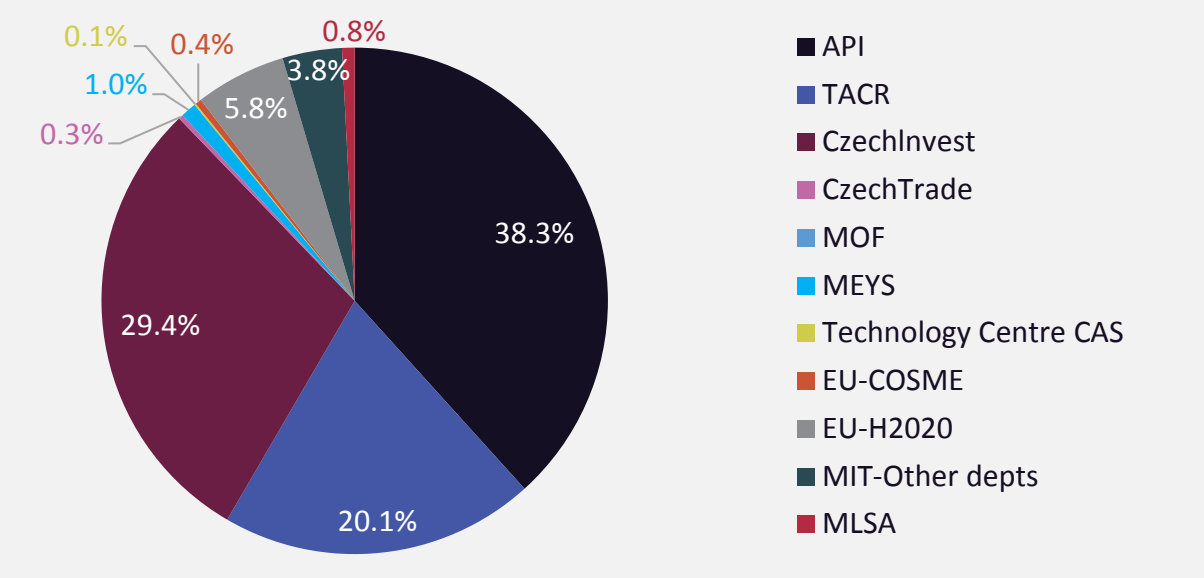
- General (8)
- Economy/societal outcomes (8)
- Instrument objective (13)
- Type of support (2)
- Mechanism of intervention (19)
- Co-financing (2)
- Grant usage (27)
- Type of regulatory instrument (9)
- Sectoral orientation (7)
- Geographic coverage (4)
- Beneficiaries (13)
- Life cycle of firm (4)
- Enterprise size (4)
- Innovation propensity (5)
- Allocated budget/funding (5)
- Allocated budget/funding source (7)
- Disbursed budget/funding (5)
- Disbursed budget/funding source (7)

To describe the relationship between above-mentioned variables, calculations were performed on two types of data: number of instruments and disbursed value of instruments.

Data were sourced from program documentation available online, followed by verification with agencies' and ministries' points of contact to ensure high quality.

The budget allocation over the life cycle for SME support instruments stands at 253.5 billion CZK (11.1 billion USD).[35,36] The bulk of the funding for these instruments is concentrated in three agencies; namely, the Agency for Entrepreneurship and Innovation/API (38 percent), CzechInvest (29 percent) and TACR (20 percent) (Figure 40). API and CzechInvest rely primarily on EU funding whereas TACR instruments are primarily funded by the national budget. On average, about 84 percent of allocated funds come from the EU community. Over 82 percent of donor funds come from the European Regional Development Fund (ERDF), followed by 7 percent from the European Commission-implemented program, Horizon 2020.

Figure 40. Share of allocated budget by agency

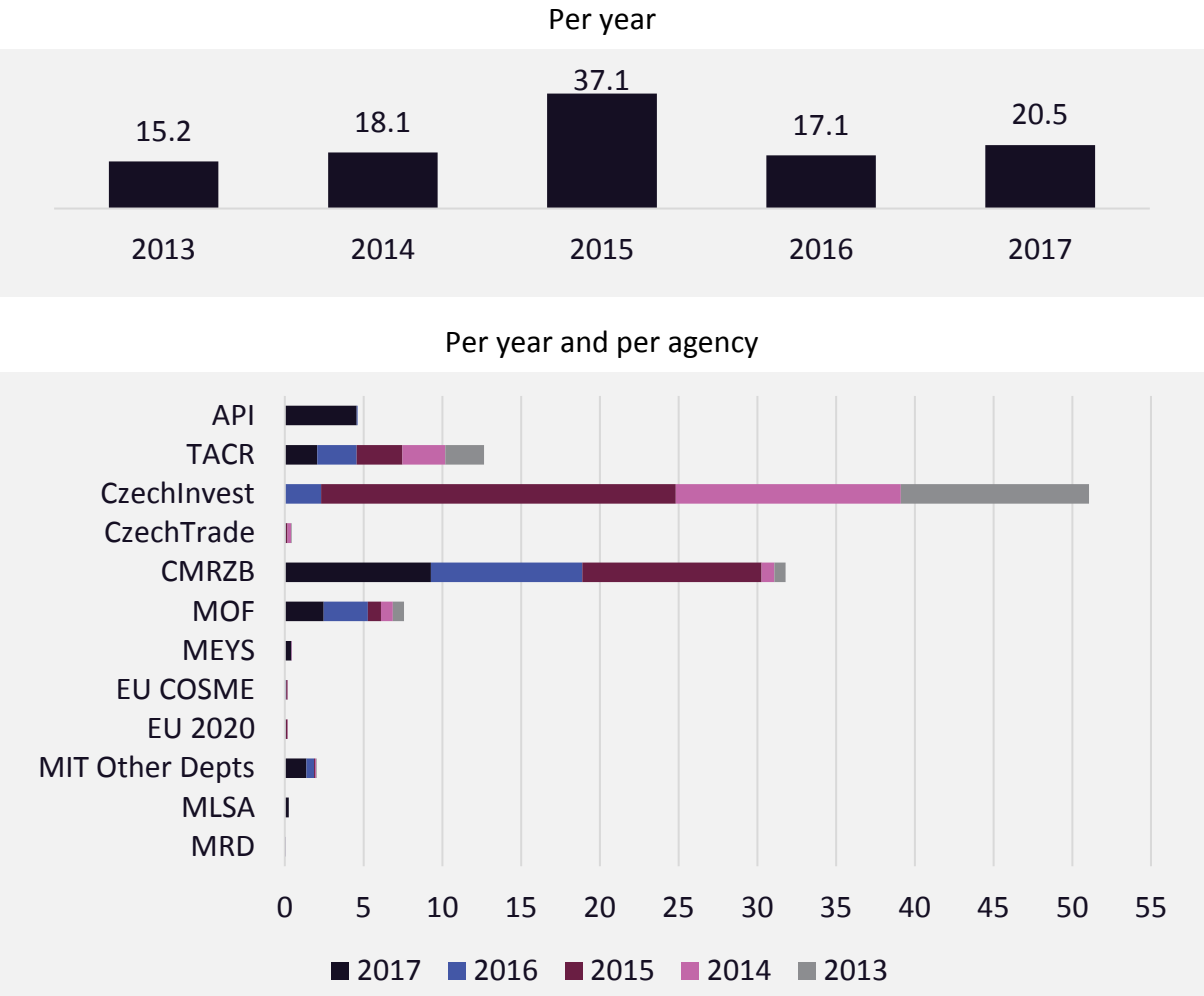


[35] Based on the mapping, there are a total of 72 instruments with available budget information (out of 93). 21 instruments have no information on budget allocation, of which 6 are CzechInvest/CzechTrade instruments, 9 are CMZRB instruments, 1 is an instrument under the Ministry of Finance, and the rest are EU-related H2020/COSME instruments. Because many of these instruments are important (given the size of disbursed values, e.g., CMZRB), disbursed funding figures are used in subsequent analyses. In terms of disbursed figures, 9 remaining instruments that have missing information are not substantial: 6 are information portals (e.g., CzechLink Start, CzechStartups.org, MY-GATEWAY, Oasis, Green Route for Export, Customer Centre for Export) and 3 are EU-related instruments (1 is an H2020 instrument-Innovfin SME guarantee-and 2 are COSME instruments-Access to finance for SMEs through Equity Facility for Growth, or EFG and Access to finance for SMEs through Loan Guarantee Facility, or LGF).

[36] It is not possible to provide a disaggregation of budget allocated by year from 2013-2017, as only 30 instruments have annual allocated budget information. The majority of the instruments report their budgetary allocations in terms of aggregated figures over the life cycle of the instruments.

Disbursed funding for SME support instruments from 2013 to 2017 totaled 108.5 billion CZK (4.71 billion USD).[37] There is a flat trend in total SME spending during this period, except for a notable jump in 2015. Disaggregating spending across ministries shows that this jump came from CzechInvest. Close to half the funding (47.1 percent) went to CzechInvest instruments, followed by CMZRZB (26.5 percent) and TACR (11.7 percent) (Figure 41 and Figure 42).

Figure 41. Evolution of disbursed funding (in billions CZK)



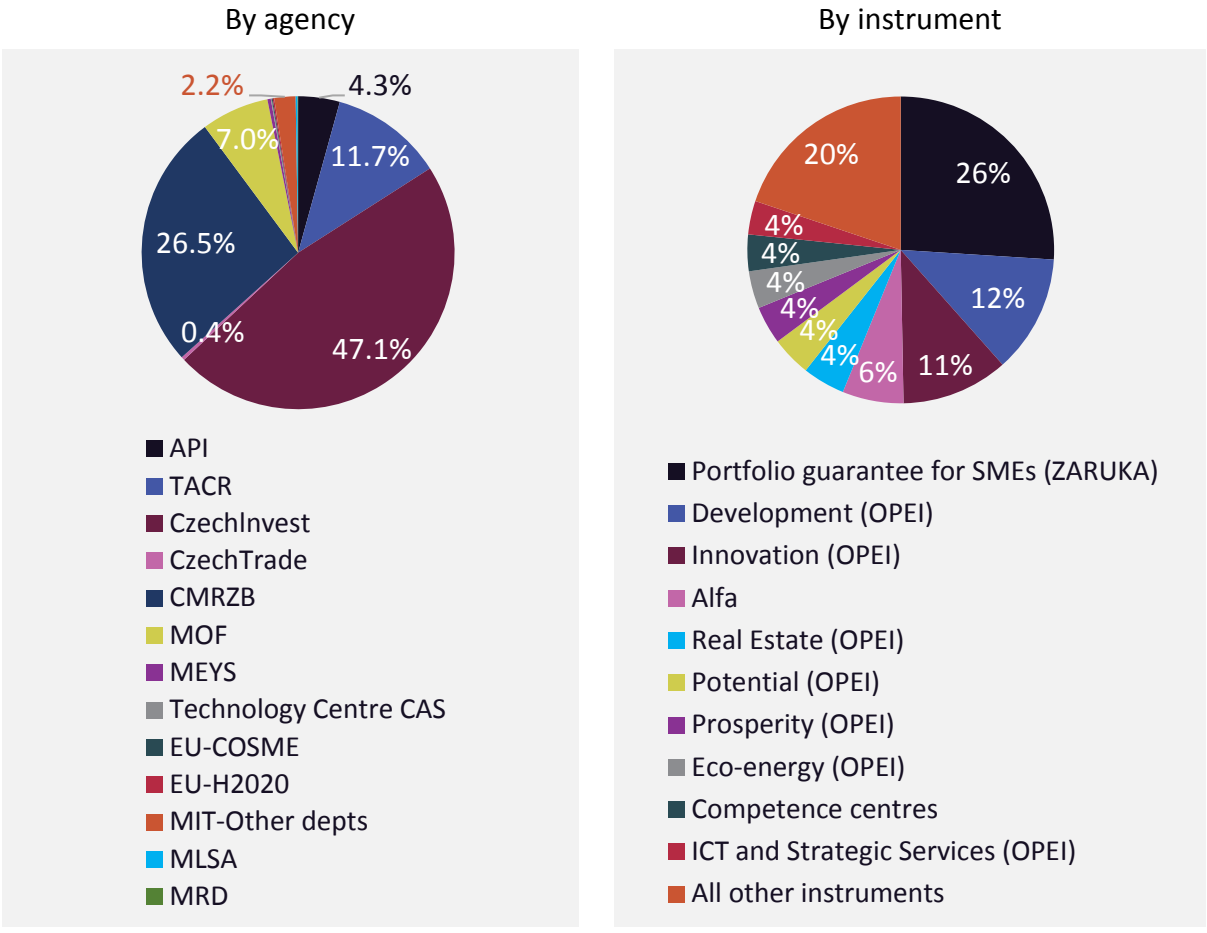
Disbursed funds are concentrated in a few instruments. Three instruments comprise about half (49.5 percent) of SME funds. Adding six more instruments brings the share to 76 percent of SME funding. Thus, around 10 percent of instruments account for the majority of SME funds. Among the 9 top-funded instruments, one focuses on access to finance (M-Guarantee/portfolio guarantee for SMEs under Zaruka programme 2015-2023[38]), six are

[37] This information is available for 84 instruments.

[38] Note that funding for M-Guarantee is a combination of guarantees payable in case of credit defaults (thus, it is an account receivable) and actual expenditures by the government (due to default). There is no available

OPEIC instruments (Development, Innovation, etc.), and two are state-funded TACR instruments. Funding for CzechInvest (the agency with the largest share of disbursements) is distributed across a lot of instruments, while CMRZB (second largest share of disbursements) depends primarily on one instrument. TACR (which has a mandate on R&D and industry-academia collaboration and was 100 percent funded by the state between 2013 and 2017) disbursed funds are concentrated in two out of 10 instruments: 55 percent of TACR funds were channeled towards the Alfa program, and 33 percent were disbursed to Competence Centers.[39]

Figure 42. Share of disbursed funding by agency and share of disbursed funding by instrument



information that distinguishes both. Because of this, disbursed funding is overestimated. Sources of funds for M-Guarantee comes from a combination of public funds and EIF-COSME LGF (EFSI). Default rates vary widely depending on the type of program and type of loan/guarantee. The average range is between 2 and 15 percent.

[39] The Alfa program supports applied research and experimental development in advanced technologies, energy resources and environmental protection, and sustainable transport. Competence Centers involve the creation and strengthening of research development and innovation (RDI) networks.

Comparing budget allocation and disbursed funding over time for a key agency, TACR[40], reveals lags in disbursements that likely indicate difficulties in implementation. TACR has 10 instruments, with a total of 51.1 billion CZK (2.2 billion USD) allocated over the life cycle of the instruments. In comparison, a total of 12.6 billion CZK (0.55 billion USD) was disbursed on these instruments from 2013 to 2017. Disbursement rates seem to have deteriorated over the period, from 71 percent in 2013 and 69 percent in 2015 to a mere 43 percent in 2017 (Figure 43).

Figure 43. Evolution of TACR funds (in billions CZK)

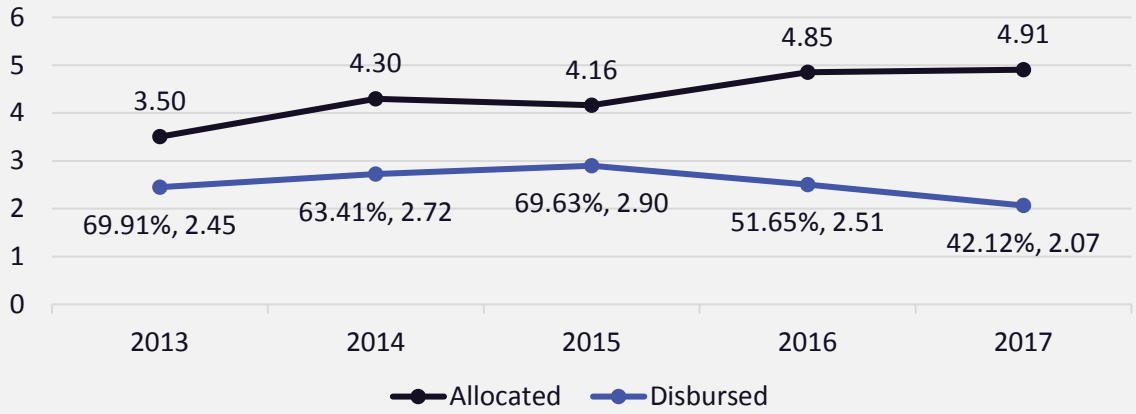
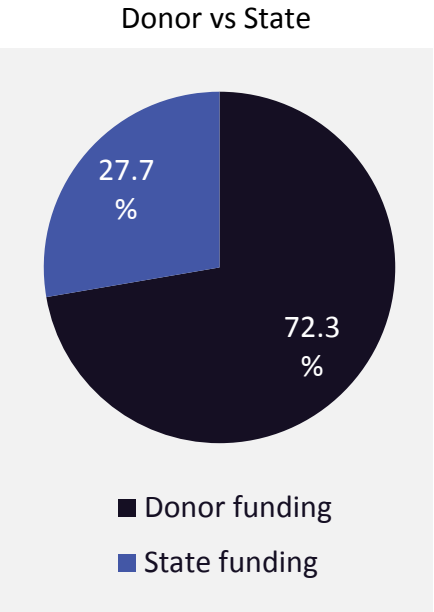
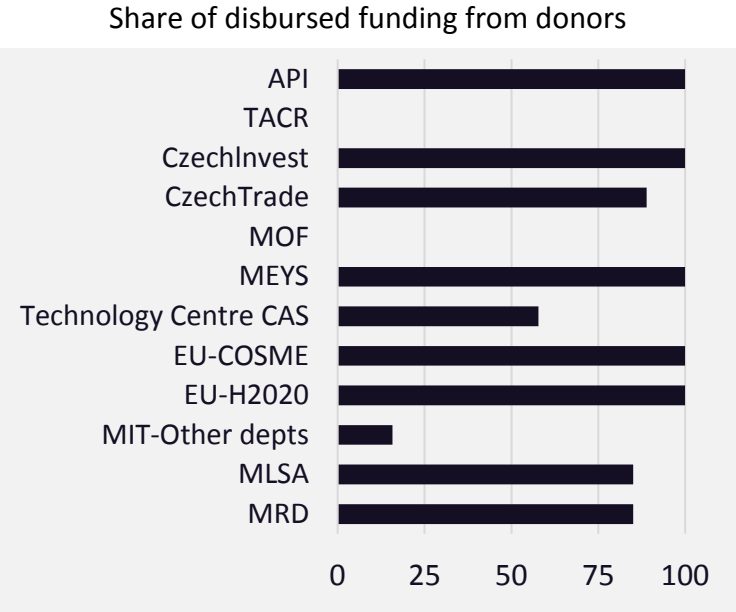


Figure 44. Sources of disbursed funding

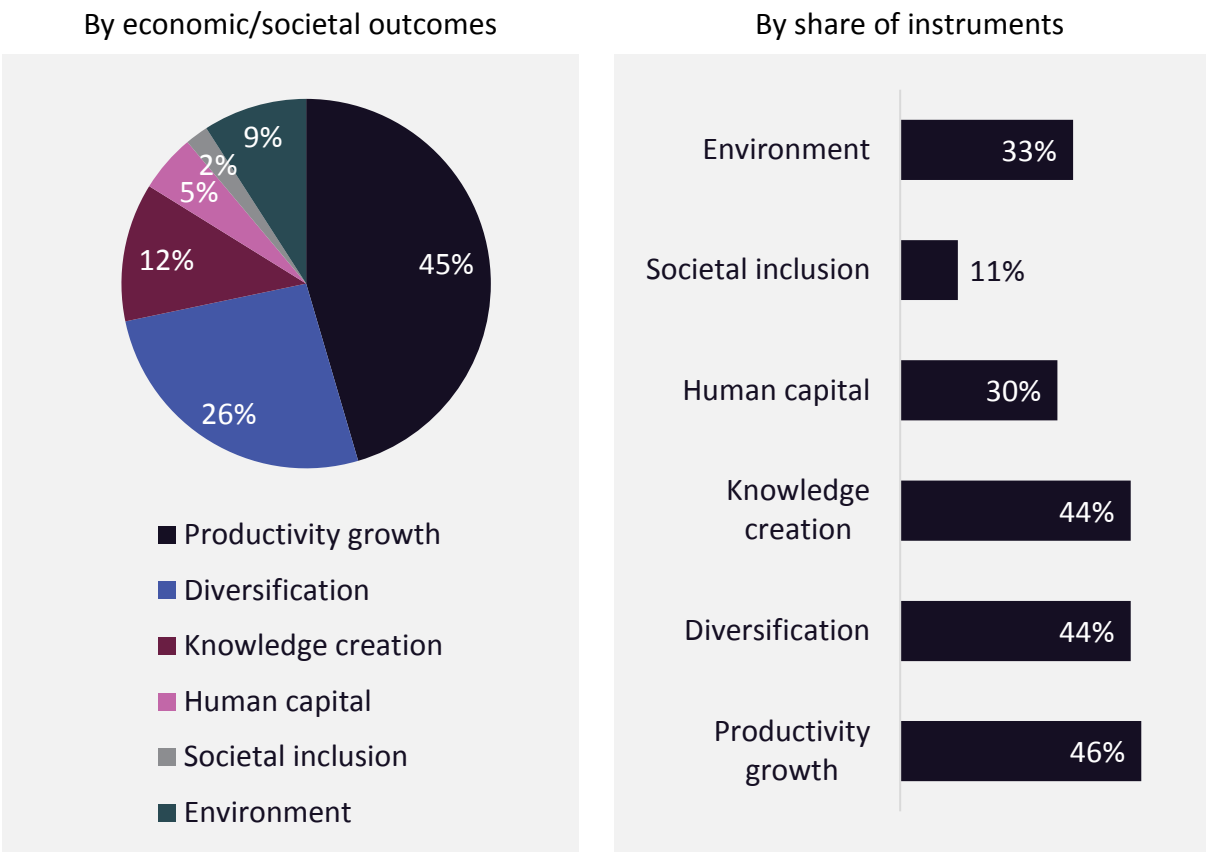




[40] There is complete information on allocated and disbursed budget annually from 2013-2017 for TACR. Moreover, TACR is primarily funded by the state.

Funding for SMEs and entrepreneurship relies heavily on the EU. Over 70 percent of disbursed funds come from the EU, particularly through the ERDF. A majority of these SME-focused agencies, including API, CzechInvest, and MEYS, are 100 percent EU-funded (Figure 44). European Commission DG Research and Innovation (2019) estimates EU allocations (based on the multiannual financial framework) to the Czech Republic at about 1.8 percent of its yearly GDP. Because ERDF funding targets lagging regions, the heavy reliance on this funding source may be contributing to the observed regional resource misallocation in the Czech economy by subsidizing less productive firms than those firms located in and around Prague.

Figure 45. Disbursed budget by economic/societal outcomes and share of instruments that target economy/society outcomes



SME support instruments are focused on productivity growth and economic diversification. Close to half (45 percent) of disbursed funds from 2013-2017 were channeled towards boosting productivity growth, and another quarter towards diversification of the economy (Figure 45). This is in line with policy needs to boost SME productivity growth and to encourage more high value-added production and exports. About 40 percent of the instruments (including only those that targeted economy/society outcomes and noting that

instruments can target more than 1 outcome) targeted productivity growth, diversification or knowledge creation. While only 9 percent of disbursed budget targeted the environment, a third of instruments did so; for example, over one-quarter (26 percent) of TACR instruments targeted improving environment outcomes through more sustainable technologies (e.g., Alfa).

Figure 46. Disbursed budget by intermediate objectives and share of instruments by intermediate objective

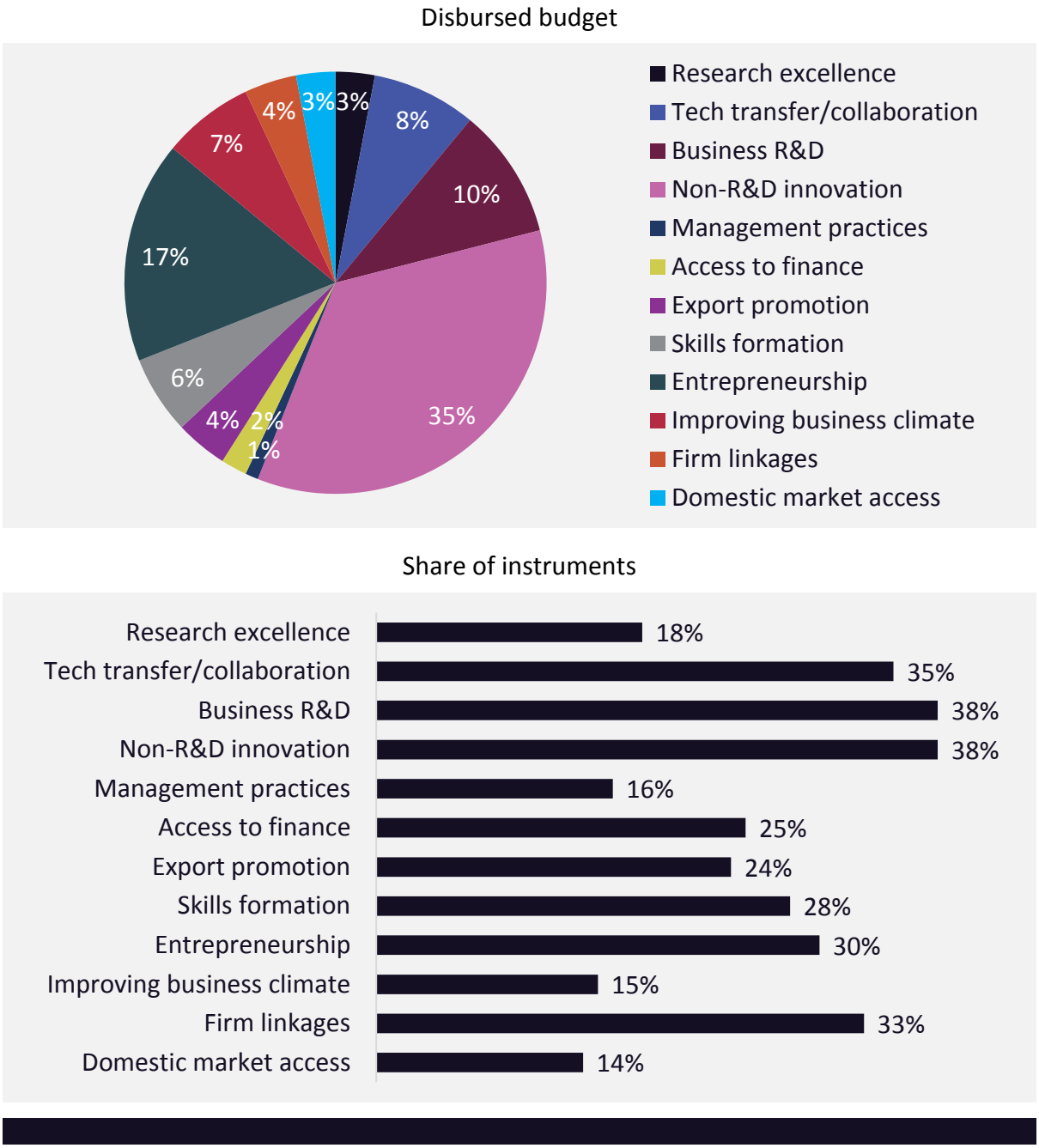
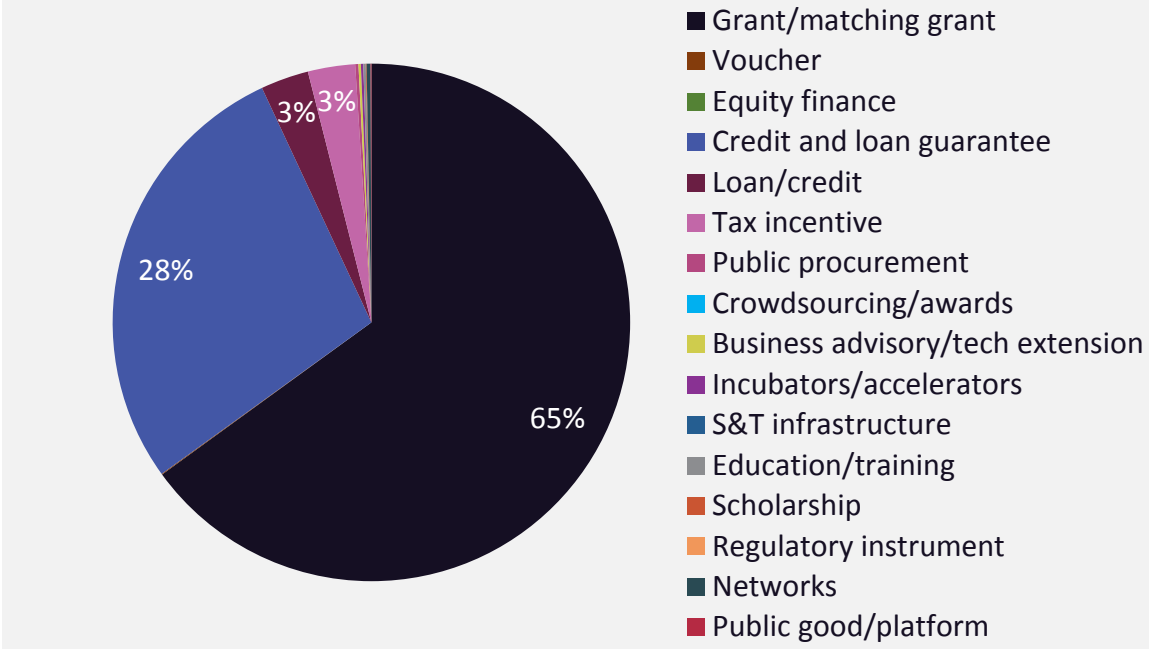
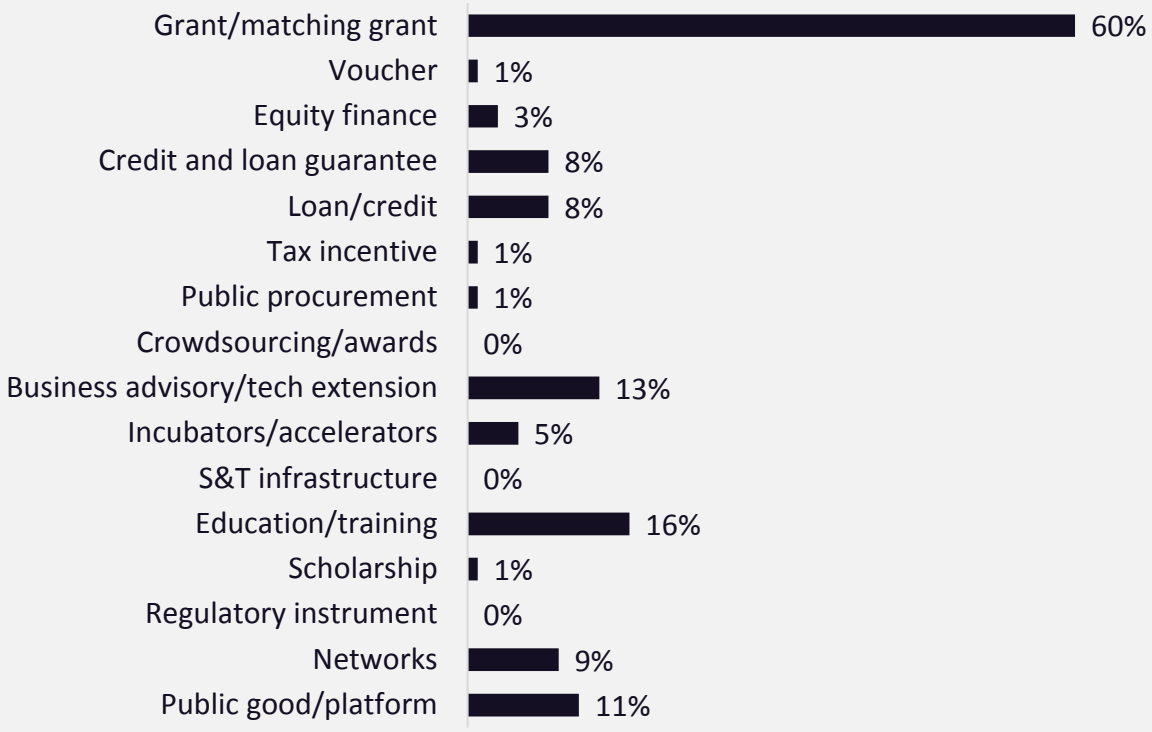


Figure 47. Disbursed budget by instrument type and share of instruments by instrument type

Disbursed budget



Share of instruments



Untangling the channels through which these economic objectives are to be achieved shows a strong focus on non-R&D based innovation. 35 percent of funds from 2013-2017 were focused on non-R&D innovation, such as through technology adoption, as a channel towards achieving productivity growth (top SME objective based on disbursed funding). Other channels include entrepreneurship (17 percent) and business R&D (10 percent). Instruments that target current SME policy needs, such as improving management practices and export promotion for SMEs, are rather scarce. Only one percent and four percent of funds targeted these policy needs, respectively. In terms of instrument count, improving business R&D and non-R&D innovation (technology adoption) tend to be the more popular focus areas of SME support instruments. This is aligned with Czech Republic's level of development and existing capabilities (Figure 46).

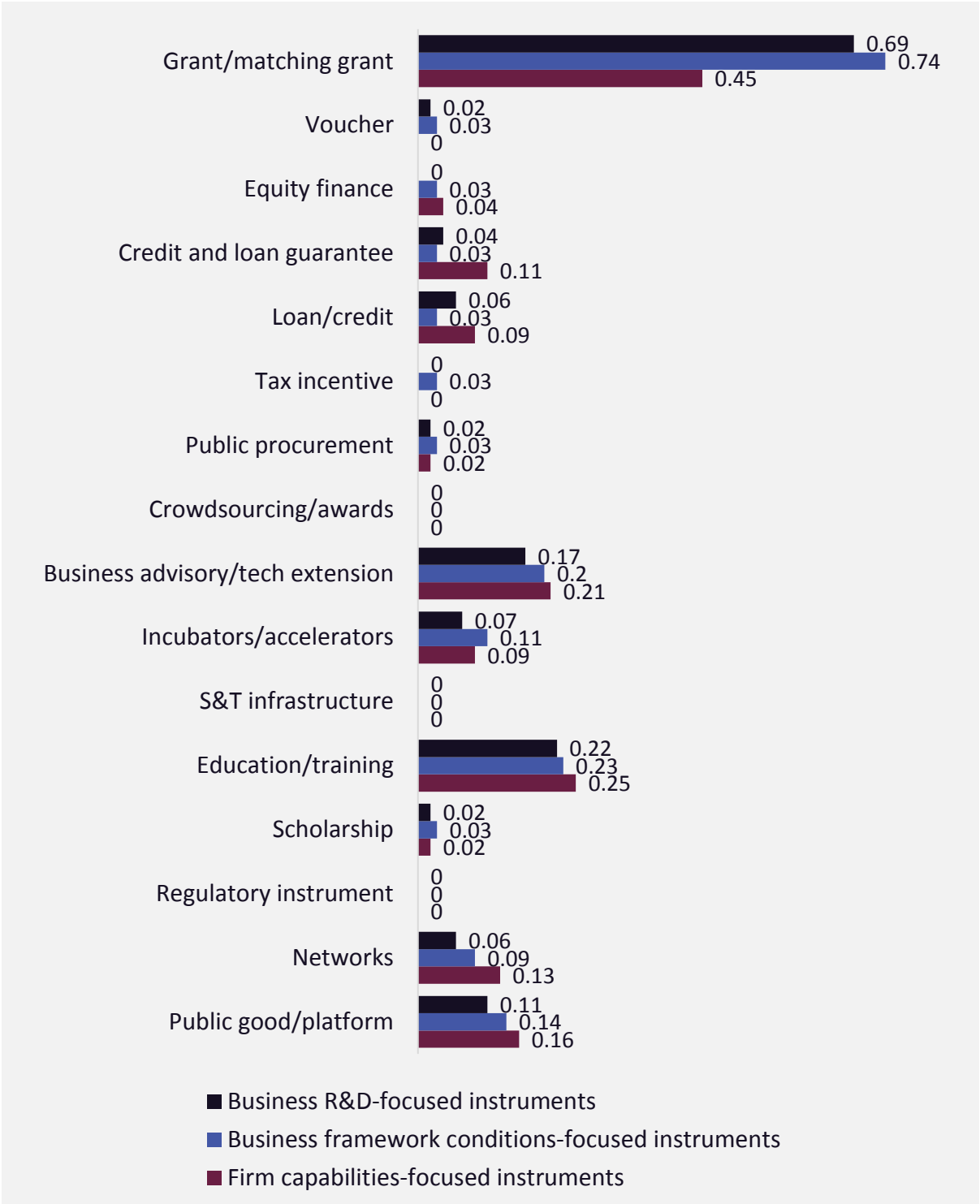
Grants/matching grants[41] are the most common type of instrument. 65 percent of SME funds were disbursed to grant-based instruments, and these instruments accounted for 60 percent of the total number of SME support instruments (Figure 47). By contrast, only 28 percent of funds and 8 percent of instruments were devoted to indirect support instruments in the form of credit or loan guarantees (indirect support instruments tend to be more commonly used by policymakers in relatively advanced economies). Instruments that used business advisory and training services represented only a small part of disbursed values. All in all, the policy mix portfolio was less focused on instruments that crowd in the private sector and/or stimulate markets (e.g., credit guarantees, vouchers, linkages programs). A focus on grants could be effective if the main market failure that prevents SMEs from engaging in productive activities could be addressed by providing financial incentives. However, this presumption is unlikely to be true for many SMEs, where business advisory and training services (directly or via matching grants) can be a critical element for success.

The importance of grants varied, depending on intermediate objectives. For example, instruments focusing on improving business R&D tended to use matching grants more intensively (74 percent of the time) compared to those intending to improve the business environment (45 percent of the time) or to strengthen firm capabilities (69 percent of the time) (Figure 48). The intensity of use of soft interventions, such as business advisory and education/training services, tended to be similar among these three focus areas. Overall, there seems to be more variation in the instrument types used for business environment-focused instruments. Given the heavy reliance on grants/matching grants, a further diversification of instrument type may be considered, depending on the objectives. For example, the use of R&D tax incentives to boost knowledge creation and business R&D is less common in the Czech Republic compared to some of its peers: for 2016, tax incentives for

[41] Grants involve a 100 percent subsidy rate, whereas a matching grant involves a certain percentage of funding matched by the beneficiary.

business R&D (generally demand-driven) are estimated to have equaled 0.05 percent of GDP in the Czech Republic, compared to 0.15 percent in Austria and 0.09 percent in Hungary.[42]

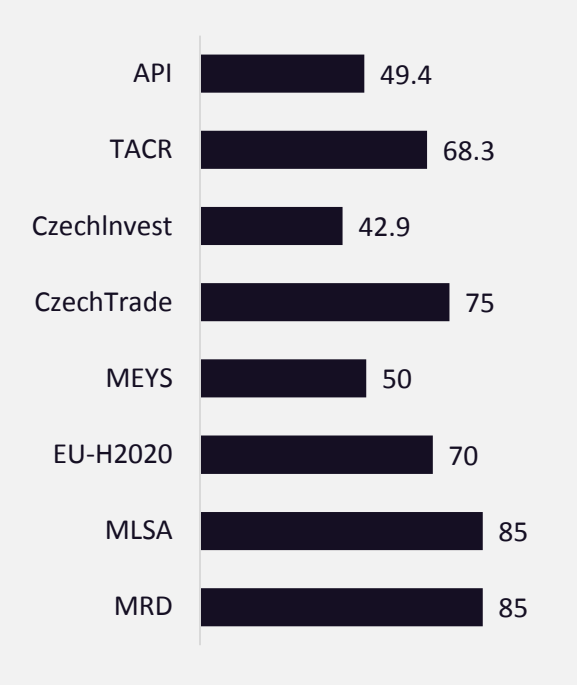
Figure 48. Common instrument type for business R&D-focused instruments, business framework conditions-focused instruments, and firm capabilities-focused instruments



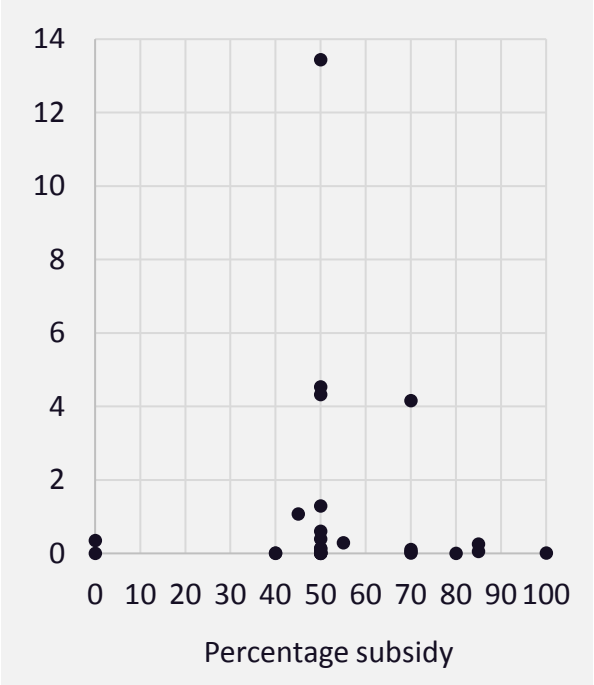
[42] OECD. R&D Tax Incentive Database. http://www.oecd.org/sti/rd-tax-stats.htm

Figure 49. Subsidy rates by agency and by project size

Average subsidy rate of matching grants by agency



Average subsidy rate by project size (in billions)



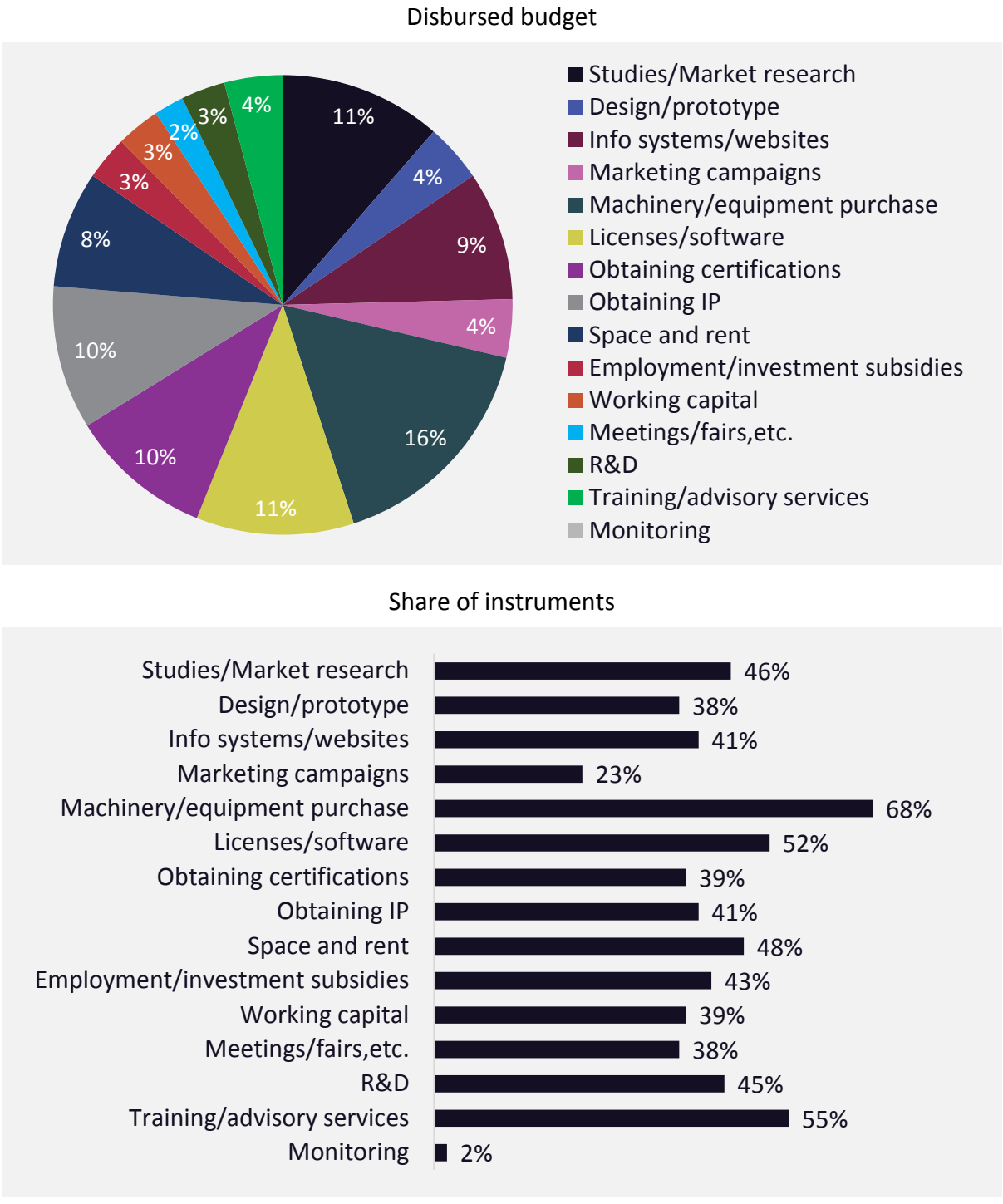
Close to half of matching grants used one co-financing criteria[43]. Out of 55 instruments that used matching grants as a mechanism of intervention, 47.3 percent had a single co-financing rate. Similarly, 43.3 percent of disbursements used a single co-financing rate. The remaining 56.7 percent used two or three co-financing criteria depending on the size of the firm and/or project activities. For example, larger firms tended to receive a smaller co-financing rate (ranging from 25 to 50 percent) compared to SMEs (small firms typically received a subsidy rate ranging between 45 and 70 percent and medium firms received 35 to 60 percent). For instruments with a single co-financing rate, the subsidy rate averaged 56.2 percent. Most of the single co-financing rates hovered at the 50 percent mark (for example, the subsidy rate for API instruments was 49 percent), regardless of the size of the project (Figure 49).

Overall, the design of co-financing mechanisms within matching grants are similar across projects. This seems to be true for projects with single or with two or more co-financing rates. However, homogeneity in instrument co-financing rates may not be optimal in practice, because different projects, objectives and beneficiaries are likely to require different levels of

[43] Co-financing rates were likely designed to match or comply with EU State Aid rules. These rules specify that measures up to EUR 200 000 per SME over any period of 3 fiscal years do not constitute State aid. Further, they provide guidance on permitted subsidies for R&D (for example, up to 100% of eligible costs for basic research, up to 80% of the eligible costs for small enterprises and 75% for medium enterprises for industrial research, etc.)

co-financing, subject to financial constraints. On the other hand, using a variety of co-financing rates may increase administrative and transaction costs. Testing and calculating the effects of alternative co-financing mechanisms can be done to ensure the desired impact. One possible strategy is to ask program applicants to disclose their co-financing needs.

Figure 50. Disbursed budget for grants/matching grants by use of instrument funds and share of instruments by use of instrument funds



Grants and matching grants are primarily used for financing firms' operations (Figure 50). 85 percent of grants/matching grants disbursed to SMEs were used to support project implementation from 2013-2017, and the remainder were used for project design/prototyping (4 percent) and pre-feasibility studies (11 percent). The largest project implementation activities included purchases of machinery and equipment (16 percent) and licenses (11 percent) and obtaining certifications (10 percent) and intellectual property rights (10 percent). As a proportion of instrument count, grants were used for machinery and equipment purchase 68 percent of the time, compared to training services at 55 percent of the time. The subsidization of firms' operations may be contributing to the observed resource misallocation in the Czech economy. By subsidizing operations, instruments may be prolonging the survival of less productive firms and impeding the reallocation of resources to younger and/or more productive firms. There is also a relative lack of attention devoted to the development of human capital.

As expected, formal firms are the main target beneficiaries of SME support instruments. From 2013 to 2017, 45 percent of SME funds were disbursed to formal firms (Figure 51). Nevertheless, the policy mix may not necessarily target just one beneficiary type (e.g., firms). For example, only 12 instruments (out of 93) had one beneficiary type, whereas 27 instruments targeted two types of beneficiaries. European Commission DG Research and Innovation (2019) finds that in 2018, EU funds benefited directly or indirectly about 4,000 firms and close to 5,000 researchers. While 95 percent of instruments targeted formal firms as beneficiaries, only 12 percent of instruments supported women entrepreneurs. One of these instruments was designed specifically to help female entrepreneurs connect with mentors[44], although none targeted potential female entrepreneurs for innovative and knowledge creating activities supporting business creation. Yet, the country needs assessment (previous section) shows that women in the Czech Republic tend to participate less in the labor force, and entrepreneurship provides an avenue to maximize the skills potential of women.

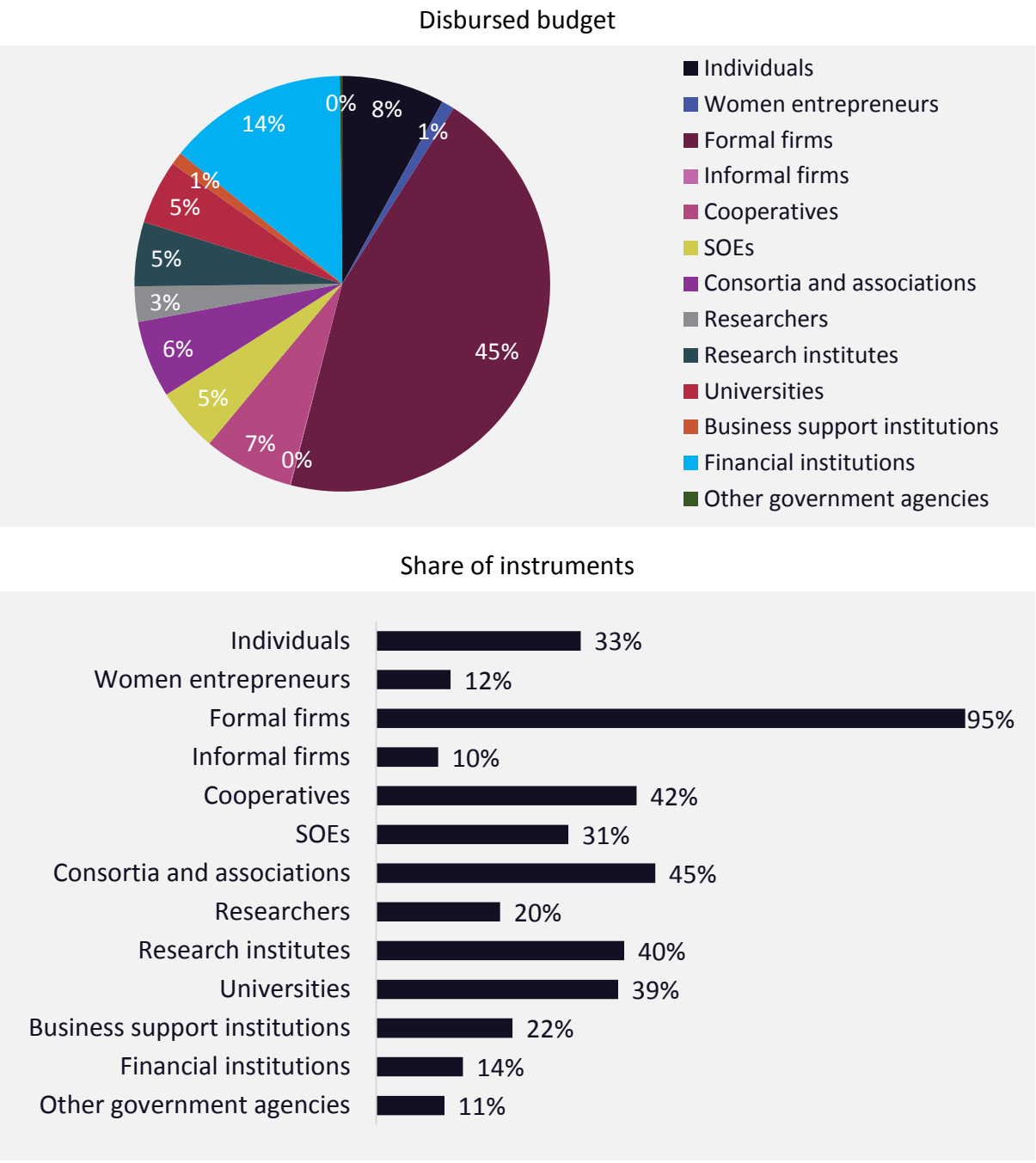
The average funding per beneficiary varied widely across agencies. The lowest funding per beneficiary were from instruments coordinated by the Technology Centre CAS and the highest from H2020 instruments. Out of 63 instruments with information on disbursements and beneficiaries from 2013-2017, funding per grantee averaged about 6.3 million CZK (about 273,000 USD). Average benefit sizes varied by instrument. For example, about 4,800 beneficiaries of Enterprise Europe Network's BISONet PLUS2 project received 3,610 CZK (156 USD) on average, whereas about 70 beneficiaries of Prosperity (an OPEIC instrument) received 59.2 million CZK (2.56 million USD) on average. EU-funded instruments reached over 23,500 beneficiaries, whereas state-funded instruments reached just about 9,400 grantees.[45] There is likewise heterogeneity in average grant size within agencies. In TACR for example,

[44] Network of mentors for woman entrepreneurs program under COSME 2014-2020

[45] A donor funded (EU funded) instrument is defined as one that has at least 1 CZK of funding sourced from the EU. A state funded instrument is defined as one that at least 1 CZK of funding sourced from the government.

big ticket instruments included Alfa and Competence Centers (Figure 52). These big-ticket instruments had the largest number of recipients within TACR. Alfa has so far reached about 700 grantees, followed by Competence Centres at close to 350.

Figure 51. Disbursed budget by beneficiary and share of instruments by beneficiary



Note: Instruments often have more than one type of beneficiaries.

Figure 52. Average beneficiary funding by agency and average beneficiary funding in TACR (in millions CZK)

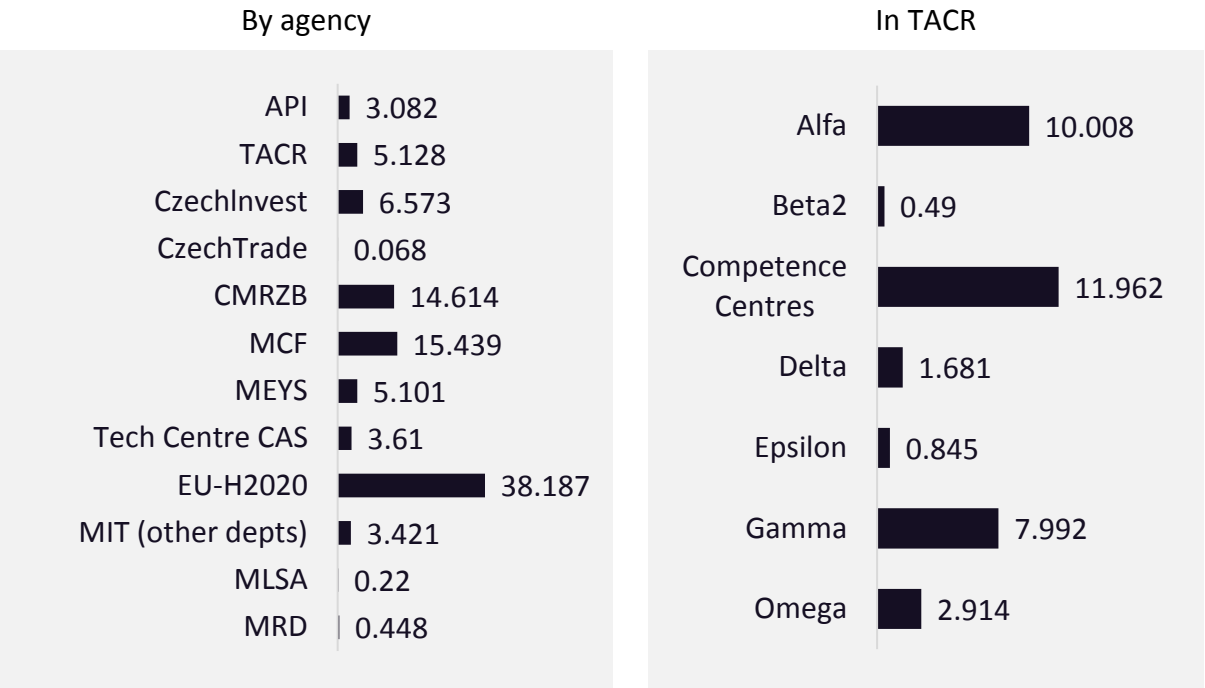
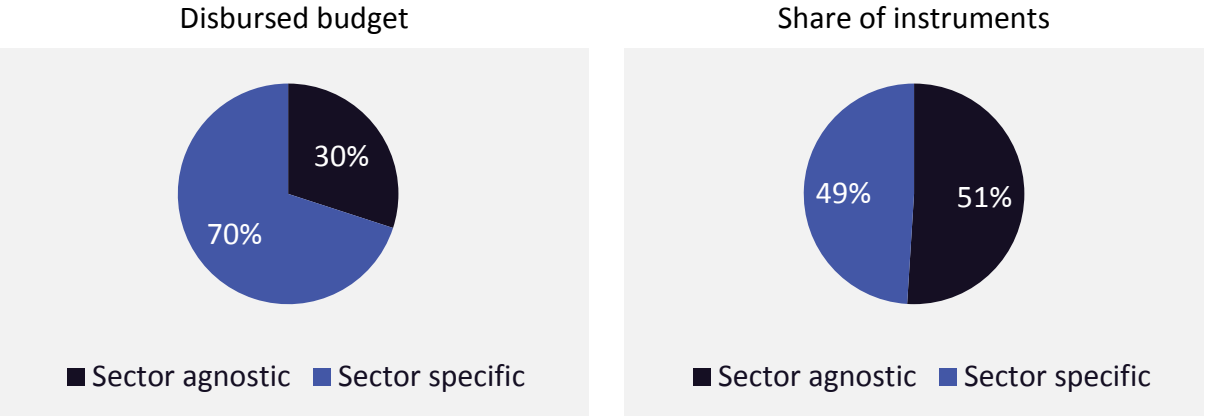


Figure 53. Disbursed budget by sector orientation and share of instruments by sector orientation



The majority of SME support instruments had a sectoral focus. 70 percent of SME funds were channeled to instruments that target certain sectors, although only half (in terms of instrument count) were sector-specific (Figure 53). This indicates that sector-specific instruments tended to have larger funding sizes. Between sectors, funding sizes appear to be larger in services than manufacturing: while manufacturing accounts for 91 percent of sector-specific instruments, it accounts for only 46 percent of disbursements for sector-specific

instruments. In comparison, while 67 percent of sector-specific instruments targeted the knowledge-intensive services sector, it represented a substantial share (30 percent) of the disbursed budget (Figure 54).

Figure 54. Disbursed budget by sector of focus for sector-specific instruments and share of instruments by sector of focus

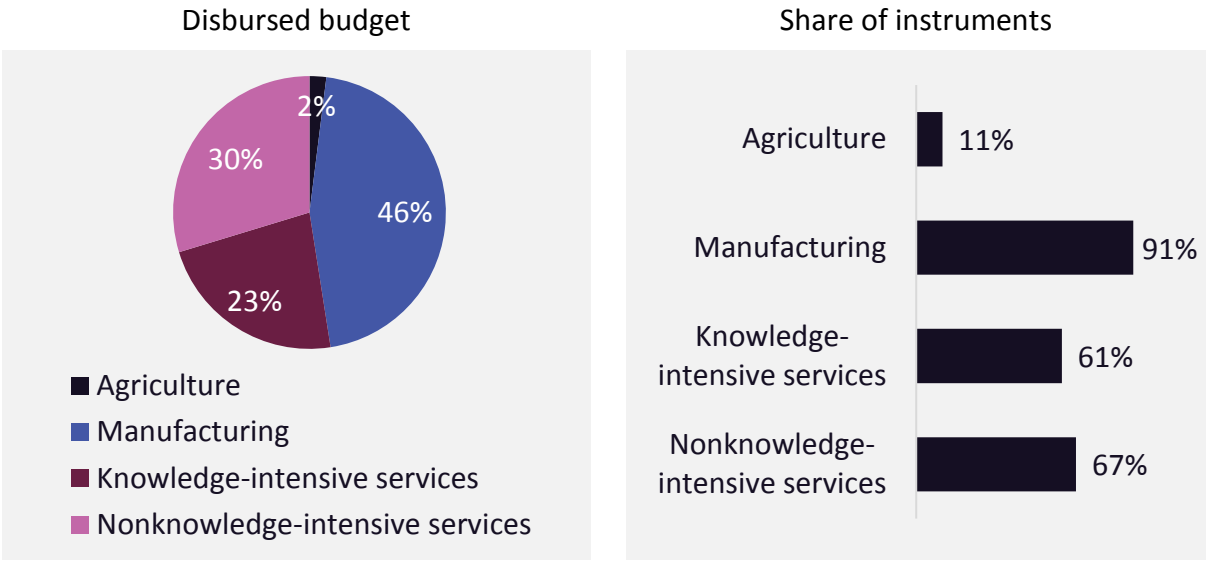
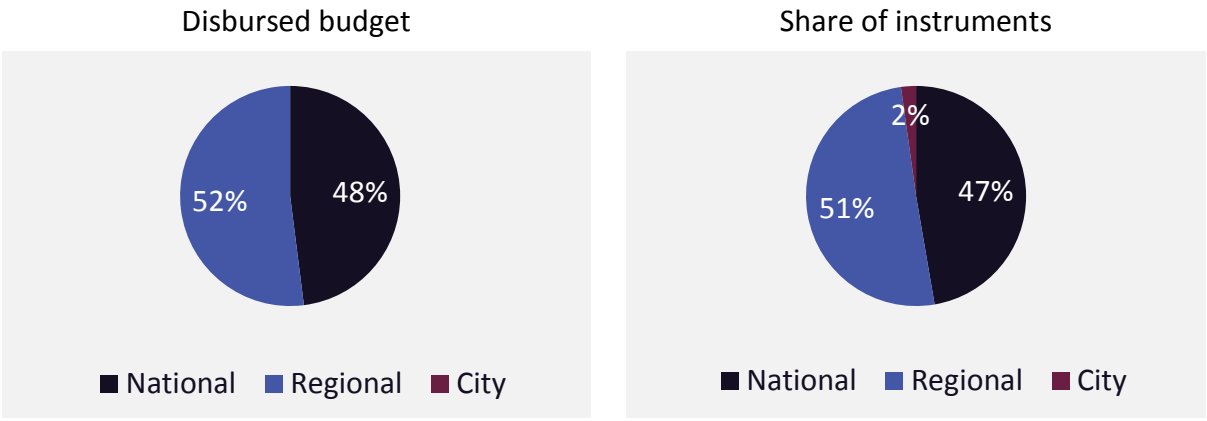


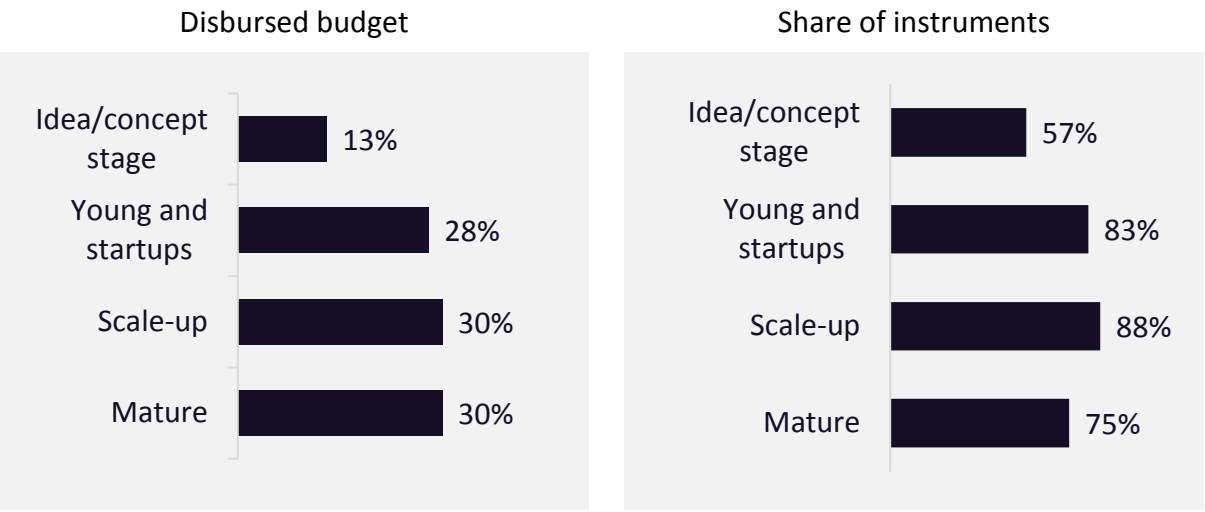
Figure 55. Disbursed budget by geographic coverage and share of instruments (count) by geographic focus



Over half of the support instruments focused on regions outside of Prague. Owing to reliance on EU funds that have regional-level targets (e.g., ERDF), 52 percent of disbursements and 50.5 percent of instruments had a regional focus (not including the capital city) (Figure

55). One instrument has a city-level focus (called 'high speed internet').[46] While the country needs assessment shows that Prague excels (or has good practice knowledge) in certain SME-related competencies, such as business environment and innovation, there are areas of improvement that Prague-based instruments could target, such as boosting managerial firm capabilities.

Figure 56. Disbursed funding by firm life cycle focus and share of instruments by firm life cycle focus



Support instruments tended to focus on existing firms more than on the creation of entrepreneurial ideas. The bulk of funding for these instruments were channeled towards existing firms, especially those in the growth (30 percent) or mature (30 percent) stages (Figure 56). There tended to be less focus on the earlier stages of the firm life cycle: only 13 percent of disbursed funds were devoted to the ideas/concept stage. In terms of instrument count, 57 percent of instruments targeted applications in the concept stage, but 75 percent of instruments targeted firms in the mature stage.[47] Moreover, 88 percent of the instruments that targeted the young and scale-up stages also supported the mature stage, but only 65 percent targeted the idea stage as well. From a funding perspective, a focus on growing firms can be expected as they are more likely to be successful (and thus create a return on investment for the economy). Moreover, growth firms are more likely to require larger funding sizes compared to those in the ideas stage. However, the significant focus on mature firms should be reconsidered, as these are less likely than younger firms to grow further. Given that the Czech Republic has already benefited from high levels of FDI and is high integrated into European global value chains, R&D-driven startups are the country's most promising avenue for productivity gains and growth. Thus, investing more money and

[46] There is no budget information available for this instrument.
[47] Note that instruments may focus on multiple life cycle stages. Only 8 instruments (8.6 percent) focused on one specific life cycle stage.

resources in risky yet innovative ideas, on balance, is more likely to boost productivity growth. This finding complements the country needs assessment and recent World Bank analysis into the early stage financing ecosystem[48], which shows that risk financing (such as venture capital and business angel financing) is an underdeveloped area in the Czech Republic.

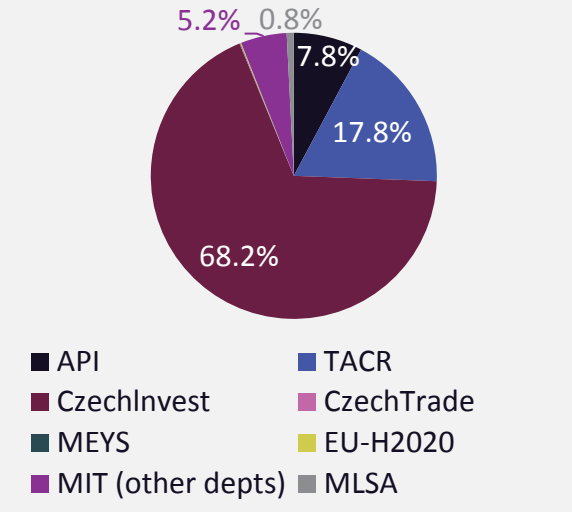
Box 3 discusses the policy mix of instruments used to support Industry 4.0 (see Annex 7 for more detail), and Box 4 discusses the policy mix of instruments designed to promote energy efficiency (see Annex 6 for more detail).

Box 3. Instruments used to support Industry 4.0

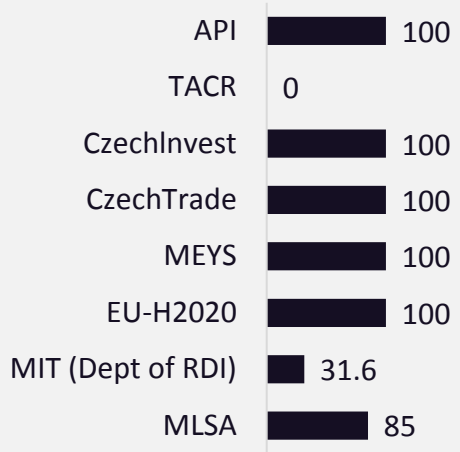
An analysis of the policy mix using the I4.0 lens can provide information on gaps that can be addressed to help Czech Republic better leverage this transformation of production processes. A total of 29 instruments are identified as related to Industry 4.0 (see Annex 7 for selection criteria), accounting for around 29 percent of SME funds over 2013-17. All I4.0-associated instruments used grants/matching grants. Average funding size per grantee was about 4.9 million CZK (212,000 USD), or only slightly smaller than the average for the overall policy mix of 6.3 million CZK (about 273,000 USD). Among 8 agencies that had Industry 4.0-related support programs from 2013-17, most relied on funds from donors, primarily the ERDF (97 percent) (Box Figure 1). The Czech government might need to consider additional complementary funding instruments to stimulate I.40 initiatives.

Share of disbursed funds by agency and EC share in agency funding

Disbursed funds by agency



EC share in agency funding



[48] Aridi, Anwar; Gray, Nelson Campbell; Ong Lopez, Anne Beline Chua. 2018. Stimulating Business Angels in the Czech Republic (English). Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/633181541532716870/Stimulating-Business-Angels-in-the-Czech-Republic

Industry 4.0 associated instruments placed significant emphasis on knowledge. The I4.0 instruments had a greater focus on skills formation than did the overall policy mix (10 percent of instruments versus 6 percent for the overall policy mix) and technology transfer and collaboration (12 percent versus 8 percent). The overall policy mix had a more substantial focus on imitation via non-R&D I&E. Of the 76 percent of I4.0 disbursed funds channeled towards instruments with a sector-specific focus, 49 percent focused on manufacturing and 30 percent on knowledge-intensive services, indicating a high concentration in more complex knowledge areas. A substantial share of funds disbursed for I4.0-associated instruments were allocated to cooperatives, research institutes and universities (12 percent each), while the overall policy mix shows a greater share of funds targeted to formal firms and a weak focus on knowledge-creating bodies.

There are opportunities for improving the impact on innovation of I4.0 instruments. 77 percent of funding for I4.0-associated instruments had a regional focus, especially for regions outside Prague, reflecting dependence on EU funding. However, considering the ever-changing nature of I4.0 technologies, dismissing support for Prague, which is considered a 'strong' innovator, may be a missed opportunity. And similar to the aggregate portfolio, I4.0-associated support was targeted towards scale-up and mature firms (60 percent). Whereas 30 percent of funds were disbursed to young firms/startups, only 10 percent of funds reached potential innovators (those in the idea/concept stage). A relative lack of emphasis on the earlier stages of the life cycle, where firms tend to grow faster and where I4.0 technologies are more likely to be created, presents another area of missed opportunity.

A more detailed analysis of the Industry 4.0 policy mix is included in Annex 7.

Box 4. Instruments used to promote energy efficiency

An analysis of the policy mix using the energy efficiency lens sheds some light on the Czech Republic's progress in its transition towards a low-carbon economy. Given that it has one of the highest carbon and energy intensity among OECD countries, the need to move towards a less carbon-dependent economy is a clear imperative for the Czech Republic. The policy mix analysis identifies 16 instruments that had energy efficiency-related objectives. Close to 20 percent of disbursed SME funds from 2013-2017 promoted energy/energy efficiency goals.

The following are the main conclusions from the analysis, many of which are similar to the findings from the aggregate SME portfolio:

- Energy-related instruments are concentrated in a handful of instruments and agencies;
- Funding of these instruments relies heavily on the EU;
- Energy-related instruments had a stronger focus on improving firm capabilities for technology adaption and diffusion, targeting all firm types (idea, young/startup, scale-up, mature), compared to the portfolio as a whole; and
- Energy-related instruments relied strongly on grants/matching grants as a mechanism of intervention.

A more detailed analysis of the energy and energy efficiency policy mix is included in Annex 6.

An analysis of the link between SME policy needs and the instrument portfolio shows some key areas of alignment but also some crucial gaps. For example, substantial funds were devoted to policy instruments targeting export diversification, whereas instruments targeting business R&D, industry-academic collaboration and advanced human capital development tended to lack robust funding despite their relative importance in improving productivity growth for SMEs. Table 2 provides a brief assessment of the link between policy needs and how the policy mix portfolio is addressing them.

Table 2. Connection between key SME productivity issues and the policy mix portfolio

Key SME productivity issue (country needs)	Relative importance in the policy mix (based on disbursed values)	# of instruments targeting need
Support for internationalization of SMEs (addressing lack of export orientation and diversification and high-value added GVC participation)	• Over one-quarter of instruments funded those with diversification objectives—a relatively significant amount. • Instruments targeting export diversification had a mix of (i) soft support, such as support for participation in trade fairs and information for SMEs seeking to go global, and (ii) hard support, such as credit loan insurance from Export Guarantee and Insurance Corporation (against political and commercial risks).	22

Key SME productivity issue (country needs)	Relative importance in the policy mix (based on disbursed values)	# of instruments targeting need
Boosting linkages and collaboration between SMEs and foreign firms and between SMEs and knowledge providers	• Support for domestic firm-FDI linkages tended to be a small proportion of disbursed funding (less than 5 percent of aggregate disbursed values). Support measures tended to focus on soft services, such as marketing (NOVUMM, Design for competitiveness) and coordinating between startups and foreign investors (CzechLink Start).	31 (SME-foreign firm linkages)
	• Industry-academia collaboration (to facilitate technology transfer, for example) did not have a strong focus, given that only 8 percent of disbursed funding supported this objective.	33 (SME-knowledge provider linkages)
Improving innovation performance (business R&D) compared to large firms	• Disbursed funding had a weaker focus on supporting business R&D (10 percent of disbursed values) compared to non-R&D innovation via technology adoption (35 percent). • Business R&D instruments could be increased to cope with structural changes related to I4.0 (note that I4.0 initiative seeks to boost applied research funding as a priority area).	35
Improving technology adoption among SMEs relative to large firms, especially on I4.0 technologies (use of cloud computing, 3D printing, e-commerce, big data analysis)	• The policy mix strongly supports technology adoption and diffusion, but instrument information tended to be vague on whether this is to support I4.0 technology adoption.	35
Supporting human capital development, particularly on advanced digital skills (ICT, STEM skills) and managerial practices	• Skills formation accounted for 6 percent of disbursements, but there is a need to provide training to improve more advanced skills and to boost STEM-related education, given I4.0 related and demographic changes (e.g., expected expansion of high-skilled employment). • Few instruments targeted management practices (4 percent of disbursed values).	26

Key SME productivity issue (country needs)	Relative importance in the policy mix (based on disbursed values)	# of instruments targeting need
Regional differences in investment climate (i.e., Prague outperforms other cities, thus affecting SMEs located in lagging cities)	• Instruments targeted on improving the business climate comprised about 7 percent of disbursed values. However, this low proportion is expected— improving the business environment is regulatory in nature, and it is difficult to attribute monetary values to regulatory initiatives. • The policy mix mapping is focused at the national level, and thus assessment of regulatory initiatives at the regional level is beyond the scope of this report.	14
Boosting risk financing availability for supporting the growth of entrepreneurial ideas	• Other than CMZRB's INOSTART program (which provides loan guarantees for up to 60 percent of the outstanding principal loan for innovative start-ups during the first 3 years of business activity, as well as business advisory services in strategy and business plan implementation) and to a lesser extent the EXPANSION program (which provides guarantees and preferential loans to SMEs and start-ups in key sectors, including industry, construction, and selected wholesale and retail trade), no instruments focused on risk financing, especially on the equity side.[49] Both instruments were not big-ticket items, compared to portfolio guarantee for SMEs (also a CMZRB instrument). • Overall, the policy mix tended to disburse more to older firms, indicating a lack of support for potential entrepreneurs with innovative ideas and concepts.	23

[49] The ESIF Fund-of-Funds Czech Republic was launched in 2017 and was not operation over the analysis period, and thus was not included in this analysis. The Fund-of-Funds provides venture capital for financial intermediaries that invest into seed- and accelerator-stage companies.

Key SME productivity issue (country needs)	Relative importance in the policy mix (based on disbursed values)	# of instruments targeting need
Added focus on vulnerable groups, such as women	• There was an insufficient focus on women's entrepreneurship (only 12 percent of instruments target women) despite the fact that close to one-fifth of disbursements went to support entrepreneurship goals.	11

Source: Authors' elaboration.

3.3.1. Cluster analysis of the SME policy mix[50]

Conducting a cluster analysis of the SME policy mix in the Czech Republic highlights two issues, namely: a lack of synergy between instruments across agencies and possible unnecessary duplication of instruments within agencies. The cluster analysis evaluates the internal consistency of the policy mix, to determine where there are overlaps in the following areas: objective, type of instrument and beneficiary focus. This analysis uncovered two main concerns: (i) a lack of coordination between agencies and (ii) overlaps in the focus of agency instruments. On the one hand, the lack of synergy suggests opportunities to boost complementarities and coordination across agencies. On the other hand, instrument redundancy indicates opportunities for instrument rationalization. Both can lead to reallocation of resources by sharpening the focus of existing instruments and/or by integrating, consolidating or eliminating instruments.

There is a lack of synergy between agencies given overlapping focus in objectives, instrument type, and beneficiary focus across agency instruments.

- There were 9 instruments in Cluster 1 involving three agencies that had the same focus on objectives in R&D, technology adoption and technology transfer, reliance on grants as a mechanism of intervention, and grantee targets (i.e., formal firms--including state-owned enterprises--research institutes and universities) (Table 3). The substantial overlap in the scope of the instruments delivered by different implementing agencies may indicate opportunities for reducing costs by combining their administration under one agency. Yet, there may also be a justification for separate interventions: for example, TACR is nationally-funded and thus has a nationwide focus. Conversely, API has a regional focus (outside Prague) given the source of funding (ERDF). Nevertheless, this suggests

[50] For more information on cluster analysis methodology and results for Czech Republic SME instruments, please refer to Annex 5.

significant duplication of effort among agencies, particularly in terms of achieving innovation and technology transfer objectives for SMEs.

- CzechTrade instruments appeared only in Cluster 2. Many of its instruments overlap with that of CzechInvest and API, particularly in regards to the linkages objective. This indicates an opportunity to merge instruments given the similar nature of these two agencies' work.

Table 3. Overlapping focus between agencies (Clusters 1 and 2) and within an agency (Cluster 6)

Overlapping focus			Instrument	Agency
Objectives	**Instrument type**	**Beneficiaries**		
Cluster 1				
R&D/non-R&D innovation as well as technology transfer	Grants	Formal firms, SOEs, research institutes, universities	Innovation project, innovation vouchers, infrastructure services	API
			Epsilon, Alfa, Delta, Theta, Competence Centres	TACR
			TRIO	MIT – RDI department
Cluster 2				
Linkages between domestic and international firms/investors	Grants	Formal firms	Marketing	API
	Networking	Startups (unregistered)	CzechLink Start	CzechInvest
	Grants (Design for competitiveness); Networking (NOVUMM)	Formal firms	NOVUMM New Marketing models for exhibitions and fairs, NOVUMM KET New Marketing models for exhibitions and fairs in key enabling technologies, Design for competitiveness (phase 2)	CzechTrade

Overlapping focus			Instrument	Agency
Objectives	Instrument type	Beneficiaries		
Cluster 6				
Non-R&D innovation/ technological adoption	Grants	Formal firms, individuals, cooperatives, consortia	Technology, Smart Grids I, Smart Grid II, Energy Savings, Energy Savings in SHS	API

There are also redundancy issues within individual agencies. API's five instruments have an overarching focus on technological adoption and grants and target the same types of beneficiaries. This overlap hints to a lack of scale of the instruments—in fact, some of these instruments had one of the lowest number of beneficiaries (e.g., Smart Grids II had 3 grantees, Smart Grids I had none, and Energy savings in SHS had 8, while Energy savings had 138). The full overlap among these instruments provides opportunities to consolidate instruments, unless there is some justification for separate interventions that is not captured in the policy mapping. One possible solution is to integrate small instruments into bigger instruments (Table 3).

The segmentation analysis finds that groups of instruments generally had different emphases, although EU-funded API instruments tended to be common across groups. Every cluster group formed seems to indicate non-similar objectives—for example, Cluster 4 focuses on access to finance whereas Cluster 3 has skills and entrepreneurship goals. However, Clusters 5 and 6 have the same objective focus on technological adoption (the main difference is that Cluster 6 also targets cooperatives and consortia and associations). Moreover, API instruments are in 4 out of 6 clusters, further indicating the countries' reliance on EC funding to achieve SME-related objectives.

- Cluster 1 (innovation): Comprised of 20 instruments; mostly from API and TACR; focused on R&D innovation, non-R&D innovation/technology adoption as well as technology transfer; all are grants-based; broad beneficiary focus (formal firms, cooperatives, SOEs, research institutes and universities).
- Cluster 2 (export diversification): Comprised of 26 instruments; mix of API, CzechInvest, CzechTrade, EU (COSME, H2020) instruments; mixed objective focus (e.g., exports, entrepreneurship, technology transfer); primarily grants with a mix of collaborative networks and public platforms/websites; beneficiary focus on formal firms and consortia and associations.
- Cluster 3 (entrepreneurial skills): Comprised of 13 instruments; from CzechInvest and Enterprise Entrepreneurship Network; focused on skills, entrepreneurship and access to finance; focused on technical assistance in the form of business

education/advisory/training; beneficiary focus primarily on formal firms with some instruments targeting unregistered startups (young firms), research institutes, universities and business support organizations.

- Cluster 4 (access to finance): Comprised of 12 instruments; from CMZRB and EU (COSME/H2020); focused on access to finance via credit guarantees (6 instruments), loans (4 instruments) and equity (2 instruments); beneficiary focus on formal firms and financial institutions.
- Cluster 5 (technological adoption through mixed methods): Comprised of 15 instruments; mix of API, CzechInvest, and one instrument apiece from EU (COSME) and MLSA; focused on non-R&D innovation/technological adoption; primarily grants with some instruments also offering a mix of grants and business education/advisory services; beneficiary focus on formal firms and individuals.
- Cluster 6 (technological adoption through grants): Comprised of 7 instruments; mostly from API; focused on non-R&D innovation/technological adoption; all are grants-based; beneficiary focus on formal firms and individuals, as well as cooperatives and consortia and associations.

While the ubiquity of API instruments suggest that these instruments do not seem to have clear aims, it also shows that these instruments are contributing to SME Strategy 2014-2020 goals. Yet, API instruments may be missing areas of emphasis, such as entrepreneurial skills and access to finance (especially risk financing, which is a clear policy need).

3.3.2. Quality of the Policy Mix: Summary of the Assessment

- The SME policy mix is aligned with the policy needs to improve productivity growth of firms, especially that of lagging firms (more likely to be SMEs than large firms). However, there may be gaps and policy needs in certain areas, such as to improve management capabilities and adoption of key I4.0 technologies (big data, automation, etc.) to catch up with more productive large and foreign firms.
- The policy mix is aligned with stated objectives articulated in the SME Support Strategy 2014-2020, such as on boosting business R&D, technological adoption/diffusion and entrepreneurship.
- Allocated and disbursed SME budget were concentrated in a few instruments. That is, around 10 percent of instruments accounted for three-quarters of disbursed SME funding. There was also heavy reliance on EC funding, particularly on ERDF, among these agencies.
- There was an apparent focus on improving firm capabilities through non-R&D innovation, (technology adoption/diffusion) as a channel towards improving productivity growth. Instruments that targeted improving management practices were rather scarce.

- There was an overwhelming focus on grants/matching grants as a mechanism of intervention. The policy mix portfolio is weak in terms of instruments that crowd in the private sector and/or stimulate markets, such as credit guarantees, vouchers and linkages programs. These indirect support instruments tend to be more common tools employed in relatively advanced economies.
- Focusing on finance through grants as the primary mechanism of intervention is unlikely to support improvements in SME capabilities, because financial imperfections are not the main constraint on SME productivity. More emphasis should be given to building capabilities with business advisory, technology extension services, and collaborative activities (whether stand-alone or complementing grants).
- About half of grant instruments used a single co-financing rate, while the remaining used 2-3 co-financing criteria. Smaller firms tended to have a larger co-financing rate (ranging from 45-70%). Overall, the design of co-financing mechanisms within matching grants looks relatively similar across projects, although co-financing mechanisms may be more effective when different projects, objectives and beneficiaries are considered.
- Grants were used to finance firms' operations, such as acquiring machinery and equipment as well as licenses and software. Little grant funding was devoted to the development of skills (e.g., advanced digital skills, managerial skills). There was a wide variation of average funding per grantee (from 3600 CZK to 38 million CZK). By subsidizing firms' operations, these instruments may be contributing to the observed resource misallocation in the Czech economy.
- Over half of SME disbursed budget was focused on formal firms. Marginal groups, such as women entrepreneurs, do not appear to have been a strong focus of SME support. Yet, supporting women entrepreneurship emerges as a key policy need given sub-optimal female labor force participation.
- SME support instruments had an apparent focus on the manufacturing sector and had a regional focus outside of Prague. This reflects the dependence on EC funds, which prioritize support to lagging regions as part of EU cohesion policy. However, if the objective is to achieve gains from the I4.0 wave, the regional focus might not be the right approach. For example, Prague-based SMEs are more likely to have lower technology gaps with the frontier. Thus, providing more support to Prague SMEs could hasten the catch-up (convergence) process with SMEs in Germany and Austria.
- In terms of the firm life cycle, support instruments tended to focus on existing firms rather than the creation of new ideas. For example, only 13 percent of disbursed funds were focused on the ideas/concept stage. Yet, R&D-driven startups are likely the Czech Republic's most promising path to productivity gains and growth.
- Analysis of the policy mix targeting I4.0 creation and adoption reveals a concentration of funds in a handful of instruments, dependence on EC funding under one agency (CzechInvest's OPEIC instruments), dependence on grants as a funding type, and an

expected focus on manufacturing and regions outside Prague. Nevertheless, compared to an analysis of the entire portfolio of instruments, I4.0-associated instruments tended to have a more diversified set of objectives that focused on both invention and imitation, as well as a more diversified set of target beneficiaries, including formal firms as well as knowledge-creating institutions.

- Cluster analysis of the SME policy mix highlights two main issues: (i) a lack of synergy between instruments across agencies and (ii) unnecessary duplication of instruments within agency.

4. RECOMMENDED AREAS FOR POLICY ACTIONS

Boosting productivity growth of SMEs in the Czech Republic requires addressing binding constraints at the firm level, as well as broader structural issues. Lagging firms (often SMEs) have to converge towards more productive firms (often large and foreign-owned) to benefit from economic growth in a shared manner. The aging population and prospects for digitization and I4.0 are increasing the demand for skilled labor. This puts SMEs at a disadvantage, as skilled workers are likely to gravitate towards higher-paying and more productive firms. SMEs need to accumulate the necessary managerial and digital capabilities (change and data management, internal stock of digital skills) to actively participate in I4.0 and reap its benefits.

This section offers a set of recommendations to foster productivity improvements through strengthening the effectiveness and coherence of the SME policy mix and addressing needs that are: (i) external-to-the-firm (between firm growth), such as the operating business and entrepreneurial environment, and (ii) internal-to-the-firm (within firm growth), such as business R&D, skilled human capital, managerial and technological capabilities, and knowledge collaborations. These recommendations are further nuanced based on three types of SMEs: newly created firms (start-ups), growing firms and mature/established firms[51] (Table 4 provides a matrix of these recommendations). It is important to note that the second phase of the CR SME Support project (ending June 2020), which consists of supporting the MIT in the development of the Strategy 2021+ and Action Plan, will involve further development of these policy directions into more practical and actionable policy actions and initiatives.

4.1. Improve the effectiveness and coherence of the SME policy mix

Approach: The SME policy mix can be improved by making it more coherent and rationalizing the SME instruments. Essentially, it is critical to rationalize existing instruments that are inefficient or ineffective, and to improve the quality of design, implementation and coordination of instruments.

- **Increase coherence of strategy mix:** It is important to create synergies across national and regional strategies (e.g., innovation policy, export strategy, RIS3 strategy, etc.) and to

[51] A nuanced approach hinges on the assumption that different types of firms face different challenges and thus systematic support for these firms is crucial for productivity improvements. Annex 3 provides a snapshot of the types of support based on the firm life cycle.

link these to the SME Support Strategy 2021+ and Action Plan currently under preparation. The series of consultations on the SME Strategy that the MIT is planning with private sector representatives, associations, and other stakeholders should be complemented by in depth discussions with relevant public sector stakeholders on the national and subnational levels to ensure coherence of the policy mix in the coming period. The MIT is well positioned to lead these consultations and outline the strategic framework for the SME agenda moving forward.

- **Rationalize instrument mix:** Rationalizing instruments reduces the barriers to entry for SMEs, who are more likely than large firms to face difficulties in responding to calls for grant proposals due to constraints on time, costs, and access to information. That is, the current system of support for SMEs is fragmented across many themes. This calls for reviewing the policy mix to combine instruments that have similar objectives, beneficiary target and instrument type, for example, thus increasing the thematic concentration of financial resources.[52]
- **Reconsider the choice of instrument type:** The emphasis on grants/matching grants presumes that access to finance is the market failure that hinders SMEs from engaging in more productive behaviour. However, this is not always the case, given that SMEs also face capability issues. Therefore, complementing grants/matching grants with soft support, such as business advisory, extension services, and training services to upgrade human capital skillsets among SMEs, should be considered. Instrument design should consider both the market failure being addressed and the needs of specific firm types (for example, young firms are less likely to benefit from indirect measures such as tax incentives, given that they are unlikely to be operational, not registered, and on a cost recovery stage in their productivity-enhancing activities).
- **Crowd-in private sector participation in more productive activities:** The private sector can be encouraged to participate through increasing business R&D and risk investments (Recommendation 2 & 3), improving management capabilities (Recommendation 4) and boosting intra-firm and inter-industry collaboration (Recommendation 6). Private sector participation is crucial to reduce reliance on public funding, especially from the EU. Moreover, it is necessary to prepare for reductions in the volume of EU funds.
- **Address gaps in the policy mix:** Some areas considered to be country needs, such as management capabilities, are left unaddressed. To date, no strategy in the Czech Republic highlights the need to support the managerial capability of firms as a priority. Yet, there is a growing literature providing evidence from developed and developing countries that management practices within firms are correlated with productivity (Bloom et al. 2013). These management practices can come in the form of adoption of quality standards, lean manufacturing, human resource (HR) incentives management, target setting and monitoring, and operational management.

[52] Table 3 showcases instruments with potential overlaps

4.2. External-to-the-firm Recommendations

4.2.1. Recommendation 1. Address constraints related to the operating business environment and competition policy

Problem: Subnational-level gaps on Doing Business contribute to gaps in innovation among SMEs. There are also national impediments, such as the high cost of bankruptcy. Additionally, there is evidence of distortions to resource allocation and restrictiveness to competition. These constraints stifle the movement of resources towards more productive activities because of the lack of a market that rewards innovative activities.

Approach:

- **Remove barriers to resource allocation**. Eliminating regulatory restrictions to competition will be instrumental for enabling more productive firms to grow, and consequently boost aggregate productivity. The country needs analysis revealed that product market regulations are more restrictive to competition in the Czech Republic than in Germany or when compared to the average of the top 5 OECD countries. Data suggests that distortions induced by state involvement and barriers – particularly driven by public ownership (specially governance of SOEs) and to domestic and foreign entry (particularly administrative burdens on start-ups; especially licenses and permits) – seem to play equal roles in explaining the overall level of restiveness to competition. Thus, there is need to conduct an in-depth assessment of product market regulation in the country to identify specific sources of competition and market constraints.
- **Address subnational business environment gaps by using Prague as best-practice example:** Prague ranks on the frontier across all Ease of Doing Business indicators, for example in 'getting electricity' and 'enforcing contracts', compared to other Czech cities. Thus, secondary cities can learn from Prague's good practice experience (World Bank 2018). Nevertheless, addressing such gaps requires a localized approach as well.
- **Address bottlenecks by considering the life cycle of firms:** New firms, firms already operating, and exiting firms are likely to face different Doing Business constraints. For example, new firms face obstacles in starting a business, whereas exiting firms may face higher bankruptcy costs. Growing firms may face firm operations constraints, including administrative burdens. Examples that would be useful to consider in improving the rules for starting a business include allowing a simple notification to serve as VAT registration (as in Croatia or Portugal), or over the medium term, consolidating VAT and corporate income tax registration with initial company registration with the court (as in Hungary) (World Bank 2018). Other examples include one-stop-shop measures where all ministries can review online permit applications (Ibid).

4.2.2. Recommendation 2. Promote innovative entrepreneurship and remove impediments to ventures' growth

Problem: Despite the availability of a myriad of entrepreneurial support instruments, deal flow of investable and high growth potential start-ups is still limited and concentrated in easy entry sectors (such as ICT).[53] The early stage risk finance market is underdeveloped and firms lack investment experience, especially in deep tech and I4.0.

Approach: Early stage innovative firms, due to their higher risk profile, often require risk capital to grow. Yet, the country has an underdeveloped risk financing capital market, such as venture capital and business angel financing.

- **Leverage domestic capital markets to invest in risky activities with economic potential:** Minimizing the financing gap in the early stages can be done by developing a risk financing market. One approach would be to develop the business angel market in the Czech Republic through a mix of demand-side (creating a pipeline of investable deal flows) and supply-side (incentivizing individuals to become a business angel investor) measures.[54]
- **Facilitate increased participation of young firms in bank-led support programs:** This could be achieved through complementing financing measures (loans, guarantees) with business advisory and technical assistance services (planning, legal advice, management, etc.).[55] Nevertheless, to ensure effective implementation and take-up of such instruments, the trust and buy-in of the private sector must be secured (through promotion of good cases).

4.3. Internal-to-the-firm Recommendations

4.3.1. Recommendation 3. Enable SMEs to develop innovative capabilities and invest in R&D

Problem: Currently, business R&D is driven by large and foreign-owned firms and there is limited demand for innovation among SMEs. Additionally, private R&D activity is mainly driven by public spending (particularly EC instruments) which creates dependency and vulnerability.

[53] While there are many startup support instruments, support services tend to be soft and aggregate funding levels are small. The majority of startups are in ICT, and there are currently about 50 startups in the I4.0 space (See Aridi and Querejazu).
[54] See Aridi, et al (2018) for a diagnostic as well as policy recommendations on how to develop and activate the business angel market in the Czech Republic.
[55] CMZRB INOSTART program that supports innovative companies is a good candidate, given that the scale of support for young innovative firms remains small.

Approach: There is room for increasing business R&D, given that the contribution of the Czech private sector (especially SMEs) lags behind its peers. A two-pronged approach is envisioned: expanding the base of SMEs engaging in R&D (extensive margin) and increasing R&D among SMEs (intensive margin).

- **Introduce promotional and indirect schemes to leverage business innovation and R&D investments:** Innovation is inherently a risky activity. Public support aims to reduce the risk for the private sector, especially startups and SMEs, to invest in innovation and ease informational barriers. In addition to the existing co-financing schemes, indirect measures such as fiscal incentives (e.g., business angel tax incentives[56], R&D tax credits[57]) and promotional schemes should complement the existing policy mix portfolio (and possibly reduce the over reliance on grants). In addition, promotional and access to information schemes targeting domestic SMEs can help increase take-up of existing instruments.

4.3.2. Recommendation 4. Build managerial capabilities that can leverage productivity-improving technologies.

Problem: Within-firm productivity gaps can be attributed to poor managerial practices and weak technology adoption and diffusion among lagging SMEs, compared to larger and more established firms. SMEs face information barriers that impede their awareness of the potential benefits of digitization and tech adoption.

Approach: Internal capabilities can be improved through adopting professional managerial practices and quality standards to be able to leverage the potentials of digitization and I4.0 technologies. Raising awareness of the potential benefits of digitization and tech adoption should be emphasized.

- **Improve management practices of SMEs:** SMEs, especially family-owned firms, have significant potential to leverage external management services and consultancies and adopt international quality standards that could upgrade their capabilities to growth, export, and connect to suppliers.[58] Instruments could target managerial capacity

[56] See discussion on tax incentives for stimulating business angles activities in Aridi et al. (2018)

[57] Recent evidence from the US finds that the introduction of state-level R&D tax credits has a positive effect on entrepreneurial activity. See Fazio, Guzman, Stern (2019). The Impact of State-Level R&D Tax Credits on the Quantity and Quality of Entrepreneurship. NBER Working Paper (No. 26099). Available here: https://www.nber.org/papers/w26099
For an overview of different international experiences in fiscal incentives, see: Guceri, Irem; Zolotarev, Andrey P.; Aridi, Anwar. 2017. Ukraine - Fiscal incentives for science, technology and innovation activities: good practice review report. Washington, D.C.: World Bank Group.
http://documents.worldbank.org/curated/en/928361509629258438/Ukraine-Fiscal-incentives-for-science-technology-and-innovation-activities-good-practice-review-report

[58] Literature shows that leveraging professional management services (non-family members) to manage companies allows fresh ideas to seep into the business, thus enabling productivity improvements such as in production processes and efficiency improvements.

upgrading, and such services could be promoted among family-owned business (through SME associations and regional authorities and intermediaries).

- **Help identify technology and digitization needs depending on SME/firm type:** Programs could assist SMEs in identifying their digital/technical needs through data-focused competitions[59], self-diagnosis tools, and/or technology extension services. Adoption of solutions related to data collection, big data analytics, e-commerce, machine learning, and artificial analysis could help SMEs upgrade and connect to GVCs. Such soft and promotional instruments and activities could help alleviate some of the knowledge barriers the prevent SMEs from improving their productivity.

4.3.3. Recommendation 5. Invest in digital and I4.0-ready human capital

Problem: A lack of skilled labor hinders the productivity growth of SMEs. Access to and retention of technically strong and digitally-savvy workers is especially difficult for SMEs aiming to adopt I4.0 solutions, as they are at disadvantage when competing with more established and bigger firms.

Approach: Recruit and invest in (*reskill workers*) digital and technical talent.

- **Recruit and accumulate digital skillsets:** Employees with needed digital skills could be trained through training and capacity building modules on data science, analytics, cloud computing, digital marketing and sales, and other digital tools. Such HR upgrading activities could be supported through existing (or adjusted) national and European instruments and programs.

4.3.4. Recommendation 6. Establish knowledge channels and systematic collaborations to boost innovation potential.

Problem: Current collaboration methods are ad-hoc rather than systematic. This hinders knowledge transfers and spill overs of technology, especially from MNEs and universities. Lack of collaboration is often cited as a contributing factor to Czech firms' status as a 'moderate' innovator (performing below EU average). Weak collaborations and local knowledge linkages also hinder the development of regional innovation systems.

Approach: Encourage collaborations and linkages with other firms and public research organizations.

- **Strengthen linkages between SMEs and foreign and large firms:** FDI inflows contribute significantly to the economy in the Czech Republic through the manufacturing sector. Yet

[59] Such as the SSP challenge-driven platform CoFit run by Czech Technical University.

these foreign firms are often delinked from the local economy, thereby contributing to productivity gaps. Best-practice measures to strengthen linkages include establishing supplier development programs to help SMEs meet the higher value-added production requirements of foreign firms. Moreover, FDI can be channeled into activities that have potential for innovation, higher value-added and linkage spill overs. For example, multinationals can be incentivized to locate innovation activities in the country. These collaborations nevertheless often require having good managers who are able to see the benefit of such collaboration.

- **Improve SME-academia collaboration:** Direct and indirect incentives for collaboration could be increased. Good practice examples of successful cases of collaboration could likewise be promoted, such as those from TACR programs (e.g., automotive and universities). Institutional measures could also be implemented, such as tying research funding to the performance of higher education institutes, which could more effectively channel resources towards results-based applied research projects. Currently, R&D institutional funding to higher education/research institutes is not tied to performance (European Commission DG Research & Innovation 2019). Financial incentives for technology transfer could also be considered, including promotion of collaboration between research institutions and SMEs.

Table 4. Matrix of recommendations for productivity growth of SMEs in the Czech Republic

Newly created firms/start-ups		
External-to-the-firm	**Business environment**	• Address business entry requirements for start-ups to lower the cost of business entry
	Access to finance	• Finance innovation through instruments targeting startups, such as business angel financing (see Aridi, et al 2018 for business angel diagnostic of the Czech Republic) as well as bank-led support programs
Internal-to-the-firm	**Innovative capabilities**	• Experiment with promotional and indirect schemes to leverage business innovation and R&D investments
	Managerial capabilities	• Improve managerial capabilities of technically strong startup teams • Help identify technology and digitization needs in the start-up sector
	Digital and I4.0-ready human capital	• Further enhance advanced digital skills and STEM education as they relate to start-up labor needs

	Knowledge channels and collaboration	• Create collaborative projects with other firms (start-ups/larger firms) and knowledge providers
Existing and growing SMEs		
External-to-the-firm	**Business environment**	• Address doing business (firm operation) constraints at the subnational levels by using Prague as best practice example • Address national level constraints such as high costs of bankruptcy to incentivize reallocation of resources to more productive sectors
	Access to finance	• Ensure effectiveness of existing instruments that finance innovation for SMEs
Internal-to-the-firm	**Innovative capabilities**	• Invest in technological adoption and diffusion as a catch-up strategy (especially for lagging firms) and as an export diversification strategy for value chain upgrading • Improve incentives for SMEs (especially lagging firms) to absorb innovative and technological capabilities
	Managerial capabilities	• Improve managerial quality across the four dimensions of management practices (operations, targeting, monitoring, human resources) • Help identify technology and digitization needs among growing firms
	Digital and I4.0-ready human capital	• Increase the pool of qualified workers who are I4.0-savvy • Ensure worker mobility • Address skills mismatches in labor markets to minimize worker competition with large firms • Minimize productivity gaps with large/foreign-owned firms by investing in education and training of workers especially, as for I4.0 related needs • Continue/boost skills development via on-the-job training for current employees and future hires
	Knowledge channels and collaboration	• Incentivize collaborative projects between SMEs and other knowledge providers • Implement linkages programs to enhance linkages between domestic firms and multinationals • Create collaborative projects with large firms and multinationals to boost inter-firm linkages as potential for knowledge/technology transfer • Build collaboration with non-linked domestic firms (with export potential) to increase the pipeline of supporting industry firms

Mature/established SMEs		
External-to-the-firm	**Business environment**	• Address doing business (firm operation) constraints at the subnational levels by using Prague as best practice example • Address national level constraints such as high costs of bankruptcy to incentivize reallocation of resources to more productive sectors
	Access to finance	• Ensure effectiveness of existing instruments that finance innovation for SMEs
Internal-to-the-firm	**Innovative capabilities**	• Incentivize long term R&D and technological programs by investing in systematic applied research, especially as it relates to I4.0 • Boost accumulation of technological capabilities and R&D spending for invention to catch-up with more innovative country peers • Improve capabilities to commercialize cutting-edge products and processes especially as it relates to I4.0 as well as for export diversification
	Managerial capabilities	• Improve managerial quality across the four dimensions of management practices (operations, targeting, monitoring, human resources), especially that of family-owned firms • Help identify technology and digitization needs among mature firms
	Digital and I4.0-ready human capital	• Improve the stock of STEM workers and R&D personnel • Ensure worker mobility • Address skills mismatches in labor markets • Identify and address deficiency in specific STEM/advanced digital skills • Continue/boost skills development via on-the-job training for current employees and future hires
	Knowledge channels and collaboration	• Continue collaborative projects between industry and universities/research institutes, and build collaboration with growing SMEs and start-ups (as applicable) • Build collaboration with non-linked domestic firms (with export potential) to increase the pipeline of supporting industry firms • Implement linkages programs to enhance linkages between domestic firms and multinationals

Source: Author's elaboration.

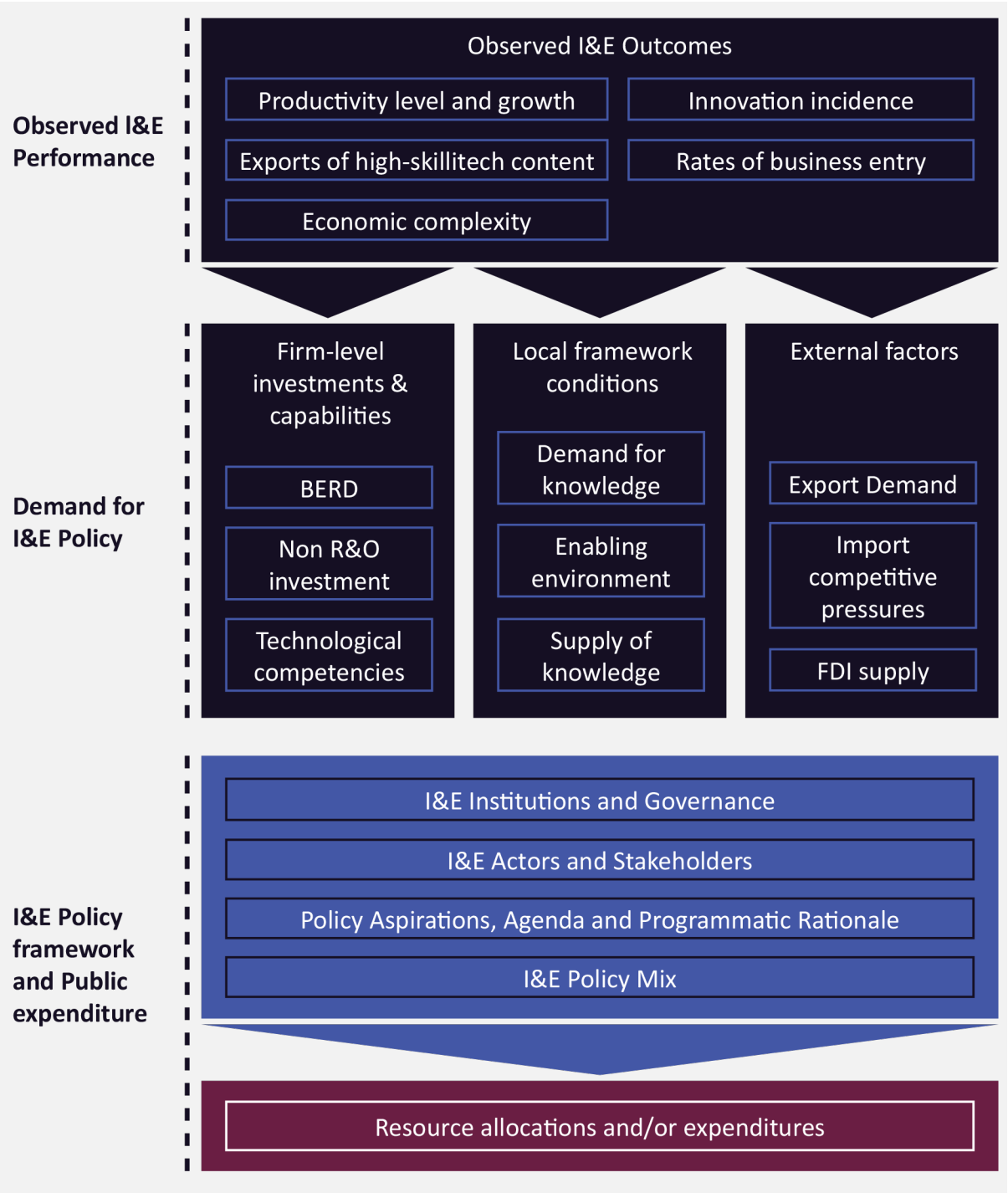
ANNEX 1: ANALYTICAL FRAMEWORK AND METHODOLOGY

The framework described here aims to answer the following questions: (a) How well is the SME policy framework addressing market and system failures? and (b) Is the allocation of public resources for SMEs consistent with the policy framework? To answer these questions, the country needs assessment provides an overarching approach to understand how consistently the country's policies and instruments respond to SMEs needs. The observed innovation and entrepreneurship (I&E) demand gaps will enable policy makers to identify policy measures to address these unmet needs for SMEs. The framework considers firms to be the main unit of analysis. As such, firm-level investments and capabilities are considered as part of the identification of productivity demand gaps, with a particular focus on SMEs. Further, this framework recognizes that not all observed outcomes remain within the control of policy makers. As such, many demand determinants are exogenous (for example, external competitive pressures, level of demand for Czech exports, and availability of foreign capital). Figure 57 provides an overview of the framework.

This analysis relies on both primary and secondary data sources. Czech Republic is benchmarked against its neighbors, namely Germany, Poland, Slovak Republic, Austria and Hungary. The analysis relies on a systematic review of relevant research papers and reports, and aggregated data from Eurostat, OECD STI Statistics, among others. In parallel, an empirical analysis – drawing on the Structural Business Survey (SBS) and CIS data, maintained by the Czech Statistical Office – was conducted to assess firm-level drivers of productivity and innovation.[60] Finally, the assessment of the SME policy mix relies primarily on qualitative interviews with public entities working on SME issues to map the SME-related instruments. A total of 93 instruments were identified, and a formal cluster analysis of the instrument mix was conducted to determine overlaps in objective, type of instrument, and beneficiary focus.

[60] See Davies, Iootty and Zouhar (2019) for more details.

Figure 57. Analytical framework to assess unmet needs for SME policies



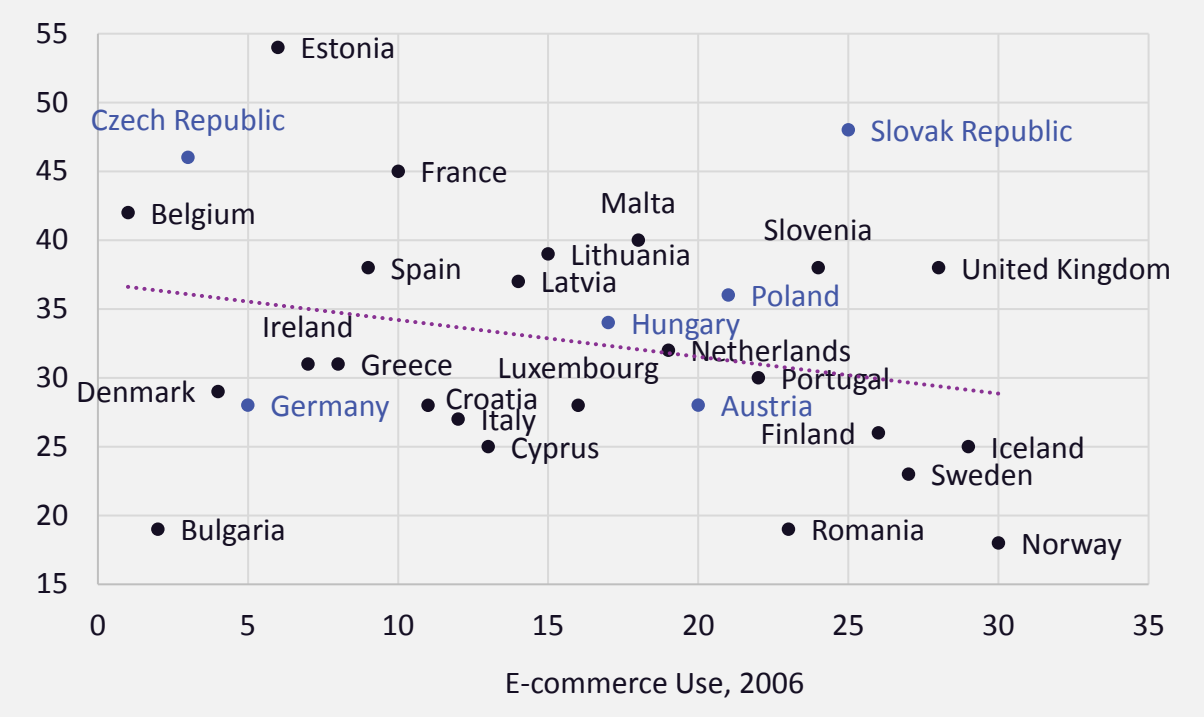
Source: Adapted from Frias (2015).

Note: BERD = Business enterprise expenditure on R&D; R&D = Research and Development; I&E = innovation and entrepreneurship.

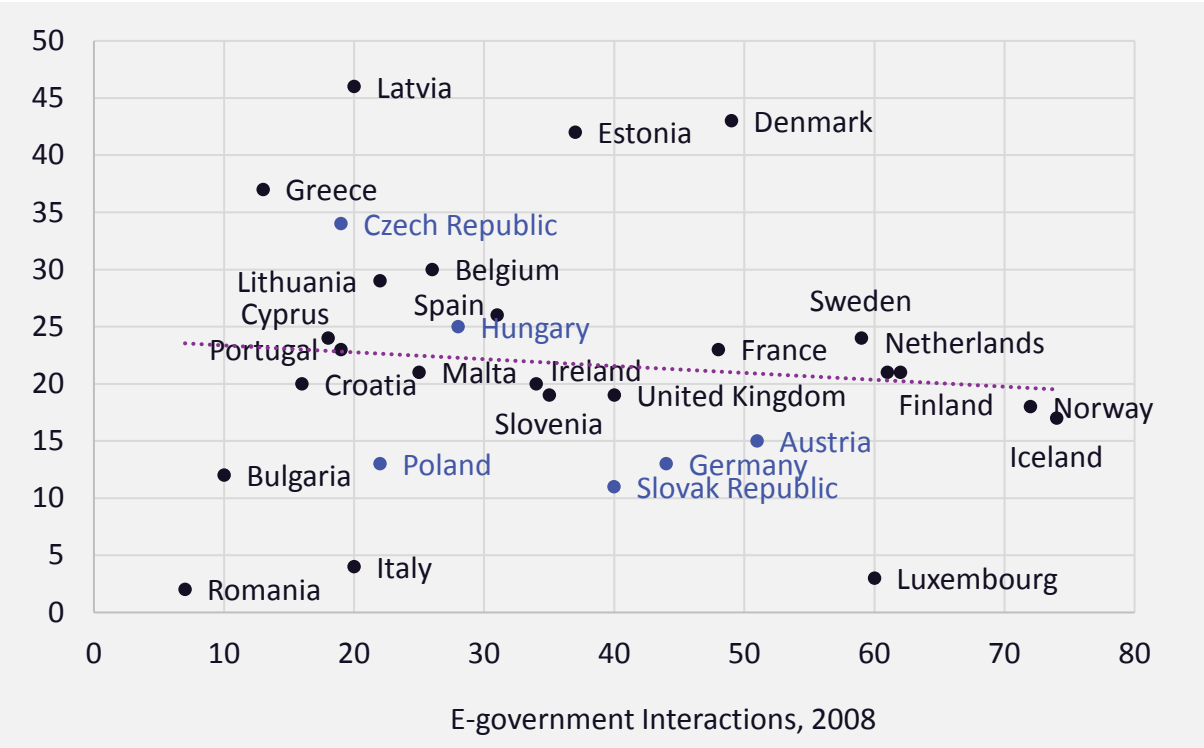
ANNEX 2. DIGITIZATION FIGURES

Figure 58. Digitization figures

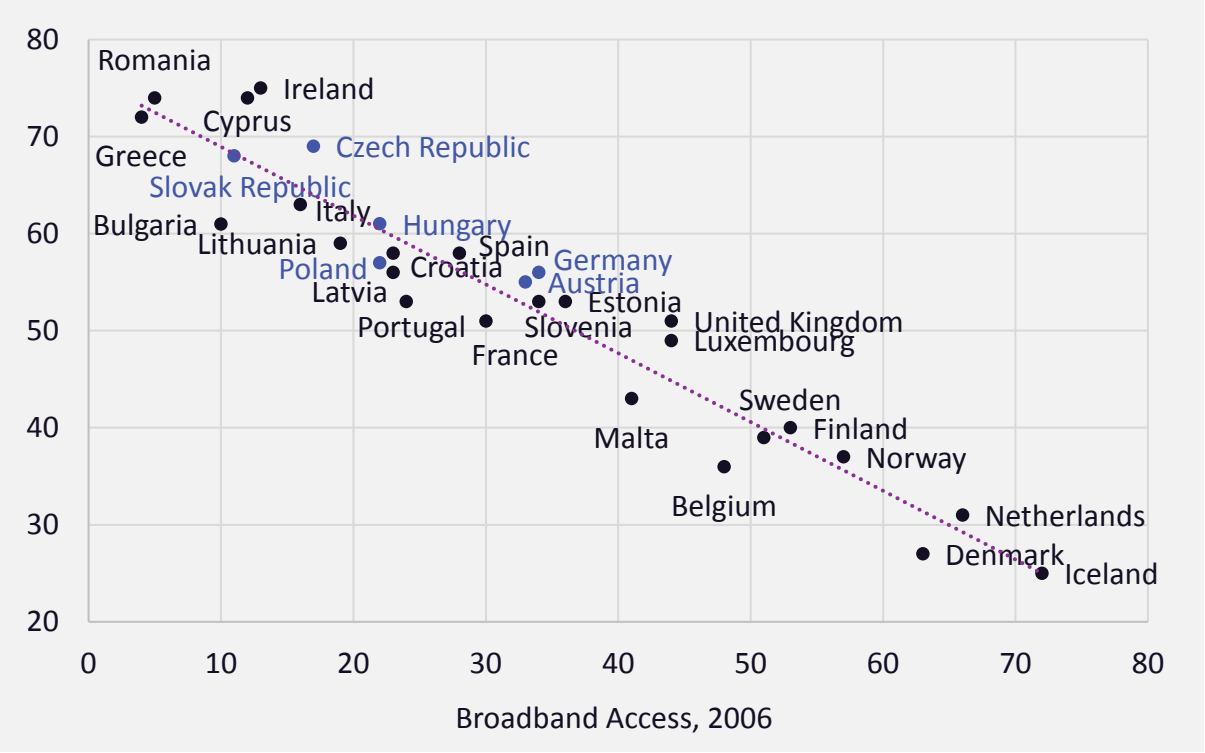
Change in E-commerce Use, 2006-2018



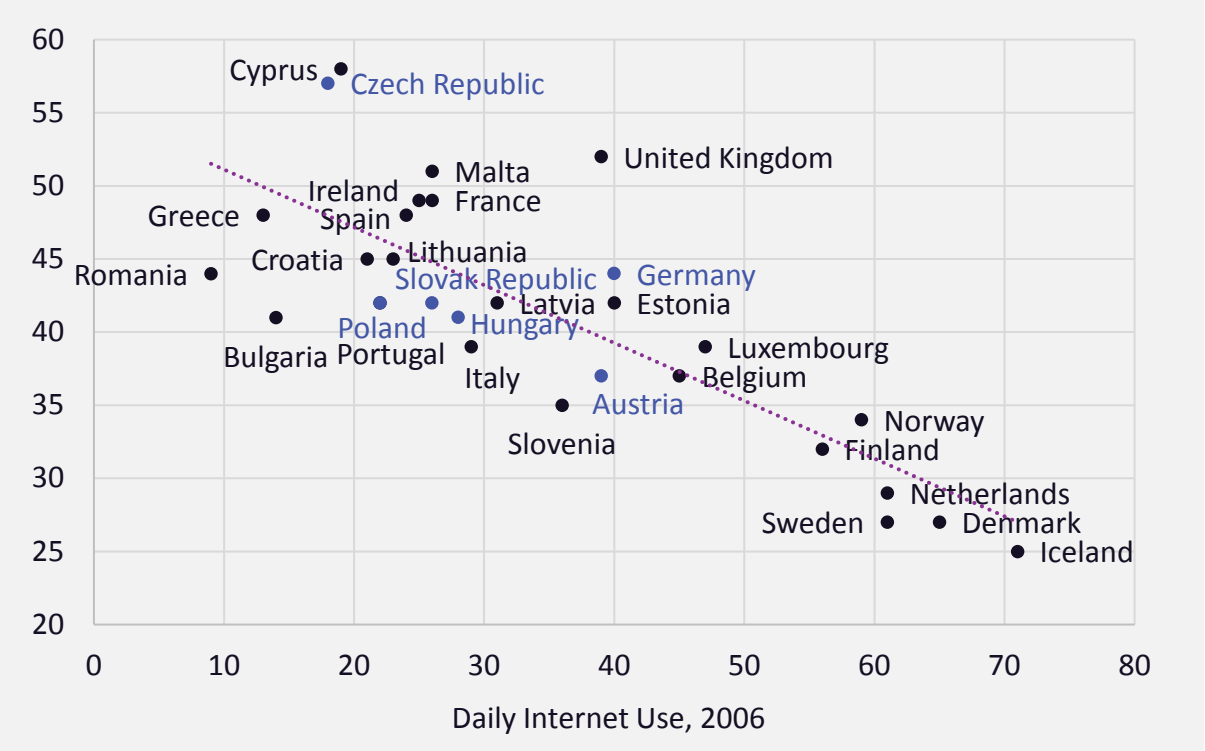
Change in E-government Interactions, 2008-2018



Change in Broadband Access, 2006-2018



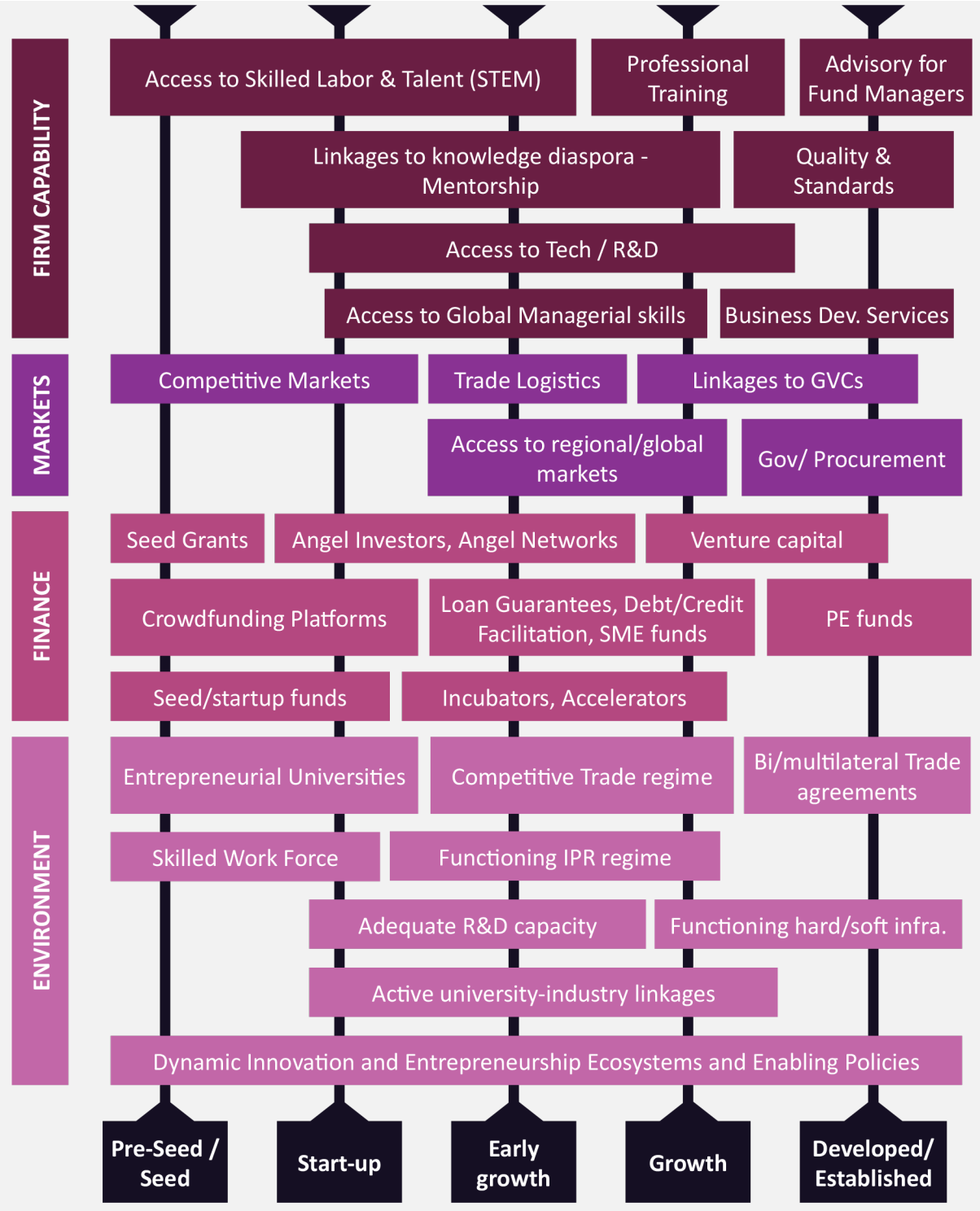
Change in daily internet use, 2006-2018



Source: Eurostat.

ANNEX 3. TYPES OF FIRM-LEVEL SUPPORT BASED ON THEIR LIFE CYCLE

Figure 59. Types of firm-level support based on their life cycle



ANNEX 4. CZECH REPUBLIC SME-RELATED STRATEGIES: A SUMMARY

SMEs development/ Entrepreneurship (State level)

SME Support Strategy 2014-2020

Overarching objective of strategy:

To support SME competitiveness which will be based on: High-quality and competitive products and services; Continuous increase in innovation capacity; Ability to produce new ideas and greater use of intellectual property protection; Ability to use research knowledge and results primarily created at domestic research organisations; Ability to react flexibly to customer requirements and to reflect them in innovated products; Application of skills arising from efficient use of the Internet and ICT; Qualitative as well as price advantage; Ability to succeed in the international market and to continue to expand both qualitatively and quantitatively; Effective cross-border cooperation.

Thematic areas and goals

- Enhancement of business environment, development of consultancy services and education for business;
- Development of enterprise based on support for R&D and innovation;
- SME internalisation support.

OPEIC 2014–2020

Overarching objective of strategy:

The strategy of the OP EIC is based on two intersecting pillars. The first pillar consists in common ideas and goals embodied in the Europe 2020 Strategy and the second one is represented by the priorities and needs of the Czech Republic identified in national and European strategic documents.

Thematic areas and goals

Complementary priorities:

- Raising the number of businesses capable of extending the technological boundaries of their industry;

- Developing entrepreneurship and lower-order innovation;
- Shift towards an energy-efficient, low-carbon economy consisting mainly in improving the energy efficiency of the business sector;
- Facilitating the development of entrepreneurship, services and access to government services by means of high-speed Internet access.

2012-2020 Export Strategy of the Czech Republic

Overarching objective of strategy:

To increase the number of exporters as well as the volume of exports and their benefits for long-term sustainable growth, employment and revenue for public budgets.

Thematic areas and goals

- Increase per capita exports by 25% by 2020, with a monitoring objective of 12% by 2016;
- Increase the number of exporters by 15% by 2020;
- Increase the number of exporters amongst SMEs by 50% by 2020.

Goals of the export strategy: (i) Diversify exports bound for countries outside the EU; (ii) Shift Czech exporters to higher value-added segments and industries in the value chains; (iii) Make maximum use of the positive synergies arising from the different pro-export activities of the state and the savings generated by the complementarity of the activities, an efficient coordination and cooperation of all stakeholders.

Updating the Export Strategy of the Czech Republic 2012-2020 (January 2017)

Overarching objective of strategy:

The main objective of the updated export strategy is now: “Increasing the number of exporters, especially among innovative companies, ensuring the sustainability of their export activities, increasing the volume and value of the added value of their exports and the number of jobs”.

Thematic areas and goals

The updated strategy identified key markets based on “sector-specific opportunities”, in addition to the original strategy’s aim of export diversification outside EU markets. It is expected that focusing on sectoral opportunities abroad and the expected future demand should support the introduction of innovations in enterprises and thus their competitiveness.

Strategic Framework Czech Republic 2030

Overarching objective of strategy:

Czech Republic 2030is a strategic framework for long-term development of Czech society, the objective of which is to improve the quality of life of all inhabitants of the Czech Republic while respecting natural limits. Based on the structural analysis of the contemporary condition and trends, the document formulates strategic and specific objectives the Czech Republic should fulfil by the year 2030.

Thematic areas and goals

Goals for economic development:

- The economy grows in long-term and the domestic sector is strong.
    - Domestic parts of the economy develop.
    - The SME sector grows.
    - The state supports the shift of the economy towards higher positions in the international division of labour and the international value chain.
    - The quality of FDI in the Czech Republic improves.
- The Czech Republic has well-functioning and stable institutions to support applied R&D and to identify opportunities in this area.
- The Czech Republic has a stable material and human capacity for R&D with the appropriate structure and direction, in which both the state and businesses invest sufficient financial resources.
    - Innovative enterprise activity is growing, based mainly on the results of domestic R&D, and the extent of cooperation between the academic and business sectors.
- Natural resources are used as efficiently and economically as possible to minimise the external costs caused by their consumption.

National Reform Programme 2018

Overarching objective of strategy:

Czech Government concept paper for economic and social policy aims to formulate key measures conducive to prosperity and sustainable growth:

- Fiscal and tax policy;
- Housing;
- Competitiveness: investment, business environment and public administration;
- Sectoral policies.

Thematic areas and goals

The Czech Republic will continue to concentrate on targeted support for SMEs in three priority areas: the fostering of a business environment, direct SME support, and improvements in the approach to financial resources and labour resources.

Issues surrounding a reduction in the administrative (regulatory) burden are also part of the complex of the National Programme Reform.

Industry 4.0 Initiative

Overarching objective of strategy:

The National Industry Initiative 4.0 aims to mobilize key sectors and industry representatives to develop detailed action plans in areas of political, economic and social life.

Thematic areas and goals

- Strengthening applied research funding;
- Establishing clear research priorities as a coordinating role for the state;
- Increase society-wide preparedness to implement Industry 4.0 oriented research;
- Raising awareness of the optimal use of the intellectual property system.

Innovation (State level)

National RIS3 strategy

Overarching objective of strategy:

To effectively target funds – European, national, regional, and private – at activities that lead to strengthening the research and innovation capacity and at promising areas and further to promote the reduction of unemployment and strengthen the economic competitiveness of the economy.

Thematic areas and goals

Six key areas in which the Czech Republic must achieve significant changes in order to strengthen the knowledge-intensity of the economy and to facilitate the development of the selected specialisation domains and their gradual refinement:

- Higher innovation performance of companies;
- Improved quality of public research;

- Improved economic benefits of public research;
- Better supply of HR, in terms of both quality and quantity, for innovative enterprise, R&D;
- Development of eGovernment and eBusiness to improve competitiveness;
- Improvement and better utilisation of social capital and creativity in addressing complex social challenges.

Innovation strategy 2019 - 2030

Overarching objective of strategy:

To increase the innovation performance of the whole economy.

Thematic areas and goals

- To increase R&D spending;
- To support protection of intellectual property;
- To support endogenous Czech companies, spin-offs and start-ups, both for academic research and for the natural needs of businesses;
- To support the most prospective centers of research infrastructure;
- Investments will be further geared towards promoting innovation and higher added value.

Regional Development (State level)

The Regional Development Strategy of the Czech Republic 2014-2020

Overarching objective of strategy:

To ensure a dynamic and balanced development of the Czech Republic's territory with respect to the quality of life and the environment, to contribute to the reduction of regional disparities and at the same time to allow the use of local potential for strengthening the competitiveness of individual territorial units.

Thematic areas and goals

- To enhance competitiveness and exploit the economic potential of regions (growth goal);
- To mitigate deepening of negative regional differences (balancing goal);
- To strengthen environmental sustainability (preventive goal);

- To optimize the institutional framework for regional development (institutional goal).

Digitalization (State level)

Digital Czech Republic 2013 – 2020

Overarching objective of strategy:

To identify and exploit the synergy effects that the ICT industry brings with it in the Czech Republic.

Thematic areas and goals

- To strengthen the digital economy with an emphasis on self-regulatory mechanisms;
- To support the development of high-speed access networks to the Internet;
- To increase ICT accessibility for all, regardless of location, social status or disability, and promote lifelong learning to enhance digital literacy.

The objectives of Digital Czech Republic v. 2.0 will be implemented through 17 measures.

Energy (State level)

National Action Plan for Energy Efficiency of the Czech Republic till 2020

Overarching objective of strategy:

The Czech Republic's national indicative target has been set at 50.67PJ (14.08 TWh) of new final energy savings by 2020.

Thematic areas and goals

Regulatory or economic instruments and education are actively used to increase energy efficiency in the Czech Republic over the long term. Economic instruments use both national funds and resources from the Structural Funds. These support instruments are targeted at households (e.g. Green Savings Programs, Panel - Regeneration of Prefabricated Houses, etc.), Industry (e.g. OPEIC, OPPIK) and Services (e.g. OPEIC, EFFECT).

The Czech Republic's National Energy and Climate Plan 2030 - 2050

Overarching objective of strategy:

Reduction of greenhouse gas (GHG) emissions, in an effort to increase the share of RES and increase of energy efficiency.

The goal of the Czech Republic is to reduce total GHG emissions by 30% by 2030 compared to 2005, which corresponds to a 44 million tonnes CO2eq emission reduction. The draft national plan also contains long-term indicative targets for 2050, based on the approved climate protection policy.

Thematic areas and goals

The document contains objectives and key policies in all five dimensions of the Energy Union.

Part of the decarbonisation dimension is also the area of renewable energy. Here, a Europe-wide target of 2030 at 32%, expressed as the share of renewables in gross final energy consumption, was agreed.

Within the energy efficiency dimension for 2021-2030, there are three objectives: (i) an indicative target for the size of primary energy sources, final consumption and energy intensity; (ii) binding target for energy savings in public sector buildings (iii) binding annual rate of final consumption savings.

EU strategies affecting the Czech Republic (EU level)

A Modern Budget for a Union that Protects, Empowers and Defends, The Multiannual Financial Framework for 2021-2027", COM(2018) 321 final

Overarching objective of strategy:

The Multiannual Financial Framework determines the amounts of the annual ceilings on commitment appropriations by category of expenditure and of the annual ceiling on payment appropriations and lays down any other provisions required for the annual budgetary procedure to run smoothly.

Thematic areas and goals

There are 7 thematic spending priorities and a theme related to "instruments outside the MFF ceilings". Focus areas are listed below, particularly when connected to SMEs:

1. Single market, innovation and digital: with focus on investing in (i) research and innovation, (ii) key strategic infrastructure, (iii) strengthening the Single Market, (iv) strategic space projects
2. Cohesion and values: investing in (i) regional development and cohesion, (ii) completing the economic and monetary union, and (iii) people, social cohesion and values
3. Natural resources and environment
4. Migration and border management
5. Security and defense
6. Neighborhood and the world
7. European public administration

ANNEX 5. CLUSTER ANALYSIS OF THE POLICY MIX

To characterize the groups of instruments, a cluster analysis using Ward's method with the Jaccard distance measure was conducted. Using 'instrument objective', 'instrument type' and 'beneficiary focus' as clustering criteria for similarity between these variables, instruments were segmented into six main groups. These variables were selected based on their prominent role in defining the scope of the instrument, and their relationship with the market failure, the levers of intervention and the chosen solutions to address the problem. These six groups have the following features:

- Group 1 (innovation): Comprised of 20 instruments; mostly from API and TACR; focused on R&D innovation, non-R&D innovation/technology adoption as well as technology transfer; all are grants-based; broad beneficiary focus (formal firms, cooperatives, SOEs, research institutes and universities).
- Group 2 (export diversification): Comprised of 26 instruments; mix of API, CzechInvest, CzechTrade, EU (COSME, H2020) instruments; mixed objective focus (e.g., exports, entrepreneurship, technology transfer); primarily grants with a mix of collaborative networks and public platforms/websites; beneficiary focus on formal firms and consortia and associations.
- Group 3 (entrepreneurial skills): Comprised of 13 instruments; from CzechInvest and Enterprise Entrepreneurship Network; focused on skills, entrepreneurship and access to finance; focused on technical assistance in the form of business education/advisory/training; beneficiary focus primarily on formal firms with some instruments targeting unregistered startups (young firms), research institutes, universities and business support organizations.
- Group 4 (access to finance): Comprised of 12 instruments; from CMZRB and EU (COSME/H2020); focused on access to finance via credit guarantees (6 instruments), loans (4 instruments) and equity (2 instruments); beneficiary focus on formal firms and financial institutions.
- Group 5 (technological adoption through mixed methods): Comprised of 15 instruments; mix of API, CzechInvest, and one instrument apiece from EU (COSME) and MLSA; focused on non-R&D innovation/technological adoption; primarily grants with some instruments also offering a mix of grants and business education/advisory services; beneficiary focus on formal firms and individuals.
- Group 6 (technological adoption through grants): Comprised of 7 instruments; mostly from API; focused on non-R&D innovation/technological adoption; all are grants-based;

beneficiary focus on formal firms and individuals, as well as cooperatives and consortia and associations.

Table 5. Czech Republic instrument grouping, by objective

Group	1	2	3	4	5	6
Number of instruments	20	26	13	12	15	7
Research	7	4	6	0	0	0
Technology transfer	17	9	7	0	0	0
R&D innovation	17	7	9	1	1	0
Non-R&D innovation	14	0	7	2	7	5
Management practices	3	1	9	2	0	0
Access to finance	1	3	12	7	0	0
Exports	2	10	9	0	1	0
Skills	4	4	13	0	3	2
Entrepreneurship	0	10	13	2	3	0
Business environment	0	4	8	0	2	0
Market access	2	1	7	1	2	0

Table 6. Czech Republic instrument grouping, by instrument type

Group	1	2	3	4	5	6
Number of instruments	20	26	13	12	15	7
Grants	19	13	3	0	14	7
Vouchers	1	0	0	0	0	0
Equity	1	0	0	2	0	0
Credit guarantees	0	1	0	6	0	0
Loans	0	2	1	4	0	0
Tax incentives	0	1	0	0	0	0
Public procurement	0	0	1	0	0	0
Business advisory services	0	1	9	0	2	0
Early stage infrastructure (incubators)	0	1	4	0	0	0

Group	1	2	3	4	5	6
Business education	0	0	11	0	3	0
Scholarships	0	0	1	0	0	0
Training	0	1	11	0	1	0
Collaborative networks and clusters	0	5	3	0	0	0
Public goods and platforms	0	4	6	0	0	0

Table 7. Czech Republic instrument grouping, by beneficiary type

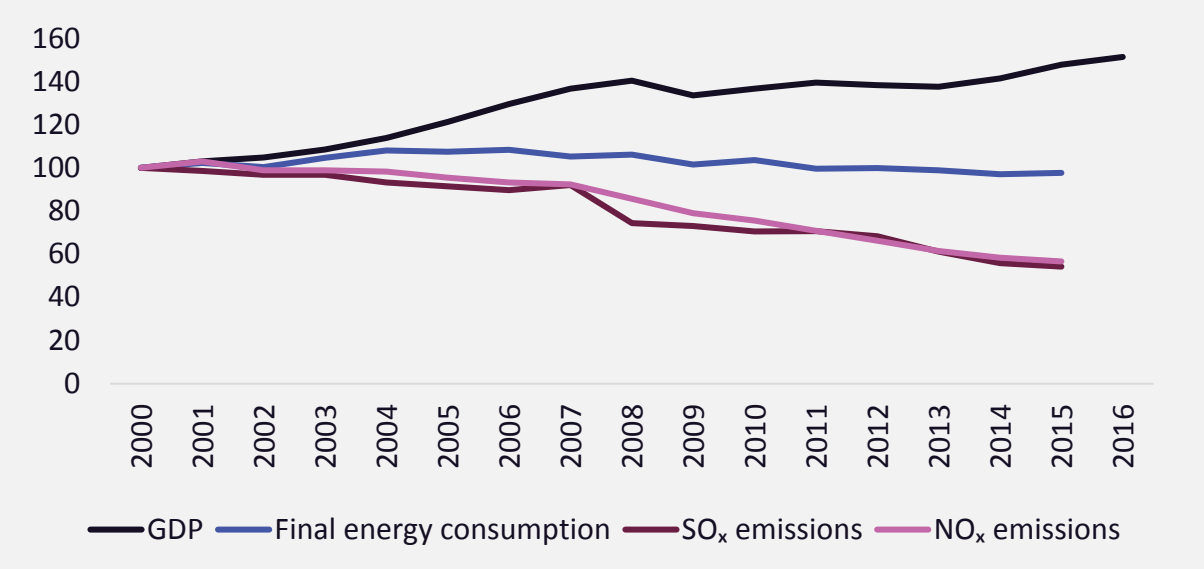
Group	1	2	3	4	5	6
Number of instruments	20	26	13	12	15	7
Individuals	8	0	4	0	12	7
Women entrepreneurs	0	2	6	0	3	0
Formal firms	20	22	13	12	14	7
Informal firms	0	1	8	0	0	0
Cooperatives	18	6	8	0	0	7
SOEs	19	2	4	0	0	4
Consortia and associations	10	17	8	0	0	7
Researchers	12	1	6	0	0	0
Research institutes	20	9	8	0	0	0
Universities	20	8	8	0	0	0
Business supports institutions	4	6	8	0	2	0
Financial institutions	0	4	3	6	0	0
Other governments agencies	3	5	2	0	0	0

Annex 6. Energy and Energy Efficiency

Analysis of environmental performance with a focus on energy efficiency[61]

Czech Republic has one of the highest carbon and energy intensity among OECD countries. Coal accounted for close to 40 percent of Czech Republic's total primary energy supply in 2015, the third highest after Estonia and Poland. Moreover, coal accounts for over half of electricity generation and over 60 percent of heat output (vis-à-vis OECD average of 24 percent). In terms of energy intensity, the country is not on track to achieve energy savings targets under the EU Energy Efficiency Directive.[62] High energy intensity and coal reliance is attributable to the country's economic structure as an industrial base. Yet, high coal intensity poses health risks (i.e., households and individuals are exposed to high air pollution levels) given that coal combustion is an important source of local air pollution and GHG emissions. To-date, carbon dioxide emitted in electricity generation and heat output is above the OECD average.

Figure 60. Changes in GDP, energy consumption, and GHG emissions (2000=100)



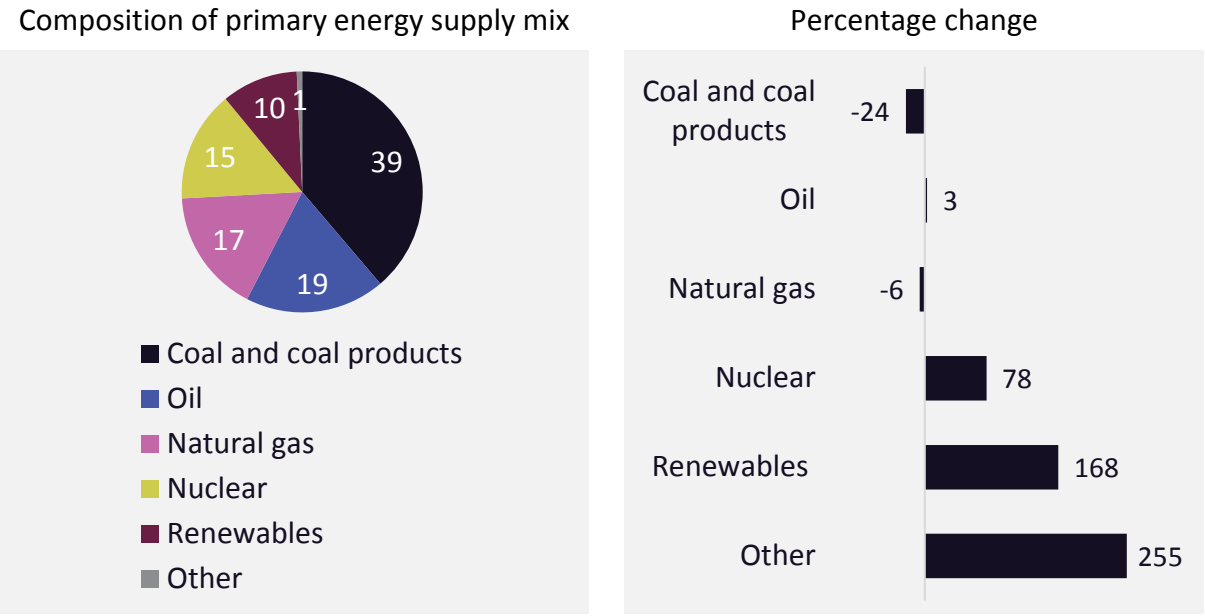
Source: OECD (2018).

[61] This sub-section draws heavily from OECD (2018). OECD Environmental Performance Reviews: Czech Republic 2018.

[62] This is despite that energy intensity has decreased by about 35 percent over a 16-year period (2000-2016) compared to average for OECD of 25 percent. (OECD 2018a)

There are efforts to move towards a low-carbon economy. For one, GHG emissions have decreased in the context of GDP improvements (Figure 60). Also, Czech Republic's energy mix has seen reductions in coal and increasing shares in nuclear energy and renewables, although this is still lower than average for OECD countries (Figure 61). For example, nuclear plants' share in electricity generation increased by 10 percentage points between 2000 and 2016, from 19 percent to 29 percent. Finally, thanks to active efforts to de-carbonize the economy, the country already surpassed its 2008-2012 Kyoto target of reductions in GHG emissions and is forecasted to achieve its 2020 and 2030 goals[63].

Figure 61. Composition of primary energy supply mix in 2016 and percentage change from 2000-2016



Source: IEA (2017) as cited in OECD (2018).

Improvements in energy savings (especially in the transport sector) and further development of fossil fuel alternatives (e.g., renewables) will be necessary to achieve longer-term GHG targets. The transport sector saw increased energy consumption of about 45 percent between 2000 and 2015 and accounted for one-quarter of total final consumption in 2015. The sector's energy mix is likewise carbon-heavy: biofuels (a component of renewable supply) represented only 5 percent of energy consumption in the sector in 2015, compared to biodiesel (79 percent). To-date, the sector is the second highest emitter of GHG, particularly road transport. This indicates that energy savings and thus reductions in GHG emissions in the transport sector is important to achieve overall longer-term energy savings

[63] This forecast made strong assumptions in terms of progress in carbon pricing and energy savings. However, such progress is yet to be seen in light of economic recovery from financial crisis and the significant increase in GHG emissions in the transport sector. (OECD 2018a)

targets. Moreover, development of renewables needs to be further boosted given its role in supporting energy security in the Czech Republic: Current share of renewables in electricity production is still below the OECD average, and this is not likely to rise in the medium term due to the elimination of support mechanisms for renewable-sourced electricity.

Energy and energy efficiency strategies

Approved in 2017, the Czech Republic 2030 strategy identifies policy priorities underpinning implementation of the 2030 Agenda for Sustainable Development. Czech Republic 2030 translates 17 SDGs into six priority areas, including People and Society, Economy, Resilient Ecosystems, Municipalities and Regions, Global Development and Governance, and has close to 200 indicators that track sustainable development progress. Relative to OECD average, it performs well on objectives related to poverty, biodiversity and water. Lagging areas include energy (focus of this Annex), climate, food, health, gender equality and implementation.

The Czech Republic is also pursuing the fulfilment of its Europe 2020 quantitative targets. Particularly on climate and energy policies, national targets include:

- Increase the share of RES in gross final energy consumption to 13 percent and the share of renewable sources in the transport sector to 10 percent;
- Improve energy efficiency by achieving national energy efficiency target, i.e., reductions in final energy consumption to a maximum of 1,060 quadrillion joules (PJ) by 2020;
- Reduce GHG emissions, i.e., maximum permissible rise in emissions outside the EU emissions trading scheme (EU ETS) is 9 percent.

Fulfilment of targets relating to RES and energy efficiency is implemented through various strategies and national policies. The State Energy Concept (or State Energy Policy) was launched in May 2015 and sought to achieve an 18-percent share (at least) of RES in the primary energy source mix. This Concept also emphasizes nuclear energy as an energy source; it seeks for an increase of nuclear supply to at least 25 percent of energy mix by 2040. Implementation of this Concept is in progress: conditions and concrete steps to achieve energy and energy efficiency goals are set and implemented through the National Action Plan of the Czech Republic for Energy Efficiency (NAPEE) (updated version was approved in May 2017) with newly proposed additional measures. Other strategies are implemented as integral components of NAPEE. For example, the Building Renovation Strategy aims for a cost-effective approach to renovation of buildings. Another example is the Savvy Energy Savings programme which seeks to motivate investors to prepare projects with a high degree of energy savings.

The integrated National Energy and Climate Plan of the Czech Republic, currently being drafted, is expected to replace the NAPEE. This Integrated national energy and climate plan

reflects the new regulation on Energy Union management, submitted by the European Commission as part of the Winter Energy Package.

There are also another strategies and policies through which SDGs could be achieved, but in-depth analysis goes beyond the scope of this work:

- Waste Management Plan of the Czech Republic 2015-2024;
- The Policy of Climate Protection in the Czech Republic (this document sets emission reduction targets for 2020 and 2030, along with long-term indicative goals for 2050);
- The Strategy of Climate Change Adaptation in the Conditions of the Czech Republic;
- The Concept for Protection from the Effects of Drought for the Czech Republic;
- Medium-term Strategy (up to 2020) of Air Quality Improvements in the Czech Republic;
- Secondary Raw Materials Policy of the Czech Republic (this document supports circular economy principles and encourages use of secondary raw materials in the manufacturing and construction sectors).

Analysis of the energy and energy efficiency policy mix

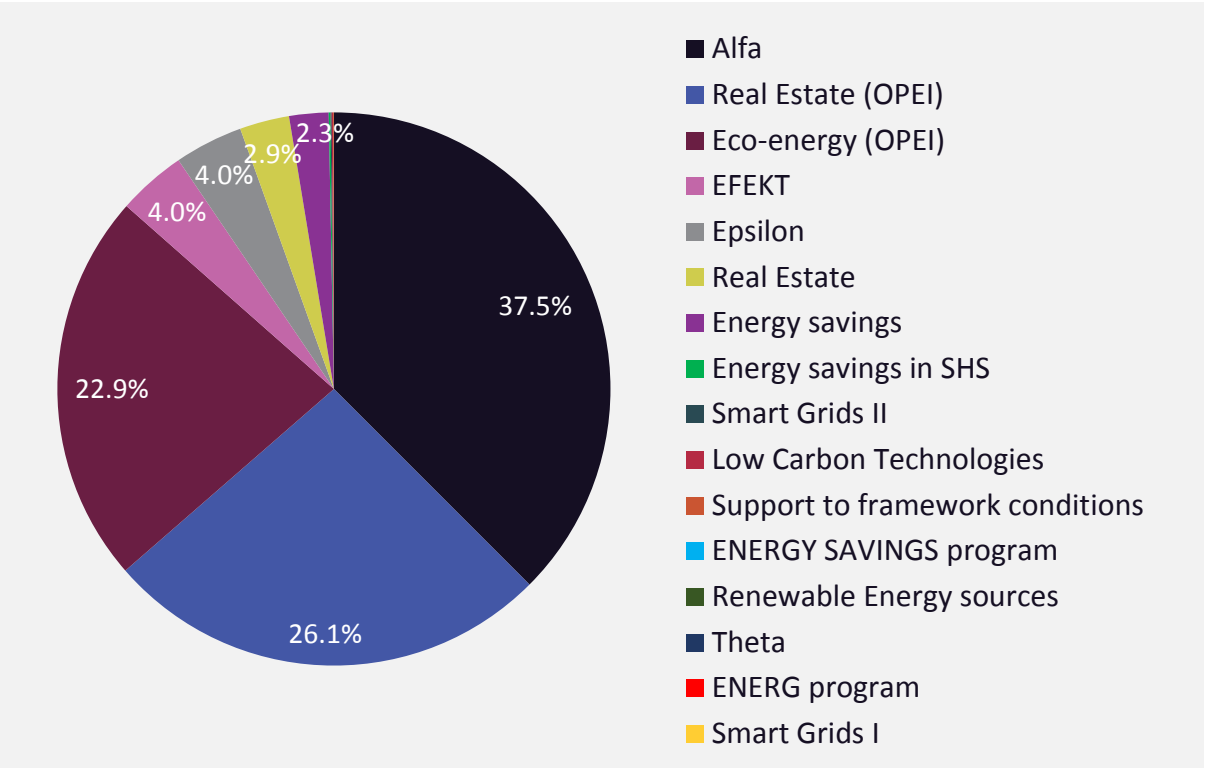
An analysis of the current policy mix using the energy efficiency lens can provide information on gaps that can be addressed to help Czech Republic transition to a low-carbon economy. The analysis identifies a total of 16 instruments that have energy efficiency-related objectives. Total budget allocated over the life cycle for these instruments stands at 88.2 billion CZK/ 3.9 billion USD (75 percent are funded by the EU, and the remaining are state-funded).[64] Total disbursed funding so far between 2013 and 2017 stands at 18.6 billion CZK/0.8 billion USD (55 percent are funded by the EU). This indicates that around 17 percent of SME funds (given that total 2013-2017 disbursed funds reached 108.5 billion CZK) are promoting energy/energy efficiency goals.

Energy-related instruments are concentrated in three instruments. SME funds between 2013 and 2017 were disbursed to three instruments, namely, Alfa (38 percent), Real Estate (15 percent), and Eco-energy (23 percent) (Figure 62). The first is a TACR instrument and the latter two are OPEIC instruments. For example, the Alfa instrument supports R&D on advanced technologies, energy resources, and sustainable development of the transport sector, among others. The Real Estate instrument seeks to modernize business properties with aims to improve production quantity and quality (efficiency) among firms. Given reliance

[64] Note that this figure does not include government revenues from sales of carbon emission allowances and other types of allowances.

on EU funding in its energy efficiency portfolio (as well as uncertainty of EU funding beyond 2020 (OECD 2018a), this likewise showcases the need for the Czech government to reconsider funding strategies to continue promoting such initiatives, such as leveraging partnerships with the private sector.

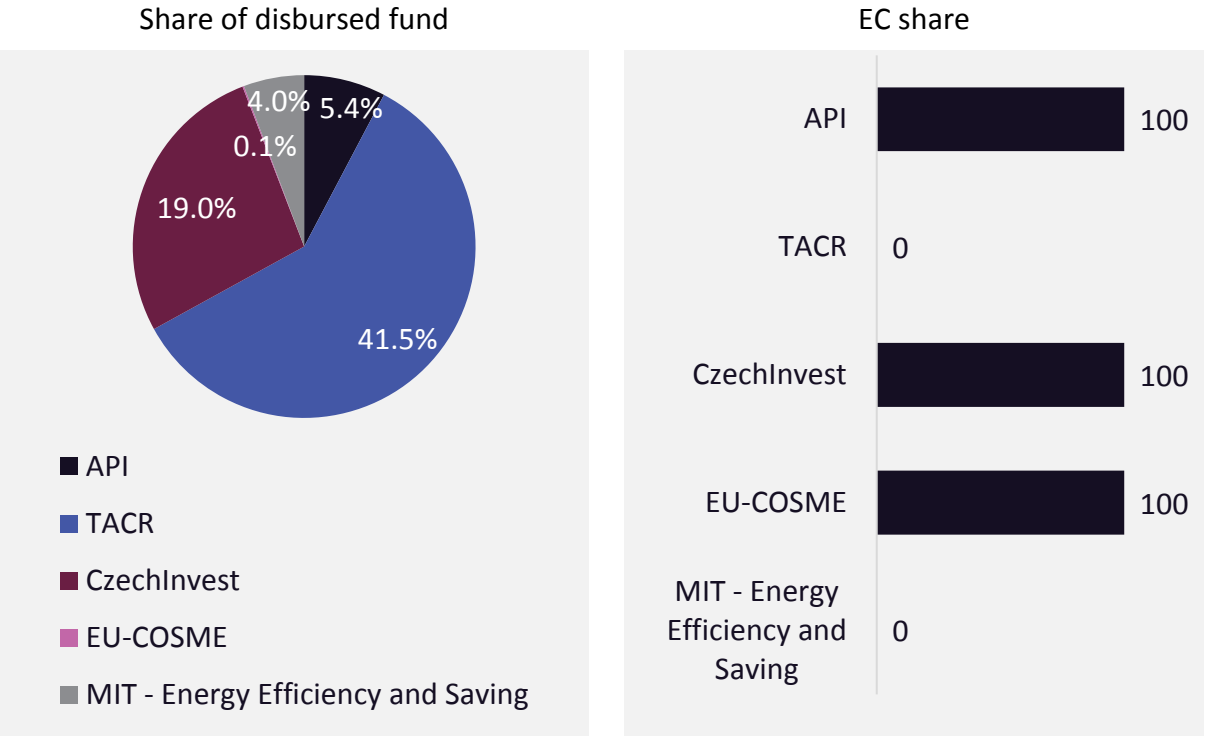
Figure 62. Share of disbursed funds by instrument



Note: Both ENERGY SAVINGS and ENERG programs are preferential loans.

The focus on energy efficiency is skewed towards two agencies and relies on EU funding (Figure 63). CzechInvest, which runs OPEIC instruments, is focused on projects associated with energy efficiency. In fact, close to half of funds from 2013-2017 were disbursed to CzechInvest, followed by TACR (42 percent). Among 5 agencies which have energy efficiency-related support programs, most rely on EU funding, with the exception of TACR and MIT's Department of Energy Efficiency and Saving. For the latter, financial support for energy efficiency improvements comes from national financial resources. For example, one of the first attempts to implement financial instruments promoting energy efficiency is the ENERG programme. Under this instrument, applicants can obtain soft loans for energy-efficient projects.

Figure 63. Share of disbursed fund by agency and EC share in agency funding

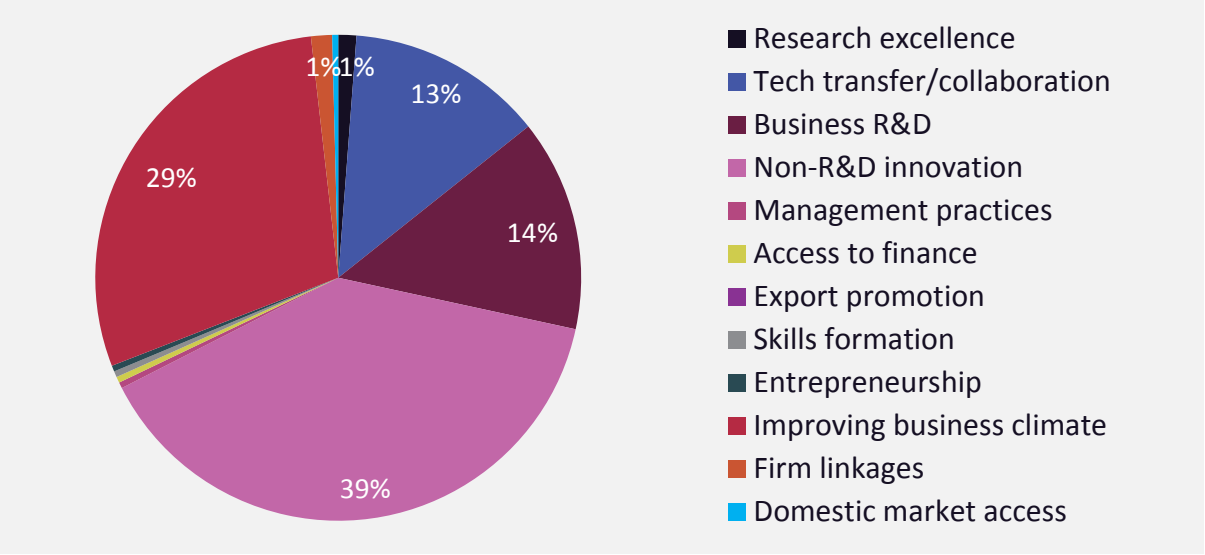


In terms of objectives, energy efficiency instruments have a relatively stronger focus on improving firm capabilities for technology adaption and diffusion (Figure 64). Close to 40 percent of energy associated instruments focus on technology adoption/diffusion (i.e., non-R&D innovation). Another 14 percent focuses on business R&D[65], and 13 percent focuses on technology transfer/collaboration. About 30 percent focuses on improving business climate conditions to promote energy efficiency. In technology transfer/collaboration, for example, Epsilon seeks to improve knowledge transfer between R&D institutions and business enterprises in the area of new technologies and materials in energy, transport and the environment. In terms of improving firm capabilities in general, the State Energy Savings Support Programme 2017-2021 focuses on providing energy advice and other soft measures. Comparing this energy efficiency policy mix with the overall policy mix portfolio (refer to Figure 40 in the main report) shows that both have a focus on imitation via non-R&D innovation among firms.

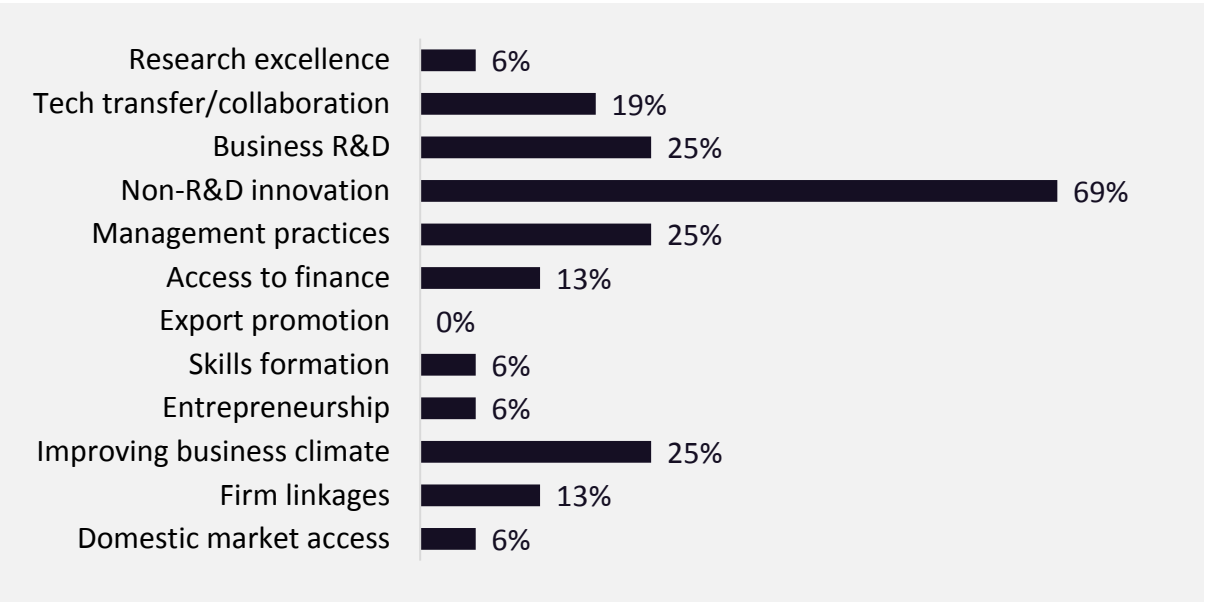
[65] As a share of government R&D budget in 2016, energy accounted for 4 percent and environmental management accounted for another 2 percent, at par with OECD averages. Public spending on energy-related R&D has increasingly focused on nuclear energy comprising 53 percent of public energy related R&D in 2015. This increase is however traded-off by reduced budgets for energy efficiency and renewables comprising just 3 percent and 14 percent respectively (this is lower than the average of 20 percent each among OECD countries). (OECD 2018a)

Figure 64. Objectives by share of disbursed funds and share of instrument count

Disbursed funds



Share of instruments



In terms of instrument count, 81 percent of energy-associated instruments use grants/matching grants. 15 percent has a single co-financing rate with an average subsidy rate of 40 percent. As a share of disbursed funds, these grants are used for either project design (e.g., market research (27 percent)) or for project implementation (e.g., machinery and equipment purchase (17 percent) and space rentals (18 percent)). For example, the instrument called low-carbon technology (under OPEIC) helps address issues in energy consumption in the transport sector, improve energy-efficient modes of transport, and

supports circular economy[66] approaches. In particular, this instrument provides support for the purchase of electric vehicles, installation of private charging points, and technologies for extracting secondary raw materials from waste that are suitable for further industrial production. Observations on reliance on grants and common grant usage are similar to the overall policy mix (Figure 65).

Considering energy efficiency goals, these instruments have the following focus areas:

- Sector: 78 percent of disbursed funds were channeled towards instruments that have a sector-specific focus, and the remaining 22 percent is sector-agnostic. For sector specific instruments, 65 percent of disbursed funds focused on the manufacturing sector, and the rest are distributed equally across services and agriculture.
- Beneficiaries: Energy associated instruments target a more diversified set of beneficiaries: 34 percent of funds were disbursed to formal firms between 2013 and 2017, followed by individuals (27 percent). This is similar to the more substantial beneficiary focus on formal firms in the overall policy mix (refer to Figure 39 in the main report) (Figure 66).
- Geographic coverage: 54 percent of funding for energy associated instruments have a regional focus, especially for regions outside Prague. In terms of instrument count, regions outside Prague are targeted 56 percent of the time. That is, 38 percent of instruments (in terms of count) can be accessed nationwide, and 6 percent at the city level (i.e., this pertains to one instrument, preferential loan under ENERG programme that provides interest-free loans to SMEs for energy savings projects in Prague[67]). A regional focus of these energy-related instruments again reflects dependence on EU funding.
- Firm life cycle: Unlike the aggregate portfolio, energy associated support is targeted across all firm types (25 percent at each stage: idea, young/startup, scale-up, mature). In terms of instrument count, all energy associated instruments target scale up and mature stages, compared to idea and startup stages which are targeted 75 percent and 94 percent of the time, respectively.

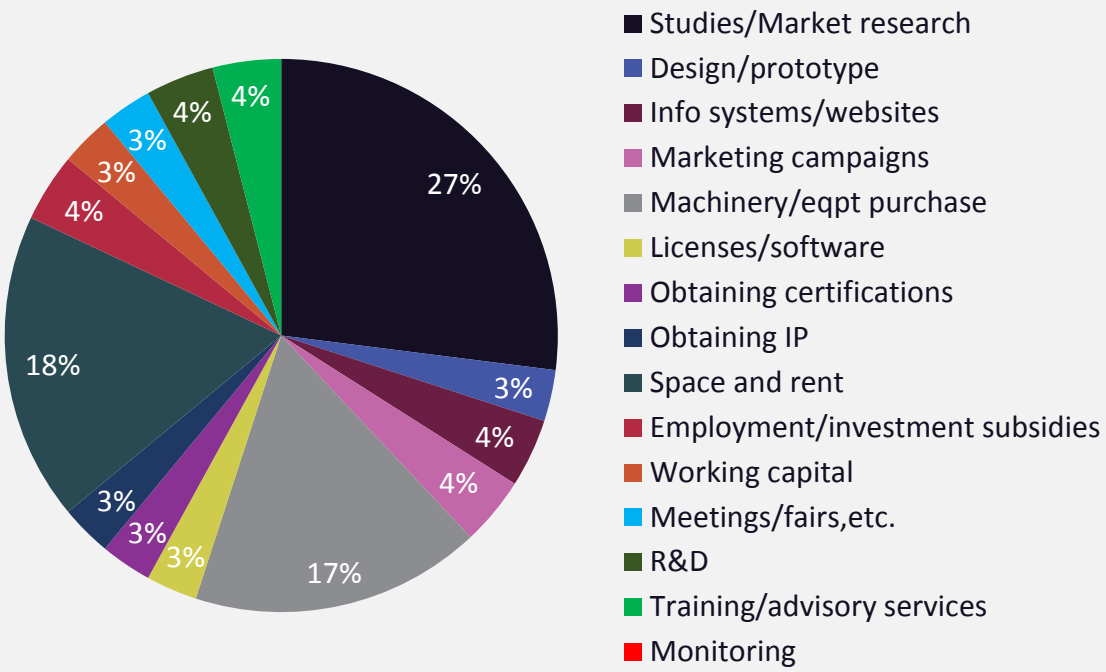
Average funding size per grantee is about 3.7 million CZK (164,000 USD). This is slightly smaller than the overall policy mix where the average funding per grantee stands at about 6.3 million CZK (about 273,000 USD). Average benefit sizes vary depending on the energy-associated instruments, but the largest grant size comes from TACR instruments. For example, a TACR recipient received on average 5.4 million CZK (about 239,000 USD) (Figure 67).

[66] Broadly, this refers to using waste as a resource in order to reduce waster generation, through recycling, reuse and other approaches.

[67] There is a corresponding preferential loan focusing on SMEs outside Prague as well, called the Energy Savings programme under OPEIC. Both have similar objectives and eligibility criteria.

Figure 65. Grant usage by share of disbursed funds and share of instrument count

Disbursed funds



Share of instruments

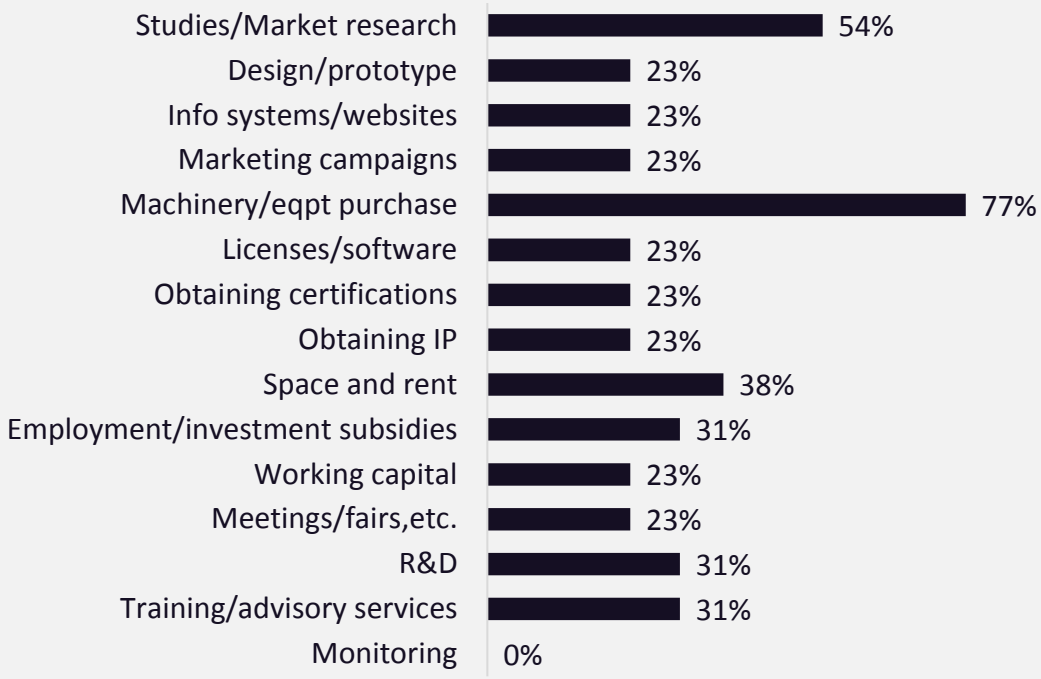
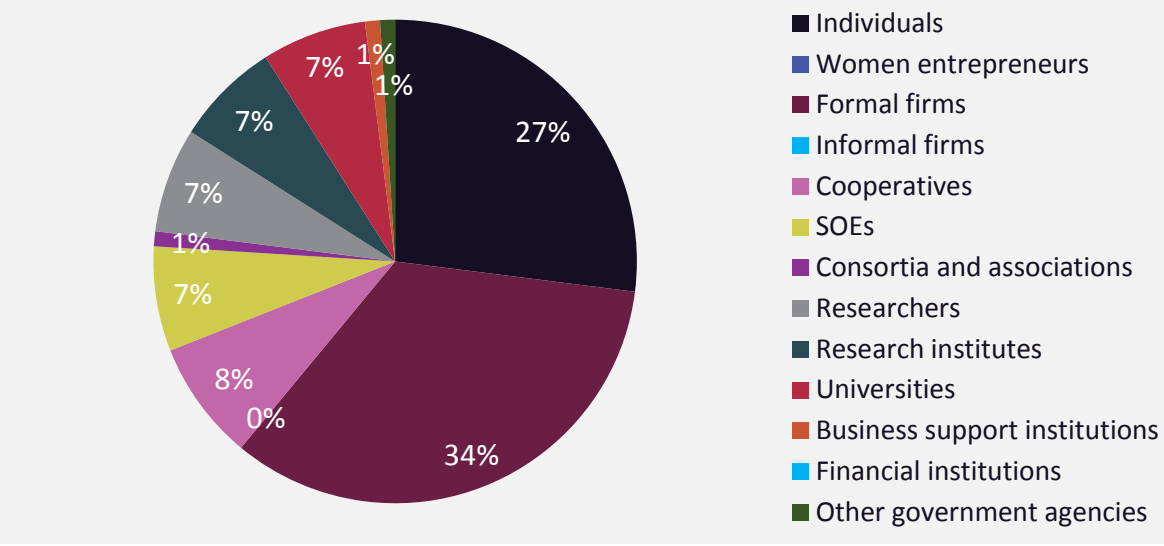


Figure 66. Beneficiaries by share of disbursed funds and share of instrument count

Disbursed funds



Share of instruments

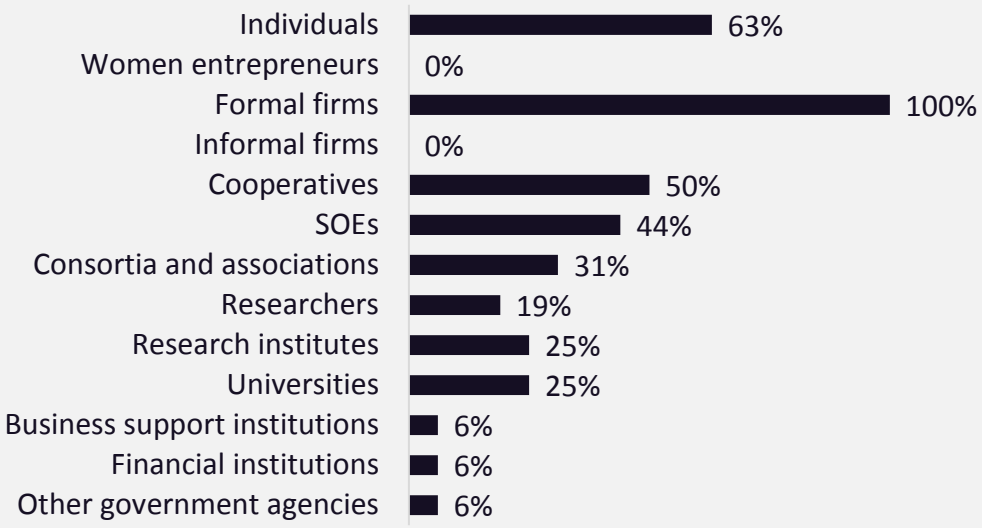
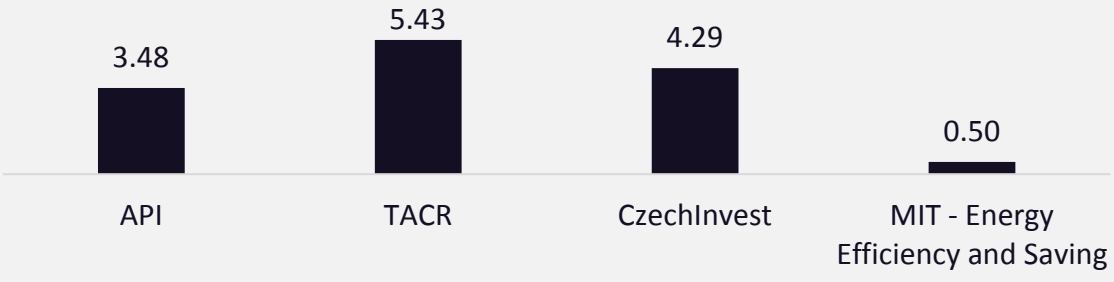


Figure 67. Average funding per grantee by agency (in millions CZK)



ANNEX 7. INDUSTRY 4.0

The ongoing I4.0 revolution is expected to continue transforming production processes. An analysis of the policy mix using the I4.0 lens can provide information on gaps that can be addressed to help Czech Republic better leverage this transformation. Ideally, SME support instruments that support I4.0 can be identified based on key I4.0 terminologies, such as IoT, AI, additive manufacturing, etc. in their call for proposals. Current SME support instruments however do not mention these terminologies in the Czech Republic. Nevertheless, the country's National Industry 4.0 initiative (Marik et al. 2016) identifies national-level instruments associated with Industry 4.0—specifically, programs under OPEIC, TACR and MIT's Department of Research, Development and Innovation. Other relevant EU programs related to Industry 4.0 are also included, specifically H2020 instruments, in the policy mix analysis.

Based on this instrument selection criteria, the analysis identifies a total of 29 instruments related to Industry 4.0. Total budget allocated over the life cycle for these instruments was 145 billion CZK (6.3 billion USD); 82 percent was funded by the EU, and the remaining was state-funded. Total disbursed funding from 2013 to 2017 equaled 31 billion CZK (1.3 billion USD); 78.6 percent were funded by the EU. This indicates that around 29 percent of SME funds (given that total 2013-2017 disbursed funds reached 108.5 billion CZK) have an I4.0 flavor.

I4.0-related funding was concentrated in 4 instruments. From 2013 to 2017, the bulk of I4.0-related SME funds were disbursed to Innovation (39 percent), Potential (15 percent), Competence Centers (13 percent), and ICT and strategic services (12 percent). Except for Competence Centers (a nationally funded TACR instrument), all are OPEIC instruments. Given the current reliance on EU funding in its I4.0 portfolio, the Czech government might need to consider additional complementary funding instruments to stimulate I.40 initiatives. As an example, The National Industry 4.0 Initiative has not earmarked additional funding for this initiative (and relies on existing instruments, e.g., OPEIC and TACR) nor has a time frame set for the initiative (European Commission, May 2017) (Figure 68).

The focus on I4.0 is heavily skewed towards one agency and relies on EU funding. CzechInvest is focused on projects associated with Industry 4.0, given that the agency also handles the OPEIC instruments. In fact, 68 percent of I4.0-related funds from 2013-2017 were disbursed to CzechInvest, followed by TACR (18 percent). Among 8 agencies that had Industry 4.0-related support programs, most relied on EU funding (primarily ERDF--97 percent), with the exception of TACR and MIT's Department of RDI. For example, all of disbursed funds for TACR's I4.0 associated instruments came from the state (as expected), and about 32 percent

of MIT RDI department's funds (which handles the TRIO program[68]) came from the EU (Figure 69).

Figure 68. Share of disbursed funds by instrument

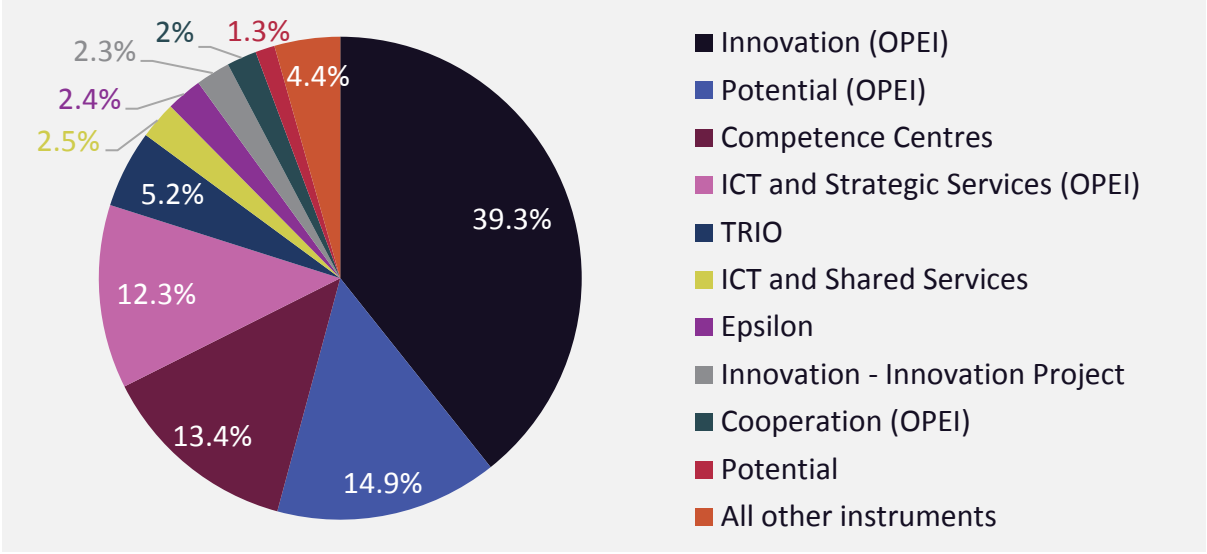
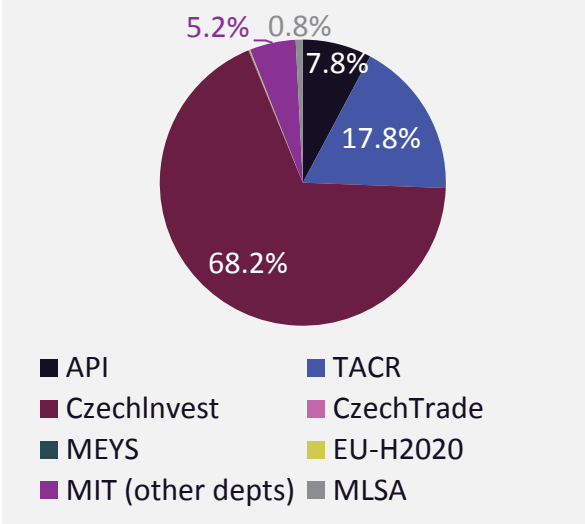
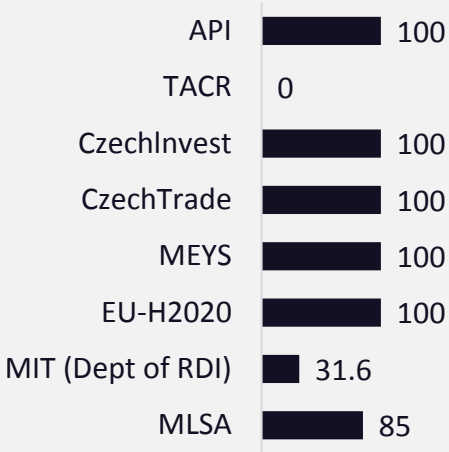


Figure 69. Share of disbursed funds by agency and EC share in agency funding

Disbursed funds by agency

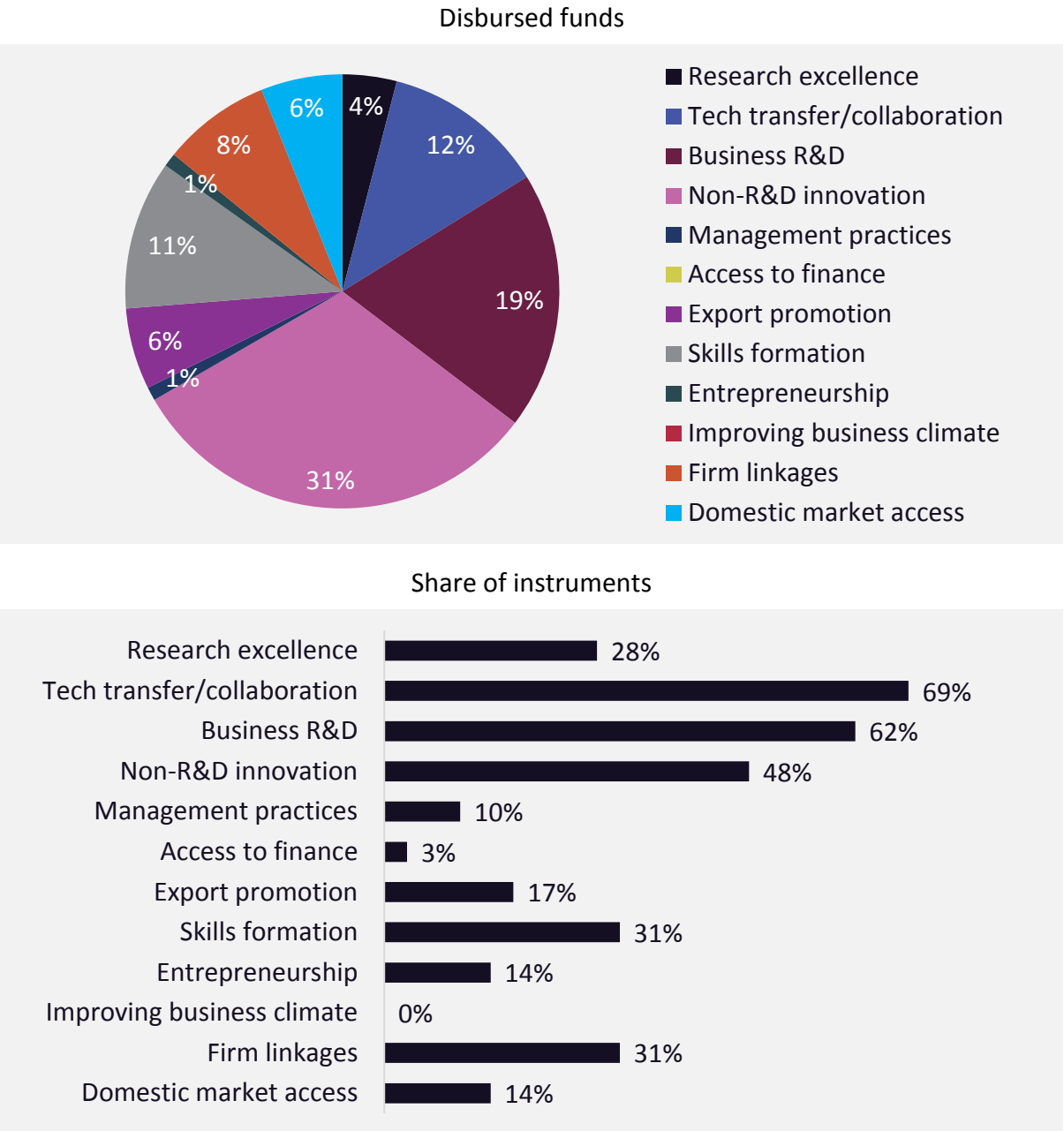


EC share in agency funding



[68] 'TRIO' provides financial aid with the goal of boosting applied research and experimental development in key sectors (e.g., photonics, micro-/nano-electronics, nanotechnology, industrial biotechnology, advanced materials and advanced manufacturing technology).

Figure 70. Objectives of I4.0-related instruments, by share of disbursed funds and share of instrument count



Industry 4.0 associated instruments have a diverse set of objectives, targeting both invention and imitation (Figure 70).[69] Close to one-third of these Industry 4.0-associated instruments focused on technology adoption/diffusion (i.e., non-R&D innovation). Another one-fifth focused on business R&D, and 12 percent focused on technology transfer/collaboration. Consistent withc the National Industry 4.0 initiative, which has a focus

[69] Comparing I4.0 policy mix to the priority areas mentioned in Industry 4.0 initiative, however, the Initiative has a stronger emphasis on invention through business R&D.

on developing digital skills (European Commission, May 2017), another one-tenth focused on skills formation. In business R&D for example, TRIO seeks to boost the use of R&D in technologies used by firms. Instrument support areas related to Industry 4.0 include "photonics, micro- and nanoelectronics, nanotechnology, advanced materials and advanced manufacturing technology" (Marik 2016). In technology transfer/collaboration, for example, Gama and Epsilon both seek to improve knowledge transfer between R&D institutions and business enterprises. Comparing this I4.0 policy mix with the earlier I4.0-agnostic policy mix portfolio shows that the latter had a more substantial focus on imitation via non-R&D I&E, and there was less emphasis on crucial I4.0 areas such as skills formation (only 6 percent of the overall policy mix were funded to support this) and technology transfer and collaboration (8 percent).

All I4.0-associated instruments used grants/matching grants. Close to 40 percent had a single co-financing rate with an average subsidy rate of 58 percent. As a share of disbursed funds, these grants were used for either project implementation (e.g., machinery and equipment purchase--12 percent, licenses and software--12 percent, obtaining intellectual property--11 percent, obtaining certifications--10 percent) or project design--market research at 8 percent and prototyping at 7 percent). Observations on reliance on grants and common grant usage are similar to the I4.0-agnostic policy mix (Figure 71).

The Industry 4.0-related instruments had the following focus areas:

Sector coverage: 76 percent of disbursed funds were channeled towards instruments with a sector specific focus, and the remaining 24 percent was sector-agnostic. For sector-specific instruments, 49 percent of disbursed funds focused on manufacturing and 30 percent on knowledge-intensive services. The remaining 21 percent of funds were channeled towards nonknowledge-intensive services. Thus, the majority of instruments focused on more complex knowledge areas, which is a positive aspect of the I4.0 portfolio.

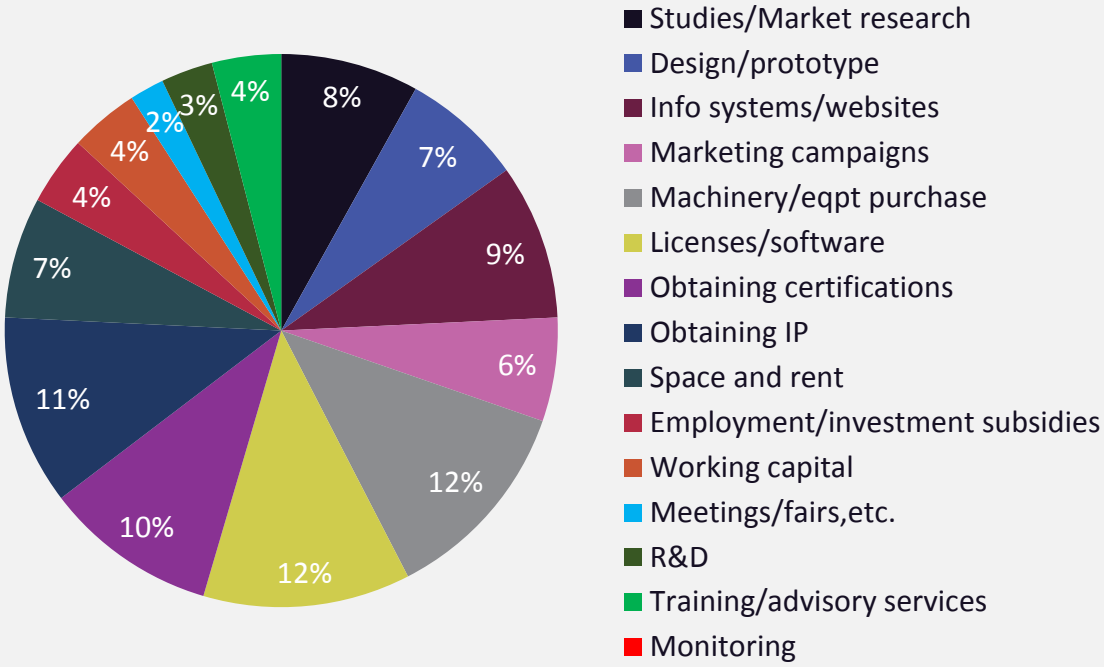
Beneficiaries: I4.0-associated instruments targeted a more diversified set of beneficiaries than in the I4.0-agnostic analysis: 26 percent of funds were disbursed to formal firms between 2013 and 2017, followed by cooperatives, research institutes and universities (12 percent each). In comparison, there is a more substantial beneficiary focus on formal firms in the I4.0-agnostic policy mix and weak focus on knowledge-creating bodies. The importance of formal firms, research institutions and universities confirms the observation that the I4.0 policy mix in the Czech Republic was focused on both invention and imitation (Figure 72).

Geographic coverage: 77 percent of funding for I4.0-associated instruments had a regional focus, especially for regions outside Prague. However, in terms of instrument count, regions outside Prague were targeted just 55 percent of the time. That is, 41 percent of instruments (in terms of count) could be accessed nationwide. A regional focus of these I4.0 instruments again reflects dependence on EU funding. However, considering the ever-changing nature of

I4.0 technologies, dismissing support for Prague, which is considered a 'strong' innovator, may be a missed opportunity.

Figure 71. Grant usage by share of disbursed funds and share of instrument count

Disbursed funds



Share of instruments

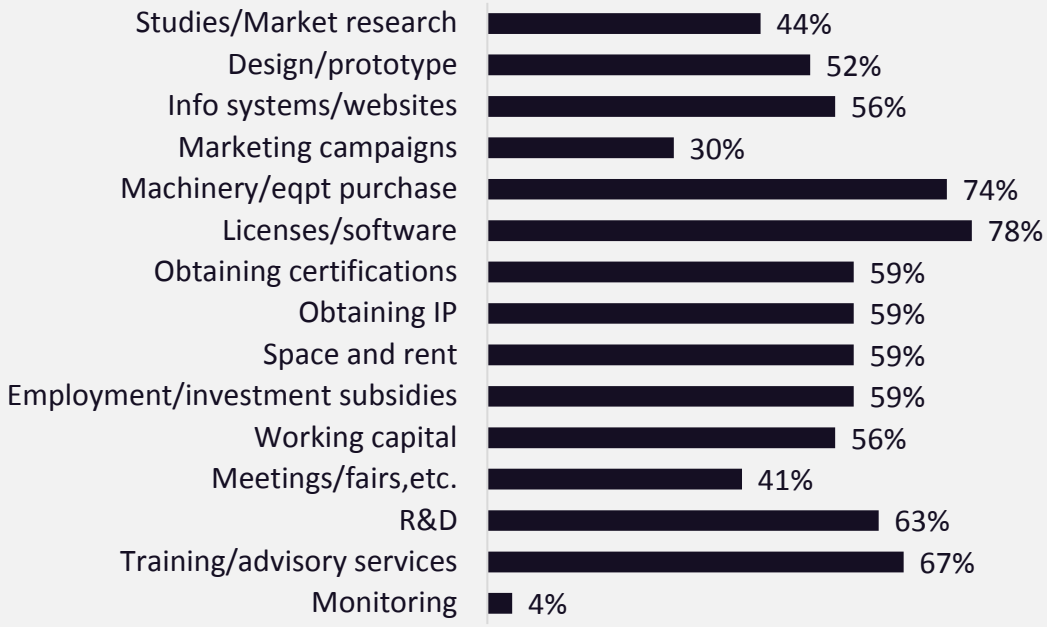
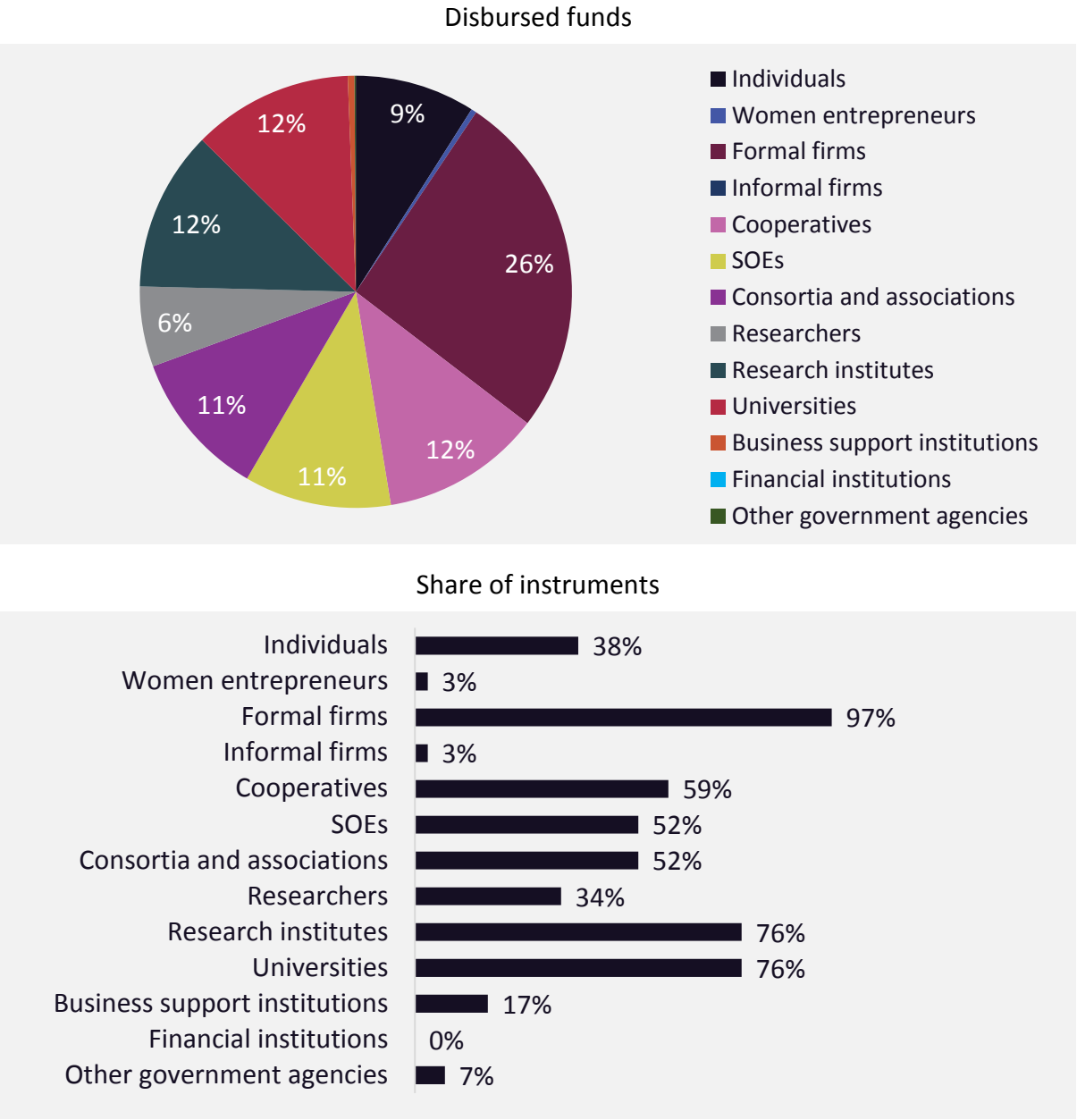
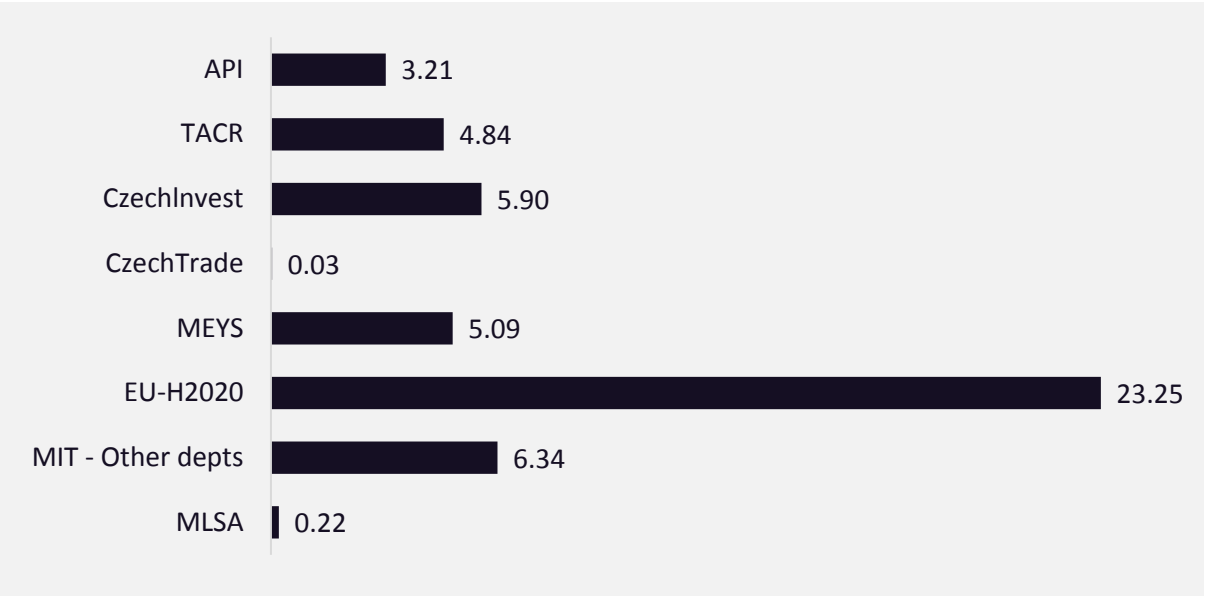


Figure 72. Beneficiaries by share of disbursed funds and share of instrument count



Firm life cycle: Similar to the aggregate portfolio, I4.0-associated support was targeted towards scale-up and mature firms (60 percent). Whereas 30 percent of funds were disbursed to young firms/startups, only 10 percent of funds reached potential innovators (those in the idea/concept stage). In terms of instrument count, 62 percent of I4.0-associated instruments targeted the idea/concept stage, 90 percent of instruments targeted the start-up/scale-up/mature stages. Overall, a relative lack of emphasis on the earlier stages of the life cycle, where firms tend to grow faster and where I4.0 technologies are more likely to be created, presents another area of missed opportunity.

Figure 73. Average funding per grantee by agency (in millions CZK)



Average funding size per grantee was about 4.9 million CZK (212,000 USD). This is slightly smaller than the portfolio-agnostic policy mix, where funding per grantee was about 6.3 million CZK (about 273,000 USD). Average benefit sizes vary depending on the I4.0-associated instruments, but the largest grant size comes from EU-H2020 instruments. For example, an H2020 recipient received on average 23.3 million CZK (1 million USD) (Figure 73).

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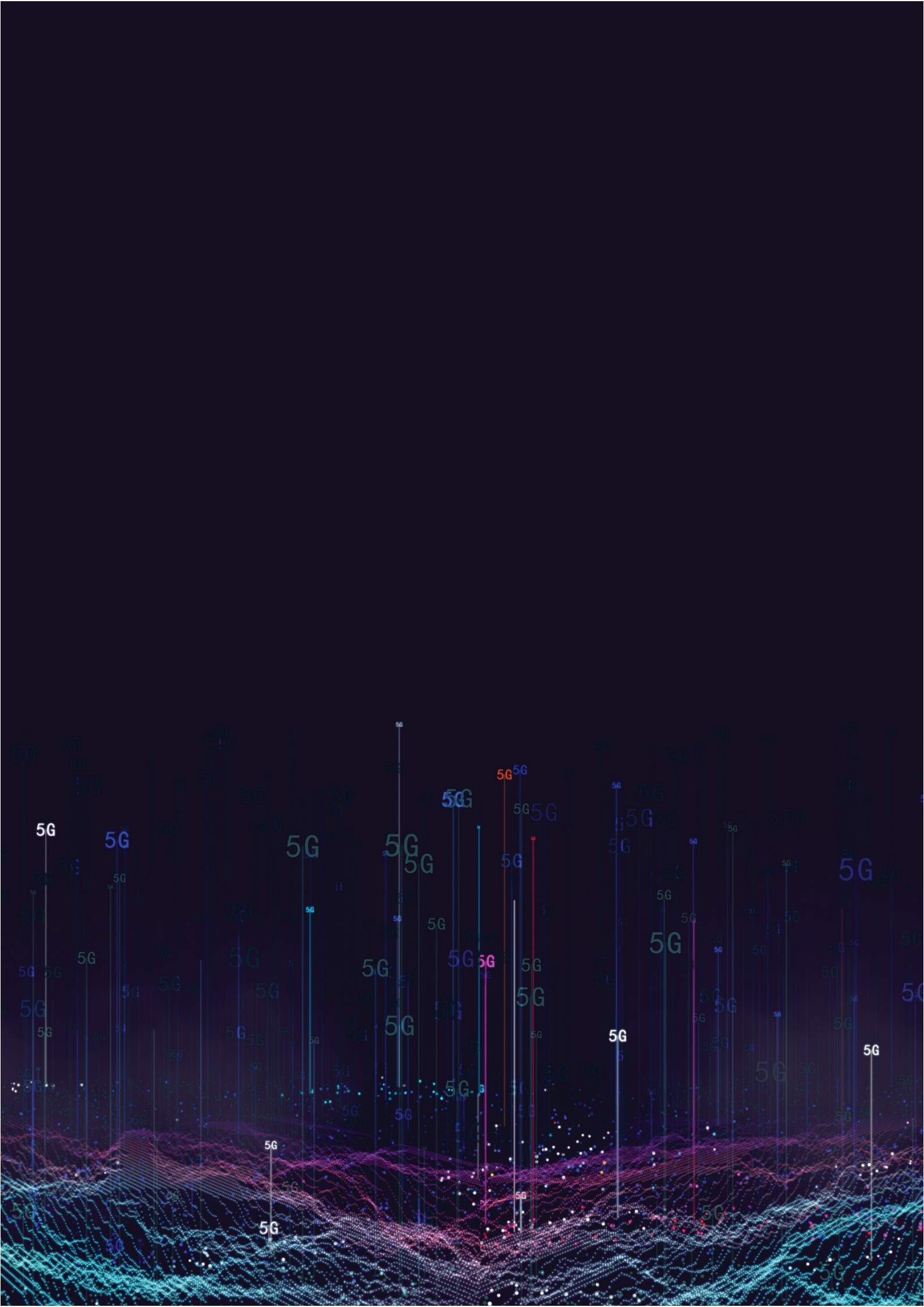
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