Report on Productivity and Competitiveness of the Slovak Republic 2020

ÚRAD VLÁDY
SLOVENSKEJ REPUBLIKY

Inštitút pre stratégie a analýzy
Úrad vlády SR
isa

Authors
Institute for Strategy and Analysis of the Government Office of the Slovak Republic:
Natália Cedzová
Jakub Dovčík
Kristína Gardoňová
Martin Hulényi
Veronika Rybanská
Zuzana Zavarská
Veronika Zlaczká

This report benefitted from the technical support project funded by the European Union via the Structural Reform Support Programme. The project was implemented by the Organisation for Economic Co-operation and Development in co-operation with the Directorate-General for Structural Reform Support of the European Commission. Special thanks to Peter Horvat, Fatima Talidi, Francesca Papa, Colin Webb, Chiara Criscuolo and Filippo Cavassini (all OECD) for the comments and inputs

We would like to thank Jan Fidrmuc, Tomáš Hellebrandt, Michal Pálenik and Oliver Rafaj for their feedback and advice.

Executive summary

Key challenges to a productive and competitive Slovak economy

The competitiveness of the Slovak economy has seen a decline in 2020 in various indicators. Most alarmingly, there are presently only 6 countries out of the evaluated 63 that are considered less competitive than Slovakia in the IMD World Competitiveness Ranking. Likewise, Slovakia's readiness for transformation into a modern and resilient economy is a matter of concern, as it is the worst performer in the region in this indicator.

The development over the last year was marked by the COVID-19 recession, which resulted in a significant drop in GDP. **Slovak industry experienced the most dramatic drop in all of EU-27 in the wake of the COVID 19 recession, reaching a 42% year-on-year decline in industrial activity in April, exceeding the shock of the Great Recession.** The speed of return to nearly pre-crisis levels also surpassed the Great Recession, as we observed a dramatic recovery in industry in the summer driven predominantly by the automotive sector. **In contrast, the labour market was less affected, thanks to the implementation of "kurzarbeit" schemes.** Total employment decreased by 1.9% from 2019 to 2020, but the drop in hours worked was more than fourfold, at 8.8%.

The COVID-19 recession may distort the landscape of the Slovak economy on the firm level. Simulation results show that young, small and less productive enterprises will particularly see an increase in their leverage ratios. Due to increased leverage, cut revenues and profits, the risk of debt-overhang may stall the growth of high potential firms over the medium turn. **Furthermore, market interventions that help cushion the impact of the COVID-19 crisis for otherwise viable businesses in the short-run may result in resource misallocation by reinforcing barriers to creative destruction and hindering innovation.** Continuing on implementing policies that enable the exit and restructuring of laggard firms and addressing the social implications of worker displacement will be vital.

Some of the non-pharmaceutical interventions aimed at dampening the COVID-19 pandemic may have lasting consequences. **Most importantly, the pandemic has caused the largest school closures in the past century.** Distance learning excluded some children from school attendance and diminished the efficiency of teaching. Moreover, it might have amplified the impact of socio-economic background on the performance of children. All these factors could have adverse and lasting consequences on the level of education attainment of today's cohort, their well – being, on their future earnings and thus, on the economy overall, if not addressed by adequate compensatory measures.

COVID-19 recession has primarily put the socially disadvantaged population at risk of work displacement. Least jobs were lost in sectors with better possibilities of home office: finance and insurance, ICT and research. These are also sectors with a higher share of younger and more educated people with less children, higher wages and more flexible working hours. On the positive note, the impact of the digitalization of work life in the long run presents an important productivity-enhancing opportunity as it leads to overall higher participation in the labour market and lower claims of state benefits, as well as lower production costs, as firms increasingly move away from brick-and-mortar structures to telecommuting and e-commerce.

The innovative capacity of the Slovak economy leaves much to be desired**. Funding for research and development represented only 0.92% of GDP in 2020, which is considerably lower in comparison to**

other EU countries. Therefore, start-ups and other R&D projects do not have favourable conditions in Slovakia to receive necessary funding for their business to grow, and are instead moving to other European countries. **Slovakia did not utilize the potential of European Structural and Investment Funds to cover the lack of funding in research and development.** Despite having a relatively high success rate in Horizon 2020 applications, Slovakia is lagging behind in the number of applications. Furthermore, most of the "Seal of Excellence" projects had the need to relocate to a different country, as the amount of funding needed to sustain them in Slovakia was insufficient.

Low levels of funding have been directly and indirectly affecting quality of education and research in the country, which are often associated with better future employment on the labour market. As a result, Slovakia has been subject to large amounts of brain drain from students leaving to study abroad. Most of these students are not returning back after their study abroad. On the other hand, it is becoming ever more challenging to attract foreign researchers into Slovakia, since universities and research centres do not possess the necessary funding to be an attractive option for them. Moreover, universities cannot compete with business organisations in Slovakia, which offer higher wages to researchers. As a result, most of the research staff in Slovakia is concentrated in the private sector Due to these problems, none of the top universities in Slovakia appear among the best 1000 universities worldwide and the number of international publications, has been consistently lower compared to other V4 countries.

Slovakia has been underperforming in making administrative services available online, as well as in internet coverage across the country. In 2020, the DESI index for the Slovak Republic revealed limitations mainly in the categories of users, forms, and data openness. The OECD's Open, Useful, Reusable Government Data index reveals existing gaps in open government data policy and provide insights for future recommendations.

The COVID-19 recession revealed the need for a better regional policy. **The unemployment rate in Slovakia displays large regional differences, with low unemployment rates in the districts in the northwest of Slovakia and high unemployment rates in the southeast of the country.** These disparities tend to increase during economic downturns, including the COVID-19 recession.

Current regional policy is not effective in dealing with the regional disparities. The flagship policy, the aid to the least developed districts, did not have a major impact in its first four years of existence as it lacked mechanisms that would ensure use of funds for the purpose of creating sustainable jobs. Other funds aimed at reducing regional disparities, European Structural and Investment Funds and regional aid, also miss the mark.

On the national level, a cost-efficient construction of highways is needed to increase the accessibility of the districts in the east of the country, as this region belongs to the least accessible parts of the EU. This could also stimulate the labor mobility in Slovakia along with changes in the housing policy aimed at supporting the development of a rental market which is one of the smallest in the region Finally, the districts in southeastern Slovakia would benefit from improvements in the educational system and social integration of the marginalized Roma community.

Key recommendations for policy makers

There is a continued need to improve public financial management, with a focus on achieving budgetary targets and improving long-term sustainability. This entails a mix of spending efficiency (such as the Value for Money initiative), introducing expenditure ceilings, as well as ensuring that priority spending is preserved. At the same time, greater focus should be directed on long-term sustainability over short-term goals (shift towards net worth). Reforms aimed at managing the effects of aging on public finances should be supported, particularly in terms of the pension system. In this context, linking the retirement age to life expectancy will increase not only the quantity but also the quality of the workforce and improve continuity in the transfer of skills.

Rapid technological change brought upon by the pandemic creates the need to define new forms of work. More flexible work arrangements, including greater use of part-time work and remote working have the potential to improve the inclusivity of the Slovak economy. At the same time, it is necessary to define new forms of work with regard to the rights of employees, and not only from the point of view of employers. Establishing adequate protection of employees' rights and ensuring occupational safety and health in these new forms of work through updated legislature will be necessary.

Moreover, as the Slovak economy faces significant risk of job displacement due to automation, cultivating lifelong learning of employees is vital**. It is necessary to train complex and adaptable employees able to respond to rapidly changing labour market conditions, i.e. not employees "for one employer and one production line"**. The goal is to increase accessibility and improve the quality of provided education to enable all citizens, regardless of their current life situation, to be able to acquire new knowledge, skills and competences. The establishment of a functional network of career counsellors, who would be able to transfer the employee throughout their productive lives and help with any retraining or career changes, could make a significant contribution to functional lifelong learning.

Job mobility support and simplification of access for highly qualified workers creates a precondition for economic growth, job creation and satisfaction of demand for insufficient and highly qualified positions on the Slovak labor market. Hence, policies that support brain gain from abroad, and mitigate further brain drain, are called for.

The primary policy goal in the education sector must be a comprehensive reform of education system, which will improve the skills level in Slovakia and ensure the harmonization of education with the needs of the labour market with regard to digitalization and Industry 4.0. The socio-economic background in Slovakia has a high impact on study results, as well as on the attained education level. Support for children from disadvantaged backgrounds, for example in the form of social scholarships, will enable students to reach their full potential and contribute to the formation of human capital in Slovakia.

Red tape surrounding research grants should be minimized and access to funding made more widely available, so that work on a publicly funded project does not create unnecessary burden. Moreover, collaborative efforts between the private sector and universities and other public research institutions should be supported, which would facilitate both better funding opportunities for research and education and wider application of scientific skills and knowledge in practice for the benefit of the whole society.

In order to facilitate greater innovative capacity within the economy, the government innovation policy should focus on better management of public schemes for funding of research and development. This can be done by cutting unnecessary limitations for applicants, ensuring international members of selection committees and focus on technological domains closer to the current capabilities of the economic actors within Slovak economy.

Funding for innovative projects should also be coordinated across departments, ensuring the effectiveness of the support for economic and social development and the compatibility with the capabilities of the private sector funding. The government should also develop capacity to interact with the key stakeholders and sectors of the economy with greater understanding of their needs, in order to create better policy and support schemes.

A new complex regional policy, which could be inspired from best practices from abroad, is necessary. The current approach of focusing on the LDD is not working, hence a change is needed. The new policy should address the issues of all regions: risk of automation in the west and a less dynamic economic structure in the east. Regional policy should be complemented by a reform of subnational self-governing entities. Currently, the income of the entities on the subnational level depends largely on earmarked transfers. A move towards revenue from taxes could help the subnational entities to better address local needs. Moreover, unification of the smallest municipalities could increase their effectiveness and increase the quality of the service they provide.

Table of contents

Introduction

"Either way, policy will matter, and wise choices could mitigate productivity-decelerating effects of the crisis and enhance the influence of productivity-accelerating factors."

(Di Mauro and Syverson, 2020, p.1)

Slovakia entered the COVID-19 recession in the midst of a productivity slump and on the verge of the middle-income trap, as we illustrated in the 2019 Report on productivity and competitiveness. The pandemic further contributed to many of the socio-economic issues that were impeding Slovakia's convergence in the past decade. Yet, the crisis also offers a time of redesigning and rebuilding. It provides a unique opportunity not to get back to normal, but to find a way forward and create a more resilient and internationally competitive Slovak economy. Therefore, as we transition into the recovery stage, the goal lies in implementing changes that boost Slovakia's standing in global value chains, reduce regional and gender inequalities, prepare for the digitalisation age, and as a result, enhance the country's productivity and competitiveness.

The 2019 Report provided a broad descriptive analysis of the development marked by Slovakia since its transition to a market economy, covering a wide array of topics. This year's Report instead adopts a two-part structure: Chapter 1 provides a succinct update of the main productivity indicators and competitiveness rankings, followed by deeper analyses of selected issues in the next three chapters. While the concepts of productivity and competitiveness undoubtedly partially overlap, for the purposes of this Report, productivity (benchmarked to other EU countries) is regarded as more important when competing within the European open market. On the other hand, beyond EU borders, for example when it comes to competition with emerging Asian economies, competitiveness measures are of greater relevance.

The first thematic chapter (Chapter 2) addresses the COVID-19 pandemic and its implications on the Slovak economy, with a particular focus on the long-term transformative effects of the crisis. We propose that the associated uncertainty exacerbated, rather than created, many of the problems in the Slovak economy, including the dynamism of the business environment, sustainability of public finances, or levels of educational attainment. This chapter also deals with the demographic characteristics of individuals most affected by the crisis, as well as the gender impact of the pandemic.

Chapter 3 focuses on the innovative capacity of the Slovak economy. As discussed in the 2019 Report, Slovakia clearly lags behind the rest of the EU in this aspect, which presents a roadblock in the transition from an assembly-line economy towards higher value-added activities. Consequently, we examine possible ways to create a supportive environment for innovation in Slovakia, and propose changes in funding to support international cooperation that would favour the quality of research projects over quantity. In order to identify the changes needed to eliminate brain drain from Slovak academia, the chapter also discusses the departure of talented students abroad and into the private sector, and touches upon the issue of ageing Slovak academic researchers.

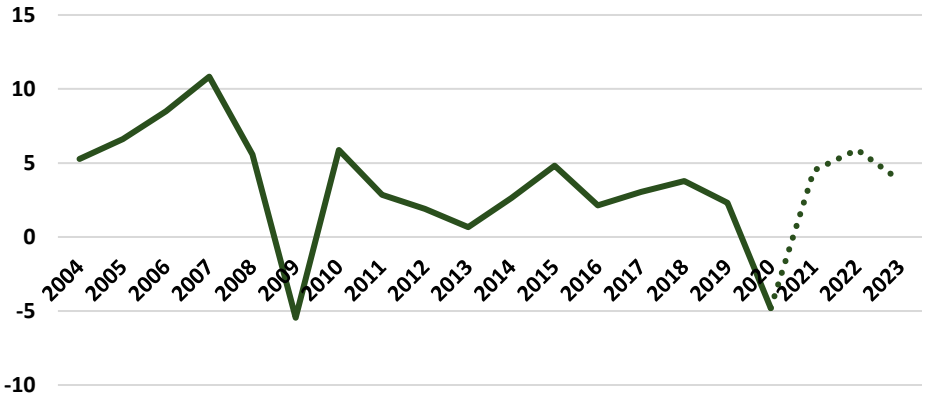
Finally, Chapter 4 addresses the differences in the level of economic and social development across Slovak regions, which have long been large. These suggest that the economic gains experienced in the past have not been shared uniformly, and that there is a potential for productivity gains in the lagging-behind regions. In this chapter, we first present the regional differences in unemployment rate on districtual level and discuss some of the potential determinants of the disparities, such as the gaps in the level of education, labor mobility and accessibility. We further examine the existing regional policies, the main goal of which was to foster convergence of the least developed districts. However, we show this approach has a considerable amount of caveats. Hence, we propose to redesign the Slovak regional policy to address the specific challenges of faced by different regions in Slovakia.

1. Macroeconomic outlook

1.1 Overview of key macroeconomic indicators

Before the COVID-19 pandemic unfolded, the Slovak economy was on a relatively favourable growth trajectory following a period of stagnation, primarily due to the growth in value-added in the service sector (NBS, 2020a). However, non-pharmaceutical interventions aimed at reducing the spread of the novel virus have caused a fall in global economic activity in the first quarter of 2020, sending the Slovak economy into a recession. A significant decline was observed in investment, private consumption, as well as in net exports. Consequently, the estimated contraction in GDP against the previous year was -4.8%, which presents a comparable contraction to the Great Recession in 2009 (Figure 1.1, Table 1.1)[1].

Figure 1.1: Yearly growth of real GDP in constant prices (in %)



Source: NBS. Note: The dotted line represents forecast values.

Yet, despite the prevailing pessimistic economic climate, we can expect a relatively swift rebound of the Slovak economy, with a return to pre-crisis levels forecast in the second half of 2021. Major sources of the recovery are European structural and investment funds (ESIF), and investment in the automotive sector (NBS, 2020b). A 4% year-on-year growth in industry revenues fuelled by car and steel manufacturers at the end of 2020 (Hojdan et al., 2021) also contributes to the cautious optimism surrounding the prospects of a V-shaped recovery.

The COVID-19 recession brought about an augmentation in the unemployment rate by 9 percentage points (Table 1.1) and a partial deviation from the historically high levels of the labour shortage indicator characterising the pre-pandemic Slovak labour market. The prompt reaction of the state to provide support and the extensive use of the so-called kurzarbeit schemes shielded the labour market from a greater downturn, and instead we see a significant decline in the number of hours worked than in employment (Figure 1.2) (NBS, 2020c): nonetheless, forecasts predict that the impacts of COVID-19 will remain visible in the labour market in the coming months, with the unemployment rate showing a further rise in 2021 (Table 1.1).

Recent analyses, such as Ebrahimy et al. (2020) have considered that the current crisis could lead to a period of higher inflation. A slight growth of price levels is expected over the medium-term (Figure 1.3), associated with the development in the markets with oil, plastics and microchips. Yet, in the

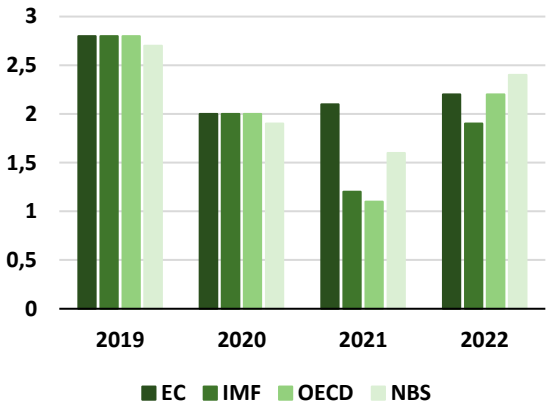
[1] For a description of key differences between the two crises, see Box 2.1.

context of the Great Moderation and the inability of central banks to stimulate inflation, it is more conceivable to increase inflation through fiscal policy. At the same time, the key concern of EU governments should be to increase the productivity and performance of the economy, to exceed the expected levels of growth incorporated into debt sustainability models.

Figure 1.2: Number of employed persons vs. hours worked (seasonally adjusted, yearly change in %)

Source: NBS

Figure 1.3: Inflation based on CPI (in %)



Source: EC, IMF, OECD, NBS.
Note: Forecast values for years 2021 and 2022.

Table 1.1: Medium-term macroeconomic forecast for CEE

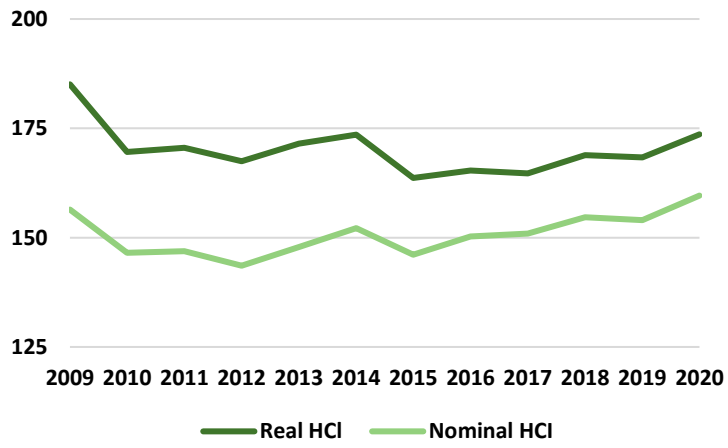
		GDP (growth in %)				Inflation (CPI, growth in %)				Unemployment rate (in %)			
		2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
SK	EC	2.5	-4.8	4.9	5.3	2.8	2.0	2.1	2.2	5.8	6.7	7.4	6.6
	IMF	2.3	-5.2	4.7	4.4	2.8	2.0	1.2	1.9	5.8	6.7	7.3	6.7
	OECD	2.5	-4.8	4.2	5.2	2.8	2.0	1.1	2.2	5.8	6.7	7.6	7.2
	NBS	2.5	-4.8	4.5	5.9	2.7	1.9	1.6	2.4	5.8	6.7	7.1	6.8
CZ	EC	2.3	-5.6	3.9	4.5	2.6	3.3	2.7	2.3	2.0	2.6	3.8	3.5
	IMF	2.3	-5.6	4.2	4.3	2.8	3.2	2.3	2.0	2.0	2.7	3.4	3.2
	OECD	2.3	-5.6	3.3	4.9	2.8	3.2	2.4	2.3	2.0	2.5	3.5	3.5
HU	EC	4.6	-5.0	6.3	5.0	3.4	3.4	4.4	3.3	3.4	4.3	4.3	3.8
	IMF	4.6	-5.0	4.3	5.9	3.4	3.3	3.6	3.5	3.3	4.1	3.8	3.5
	OECD	4.6	-5.1	4.6	5.0	3.3	3.3	3.9	3.9	3.4	4.2	4.0	3.4
PL	EC	4.7	-2.7	4.8	5.2	2.1	3.7	4.2	3.1	3.3	3.2	3.5	3.3
	IMF	4.5	-2.7	3.5	4.5	2.3	3.4	3.2	2.5	3.3	3.2	4.9	4.5
	OECD	4.5	-2.7	3.7	4.7	2.2	3.4	3.8	3.3	3.3	3.2	3.4	3.4
AT	EC	1.4	-6.3	3.8	4.5	1.5	1.4	2.1	1.9	4.5	5.4	5.0	4.8
	IMF	1.4	-6.6	3.5	4.0	1.5	1.4	1.6	1.8	4.5	5.3	5.5	5.3
	OECD	1.4	-6.7	3.4	4.2	1.5	1.4	2.0	1.9	4.5	5.4	5.1	4.8

Source: EC, IMF, OECD, NBS.
Note: Forecast values for years 2021 and 2022.

1.2 International competitiveness of the Slovak economy

For small open economies such as Slovakia, price competitiveness of exports is especially crucial. Harmonized Competitiveness Indicators (HCI) present a useful metric in this context, as it provides a comparable measure of price competitiveness across Eurozone countries in line with the REER of the euro. On Figure 1.4, we observe a loss of Slovak competitiveness in 2020 based on HCI. A 3.7% year-on-year growth in the real HCI reflects the strengthening of the euro against our trading partners (the nominal HCI), as well as a greater increase in Slovak price levels compared to these countries. In terms of the nominal HCI, there was a 3.1 percentage-point deterioration in competitiveness, resulting from adverse exchange rate movements against countries outside the Eurozone (EZ) with whom Slovakia engages in trade. The remainder of the increase in real HCI is due to the terms of trade outside the EZ.

Figure 1.4: Harmonized Competitiveness Indicators of Slovakia (index 1999=100)



Source: ECB.
Note: Real HCI based on the consumer price index. Values above 100 represent a worsening in competitiveness.

The declining competitiveness of the Slovak economy is also manifested in its position in global rankings. The National Productivity Board (2020) has pointed to the unfavourable position in various global competitiveness rankings in last year's Report, when Slovakia claimed the 53rd place in the IMD World Competitiveness Ranking out of 63 evaluated countries. The year 2020 brought a concerning drop in Slovakia's standing by another four places (Table 1.2), and there are presently only 6 countries that the IMD considers less competitive than Slovakia. Slovakia also lags significantly behind neighbouring countries (Figure 1.5). The problematic areas are, above all, government efficiency and business efficiency, where Slovakia is at the tail end of the international comparison. The main challenges lie ahead in stabilizing public spending, increasing the skills of the workforce in respect to high labour costs, strengthening digitization across the economy, reforming the education system to better suit the needs of the labour market, and strengthening the business environment (IMD, 2020).

Major improvements compared to last year were made in transparency, as well as in the amount of expenditure allocated to education, but the negative development in the health of the public budget or the extent of tax evasion exceeded the positive effects in the sphere of institutional quality. We also see slight improvements in the innovative environment, manifested in the number of patent applications per capita, the days required to set up a start-up, or the number of steps required to set up a start-up (IMD, 2020). However, these improvements have not been sufficient to keep up with the

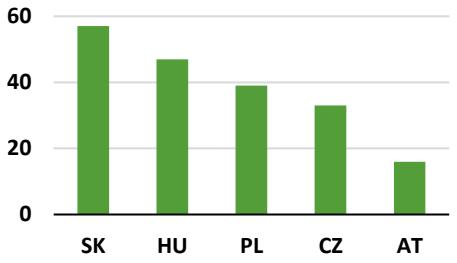
pace of development in other countries, and hence we still see a slump in the area of business efficiency.

Table 1.2: Changes in the position of Slovakia in the IMD World Competitiveness Ranking

	2019	2020	Change in rank
Overall	53	57	4 ↓
Economic performance	42	49	7 ↓
Government efficiency	57	60	3 ↓
Business efficiency	60	61	1 ↓
Infrastructure	44	46	2 ↓

Source: IMD.

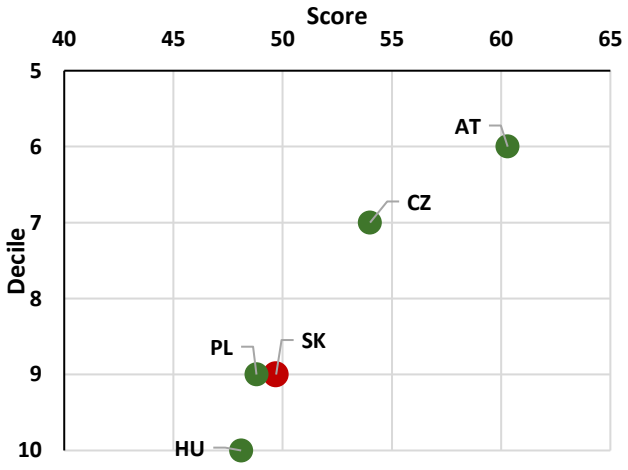
Figure 1.5: Position of CEE countries in the IMD World Competitiveness Ranking



Source: IMD. Note: Higher values represent a worse position of the country.

This year's Global Competitiveness Report by the World Economic Forum dropped the annual ranking of countries, but instead issued a special edition, which focuses on 11 priorities for long-term economic transformation towards shared prosperity and sustainability. Each of these priority areas was rated on a scale of 1-100 (Table 1.3). In the overall ranking, Slovakia scored 49.7, placing it in the ninth decile among emerging economies such as Poland, Argentina and India (Figure 1.6). As NBS (2021, p.26) has put it, "the sources of technological progress taken over from abroad thanks to the arrival of foreign investors and their suppliers seem to be exhausted. Slovakia does not sufficiently replace imported technologies and know-how with domestic innovations."

Figure 1.6: Readiness for economic transformation (summary score and decile)



Source: World Economic Forum. Note: the score is displayed on a scale of 0-100. The minor axis shows the decile in which the country is located. The higher the decile, the worse the result for the country.

Slovakia is achieving satisfactory results in its ability to modernize infrastructure in order to accelerate the energy transition and expand access to electricity and ICT (Table 1.3). However, Slovakia's readiness for transformation into a modern and resilient economy is a matter of concern, with the World Economic Forum mentioning Slovakia as the worst performer in the region in three of the eleven priority areas.

Market concentration has increased over the last decade, and modern policies to restore competition will have to consider new market drivers, such as digital platforms and intangible assets. A healthy business environment will require proactive efforts to facilitate market entry for new firms and improve antitrust frameworks. Moreover, economies undergoing digital transformation will need breakthrough technologies and new products to unlock their potential. Based on the data on the state of research and development and the role of the public sector in managing this development, Slovakia finds itself on the tail side of countries ready to create "markets of tomorrow", with innovation and cooperation between research institutions and the private sector lagging significantly behind other economies (for more details see Chapter 3).

At the same time, diversity, equality and inclusion must be an integral part of any country's innovation-based economic transformation strategy. Despite the limited data in the inclusion assessment, Slovakia falls behind the other V4 countries and most of the other surveyed countries (World Economic Forum, 2020).

Table 1.3: Assessing CEE countries' readiness for transformation in 11 priority areas

n.	Priority area	SK	CZ	HU	PL	AT
1	Ensure public institutions embed strong governance principles and a long-term vision and build trust by serving their citizens	50	56.3	46.1	46.7	69.9
2	Upgrade infrastructure to accelerate the energy transition and broaden access to electricity and ICT	84.9	81.6	86.4	77.8	83.8
3	Shift to more progressive taxation, rethinking how corporations, wealth and labour are taxed, nationally and in an international cooperative framework	44.4	46.8	30.7	33.6	49.9
4	Update education curricula and expand investment in the skills needed for the jobs and "markets of tomorrow"	46.5	48.5	40.8	41.9	60.6
5	Rethink labour laws and social protection for the new economy and the new needs of the workforce	58.7	63.1	53.7	59.8	66.4
6	Expand eldercare, childcare and healthcare infrastructure, access and innovation for the benefit of people and the economy	35.5	40	34.4	30.3	42.8
7	Increase incentives to direct financial resources towards long-term investments, strengthen stability and expand inclusion	54.7	58.2	52	62.7	88.3
8	Rethink competition and anti-trust frameworks needed in the Fourth Industrial Revolution, ensuring market access, both locally and internationally	49.1	60.4	55.2	61.5	58.6

9	Facilitate the creation of “markets of tomorrow”, especially in areas that require public-private collaboration	39.3	41.9	39.4	37.5	47.3
10	Incentivize and expand patient investments in research, innovation and invention that can create new “markets of tomorrow”	31.3	40.2	36.7	32.1	38.8
11	Incentivize firms to embrace diversity, equity and inclusion to enhance creativity	52.2	57.3	53.5	52.7	56.6

Source: World Economic Forum (2020).

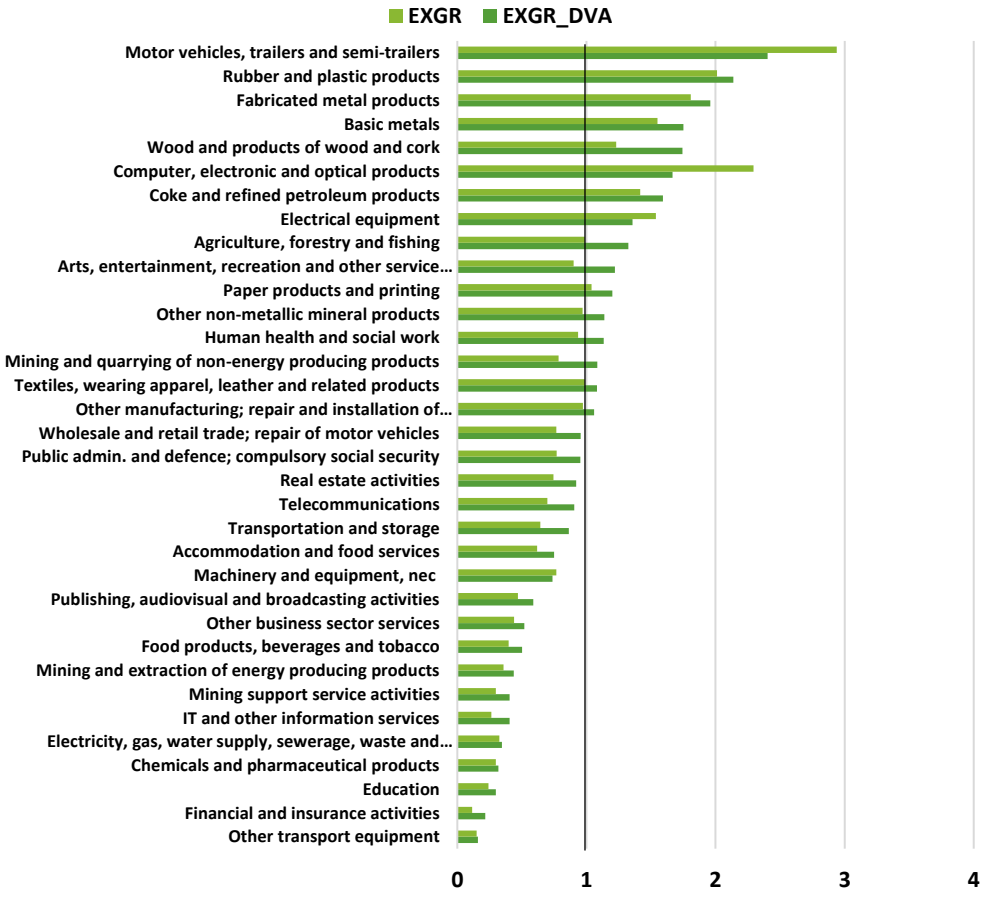
Another form of measurement for country’s competitiveness are the Revealed comparative advantage (RCA) indicators. These show a country’s industry specialization by comparing its industry share (of total exports, value added etc.) with an equivalent world average industry share. Traditionally, the RCA indicators have been calculated based on gross exports of goods, but using OECD’s TiVA database, we can distinguish countries' value added in exported goods and services. The RCA indicators in this section are calculated based on Equation 1.1:

$$RCA_{c,i,t} = \frac{\frac{EXGR\_DVA_{c,i,t}}{\sum_i^I EXGR\_DVA_{c,i,t}}}{\frac{\sum_c^C EXGR\_DVA_{c,i,t}}{\sum_c^C \sum_i^I EXGR\_DVA_{c,i,t}}}, \quad 1.1$$

where C and c denote the EU member states and the rest of the world, respectively. Further, i represents industry $i \in I=\{1,\ldots,36\}$ and t denotes the year. , industry *EXGR_DVA* correspond to domestic Value Added embodied in gross exports.

Figure 1.7 shows the RCA rating of Slovak industries compared to EU27. The RCA of Slovak motor vehicles, trailers and semi-trailers industry is triple the size of the EU27’s; on the other hand, financial and insurance activities and education lag significantly behind, which reflects Slovakia’s strong manufacturing orientation and lack of a dynamic capital market.

Figure 1.7: RCA index with world in value added and gross terms in 2015 by industry

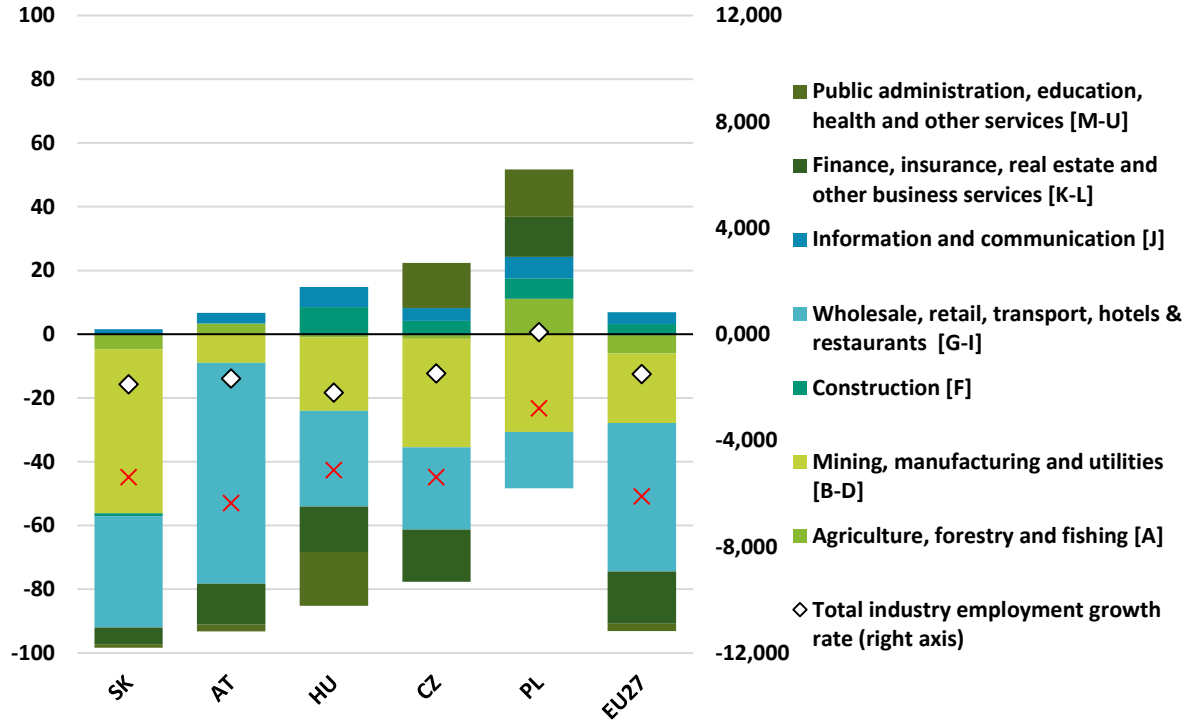


Source: OECD' calculations based on TiVA indicators. Note: EXGR denotes gross exports; EXGR_DVA denotes the domestic value added content of gross exports.

1.3 Analysis of Slovak productivity

A major development in terms of analysis of productivity in 2020 is the introduction of government financed furlough or "kurzarbeit" schemes to help firms to fight layoffs during the pandemic. The effect on labour input of these schemes is seen in Figure 1.8. The COVID-19 pandemic caused the most significant economic shock to the global GDP in the post-second world war era. However, as was noted earlier, total employment figures expressed in persons do not follow the same pattern. On average, in the EU, the decline in GDP is four times higher than the contraction in employment. The majority of job losses are attributed to the sectors belonging to wholesale, retail, transport, hotels and restaurants. Of these, retail and transport services, considered as "essential services", were probably less affected than hotels and restaurants, whose operations were hit hardest by the non-pharmaceutical interventions introduced to limit the virus's spread.

Figure 1.8: Relative contribution to change in total employment by major sectors of economic activity in 2019-20 (in %)

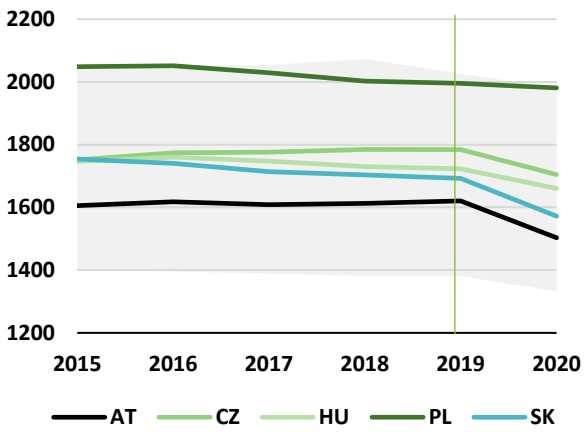


Source: OECD' calculations based on Eurostat's National Accounts database. Note: EU27 corresponds to weighted average of 27 EU member countries as of 2020.

On the other hand, hours worked followed suit with GDP. On average, the annual hours worked per person employed within the EU dropped by almost 5% (Figure 1.9). This drop can be explained by the different rate of decrease based on employment measures. For example, in Slovakia, the total employment figures decreased by 1.9% from 2019 to 2020 but the drop in hours worked was more than fourfold, at 8.8%. This can lead to an opposite labour productivity evolution in 2020 based on the different labour input measures used.

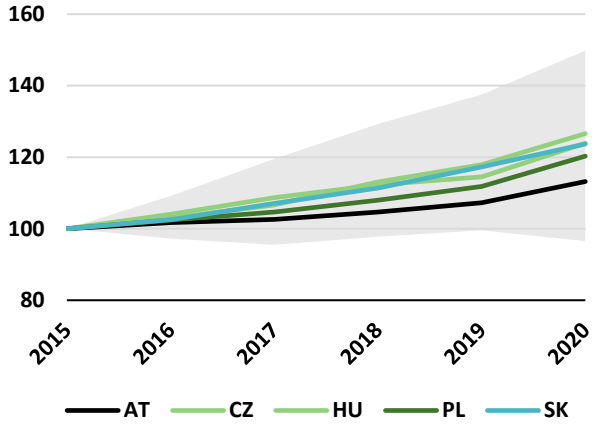
At the same time, the unit labour costs (ULC) per person growth accelerated in the Central Europe area. For Austria, Hungary and Poland, ULC grew more than two times faster than in the pre-COVID-19 years (Figure 1.10). This development is most probably related to incurred costs of severance payments (as an example, see agriculture in Table 1.4) and remuneration for accrued time off.

Figure 1.9: Annual hours worked per person employed



Source: OECD calculations based on Eurostat's National Accounts database. Note: grey area is the EU range, which corresponds to maximal and minimal values of available 27 EU member countries as of 2020. Belgium and Sweden are not included in 2020 EU range, due to the lack of data for hours worked.

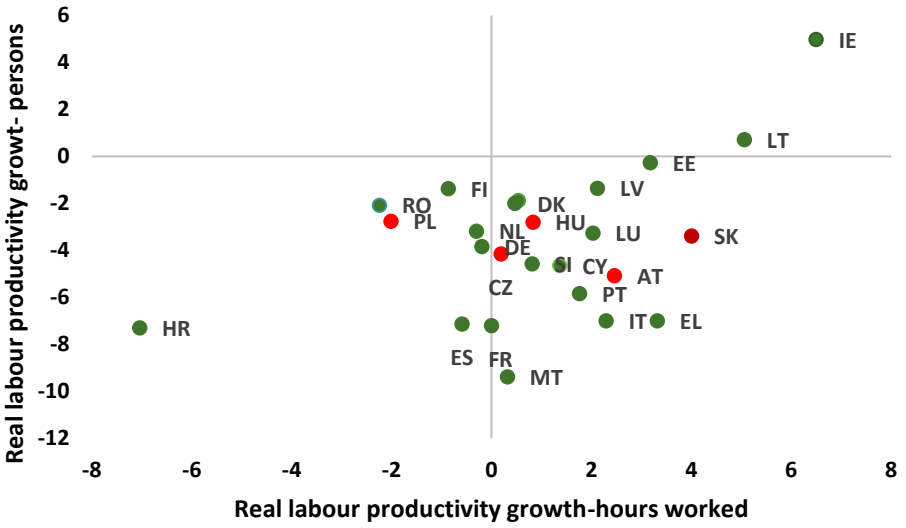
Figure 1.10: Nominal unit labour cost based on persons



Source: OECD calculations based on Eurostat's National Accounts database. Note: Index 2015=100. EU range corresponds to maximal and minimal values of available 27 EU member countries as of 2020.

The main reason behind that is the deployment of furlough or similar job retention schemes where the governments pay part of employees' salaries, even though they stay at home and do not work. This effect can be seen in 1.11, comparing real labour productivity growth rates between 2020 and 2019, based on persons and hours worked. For most EU member states, the labour productivity in persons decreased and at the same time per hour worked grew.

Figure 1.11: Real labour productivity growth in 2019-2020 (in persons and hours worked)



Source: OECD calculations based on Eurostat's National Accounts database. Note: Growth is calculated based on Index where 2015=100

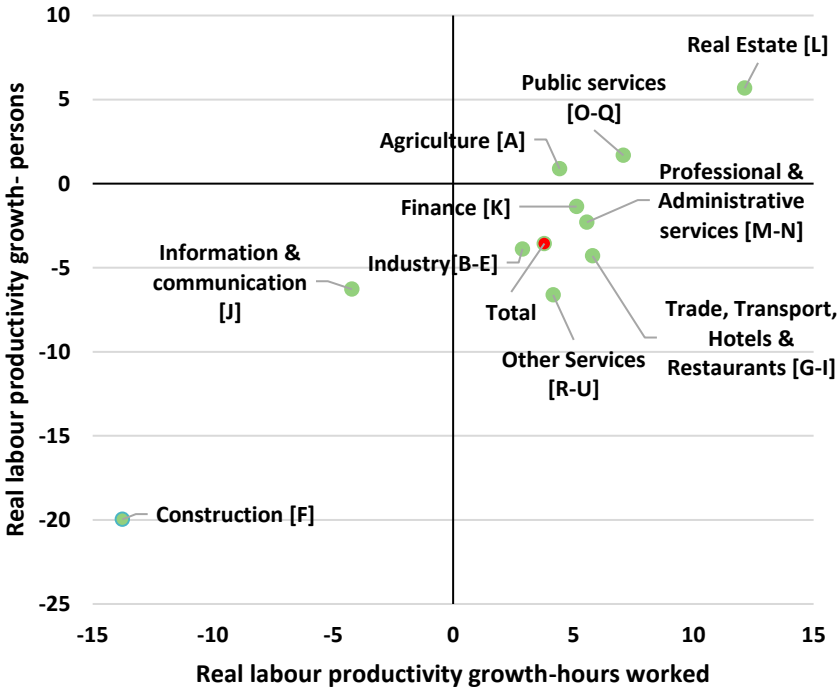
A new perspective on productivity evolution during the pandemic in Slovakia is given in Figure 1.12. Three clusters of industries can be distinguished —one where there is a drop in both labour productivity measures. The most significant drop in productivity can be observed in construction

sector, where Gross Value Added (GVA) in 2015 prices decreased by 20% (more than any other industry) and the total number of workers did not change, although hours worked were on average shortened. Rather surprisingly, labour productivity also decreased in the information and communication services. This sector was one of two that experienced an inflow of workers (another industry with employment growth was public services).

The second cluster consists of three industries for which both measures of labour productivity show positive growth. The real estate and public services were the only two sectors where GVA increased between 2019 and 2020. On the other hand, agriculture sector is in this group because a drop in both measures of employment more than offsets the fall in GVA.

For all industries in the last group, the drop in GVA is more than offset by a drop in hours worked, so labour productivity per hour worked is growing, but the decrease in employment is lower than GVA, leading to negative productivity growth based on persons.

Figure 1.12: Real labour productivity growth in persons and hours worked by industry in 2019-2020 (in %)



Source: OECD calculations based on Eurostat's National Accounts database.

Table 1.4 summarises changes in between 2019 and 2020 for GVA, persons employed, hours worked and compensation of employees by industry in Slovakia . The most notable consequence of the pandemic is that the hours worked shrank across all industries in Slovakia, ranging from 1.1% in Information and communication to more than 10% in industry, trade, transportation, accommodation, and restaurants and other services. Overall, the compensation of employees is approximately at the level before the pandemic, as the rise in public service and professional and administrative services' remuneration is offsetting the reduction in manufacturing and construction.

Table 1.4: Growth rates of selected variables by industry (in %)

Industry	Value Added, 2015 prices	Persons employed	Hours worked	Compensation of employees
Total	-5.4%	-1.9%	-8.8%	0.0%
Agriculture [A]	-2.3%	-3.2%	-6.4%	-0.1%
Industry [B-E]	-7.9%	-4.2%	-10.5%	-3.6%
Manufacturing [C]	-7.6%	-4.3%	-10.9%	-4.2%
Construction [F]	-20.2%	-0.2%	-7.4%	-2.9%
Trade, Transport, Hotels & Restaurants [G-I]	-6.8%	-2.6%	-11.9%	-2.1%
Information & communication [J]	-5.3%	1.0%	-1.1%	1.5%
Finance [K]	-1.2%	-2.5%	-8.5%	-0.1%
Real Estate [L]	5.2%	-0.5%	-6.2%	-5.0%
Professional & Administrative serv. [M-N]	-2.7%	-0.5%	-7.9%	5.0%
Public serv. [O-Q]	2.1%	0.4%	-4.7%	5.1%
Other Services [R-U]	-9.6%	-3.2%	-13.2%	-4.6%

Source: OECD calculations based on Eurostat's National Accounts database.

2. The impact of COVID-19 on Slovak productivity and competitiveness

The COVID-19 recession hit the Slovak economy merely a decade following the Great Recession and as was the case in 2009, brought about a sharp decline in economic activity, as well as in employment. However, there are noteworthy differences between the present and the previous crises that should not be overlooked (Box 2.1).

Box 2.1: Comparing crises— key differences between the Great Recession and the COVID-19 recession

The key difference between the Great Recession and the COVID-19 recession stems in the shock that triggered the downturn. In the case of the former it was an endogenous stress within the financial sector, while for the latter was latter the origin was outside the global economic sector. The Great Recession started with a financial crisis in the US in 2007 and transcended into a global economic crisis only after some time. The subsequent decline in Slovakia in 2009 was primarily attributable to sluggish foreign demand, which in turn affected domestic demand through developments in the job market (Gylánik, 2020). On the other hand, of the COVID-19 recession was much more unexpected and severe and non-pharmaceutical interventions aimed at slowing the spread of the virus brought the economy to an immediate halt (Roland Berger, 2020).

A major role played by the shock from the supply side is also a unique feature of the COVID-19 recession, which preceded the drop in domestic and foreign demand as a result of uncertainty, growth in unemployment and a lack of consumption opportunities (Boskin, 2020). According to Gylánik (2020), there is some risk of long-term weakened supply in the labour market, which would require additional measures supporting firm liquidity, demand, and employment for a sustained period of time.

The temporary lifting of lockdown measures in the third quarter of 2020 was associated with a lively rebound of the Slovak economy. State support certainly represented an important driving force behind this recovery, as it shielded the economy from massive job cuts and retained the purchasing power of consumers (OECD, 2020). Yet despite the plethora of fiscal and monetary stimuli, including significant reductions in the interest rates, recovery from the previous recession was far less dynamic than current forecasts predict. Here, a critical difference lies in the health of the financial sector (DeGrauwe a Ji, 2020). The Great Recession directly hit the banking sector, making it reluctant to extend credit, which resulted in a slow recovery. This is in stark contrast to the COVID-19 recession, where banks have not yet shown signs of distress and are therefore not expected to impede recovery.

Nonetheless, a common element between most crises is that they tend to bring about significant changes in the economy and create a “new normal”. Buti and Messori (2020) identify three phases of the COVID-19 recession, each with its unique implications: emergency, transition, and recovery. Social issues will remain critical in the first, emergency phase. Subsequently, a need to fill the investment gap, both public and private, will emerge in the transition phase, and recapitalization is expected to become critical in the recovery phase (Buti, 2020). Building on this three-phase distinction, in this

chapter, we will examine short-, medium- and long-term impacts of the COVID-19 recession[2], with the greatest emphasis placed on the long-term effects, which have the potential of permanently transforming Slovak productivity and competitiveness.

2.1 Short-term implications of restrictive measures on Slovak productivity and competitiveness

Lockdowns and business closures imposed by government authorities have brought economic activity to a standstill in March 2020, when the first case of COVID-19 was identified within Slovak borders. The government's prompt and strict initial response, as well as general compliance with non-pharmaceutical interventions by the public has kept the spread of the virus well under control until the fourth quarter of 2020, when the second wave hit Europe, this time not sparing Slovakia (Figure 2.1). The drastic upsurge in cases in CEE countries during the still-ongoing second wave has resulted in a severe public health crisis in Slovakia, unfortunately placing Slovakia in the global lead in terms of deaths per capita in mid-February 2021[3], and claiming over 4,000 excess deaths over the course of just 3 months (Figure 2.2).

While the social impacts of the COVID-19 pandemic began to be particularly grave at the end of 2020, the economic impacts were the harshest at the beginning of the year. Looking at OECD's Weekly Tracker, which uses machine learning on Google Trends data to provide high-frequency estimates of economic activity, we can see that the year-on-year growth rate in weekly GDP has significantly contracted in mid-March, hitting the minimum of -19.6% in the first week of April. The summer months have seen a slowdown in the spread of the virus, which allowed economic activity to rebound, albeit still oscillating around zero percent. What is particularly notable, however, is the much less severe decline in activity associated with the second wave of lockdowns in the fourth quarter of 2020, where the downturn remained in the single-digit range (Figure 2.3). A similar trend can be observed across all considered neighbouring economies, suggesting a possible degree of adaptation of businesses, consumers, as well as the labour market, to the "new normal" as time passes.

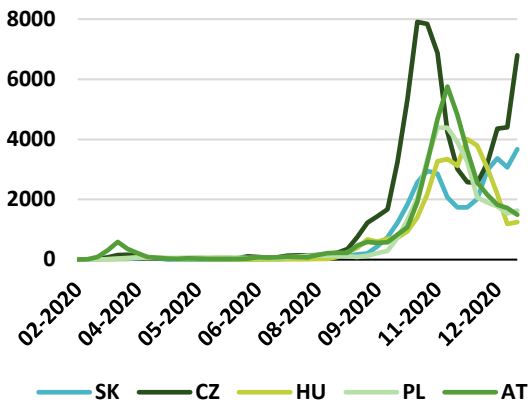
Likewise, the first wave of the pandemic brought about a major collapse in industrial production and revenues, largely resulting from Slovakia's heavy reliance on the automotive sector (Plutzer, 2021). Slovak industry experienced the most dramatic drop among all of EU27 in the wake of the COVID-19 recession, reaching a 42% year-on-year decline in industrial activity in April, which far exceeds the Great Recession in its scale (Plutzer, 2021). The speed of return to nearly pre-crisis levels also surpassed the Great Recession, as we observe a dramatic revival in industry in the summer, fuelling optimism regarding a V-shaped economic recovery. The deterioration of performance in sectors related to automobile production, and Slovakia's above-average openness, coupled with lockdown measures explain over 90% of the observed downfall in industry in the first half of 2020 (Plutzer, 2021). The observed volatility experienced due to Slovakia's lack of diversification in its industrial composition and strong dependence on trading partners deserves some reflection in terms of Slovakia's competitiveness and resilience in times of crises (Figure 2.4). The heavy representation of the automotive sector in the economy (three times the EU27 average) caused a sharp drop in the wake of

[2] For the purposes of this Report, short-term implications are those that are expected to be significant in the coming 12-month period, medium-term implications refer to the next 3 years, while long-term implications are such that will have lasting effects beyond 3 years into the future.

[3] Based on the rolling 7-day average of deaths per million inhabitants.

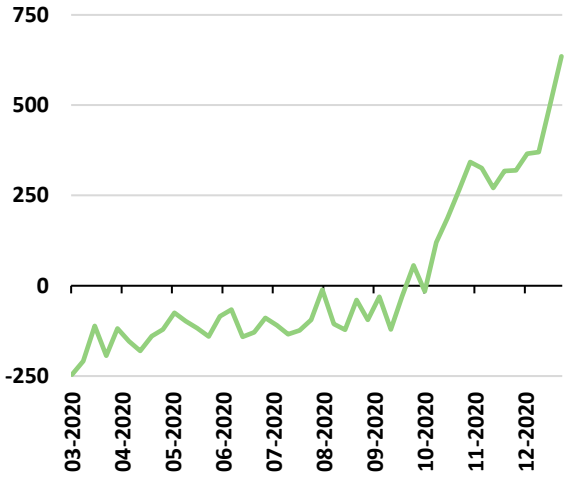
crisis, but also resulted in a swift recovery. A greater diversification of the Slovak economy, especially into greater value-added activities such as R&D, continues to be of strategic importance, in order to strengthen the resilience to long-run structural changes and move towards more sophisticated activities than production.

Figure 2.1: Weekly COVID-19 incidence rate (in number of persons per 1M inhabitants)



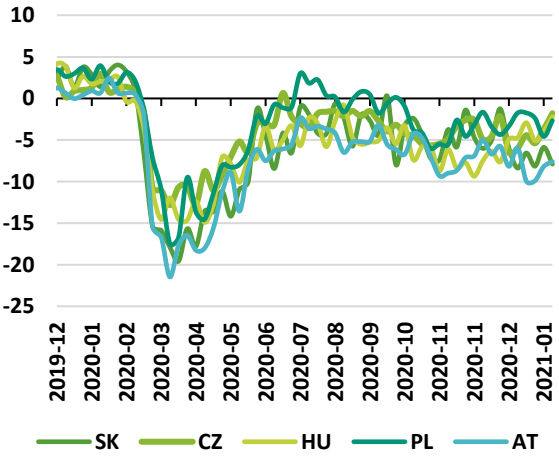
Source: Our World in Data.

Figure 2.2: Weekly excess mortality in 2020 (in number of persons)



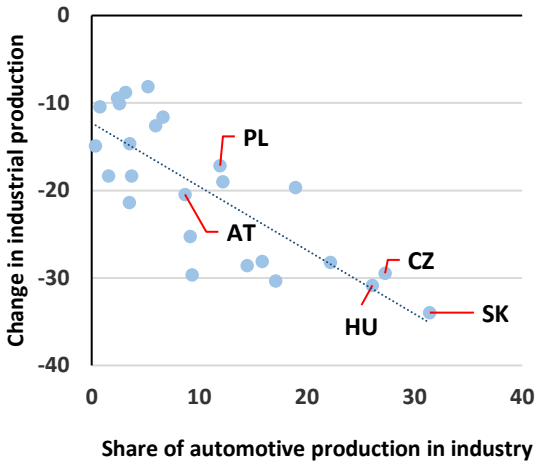
Source: Zavarská (2021). Note: Excess mortality captures the difference between the observed total number of deaths and the expected number of deaths at a given time and place, taking into account seasonal fluctuations and historical trends.

Figure 2.3: OECD Weekly Tracker of GDP growth based on Google Trends (in %, y-o-y growth rate in weekly GDP):



Source: OECD.

Figure 2.4: Automotive-sector dependence and fall in industrial production in EU27 (in % and Y-o-Y %, respectively)



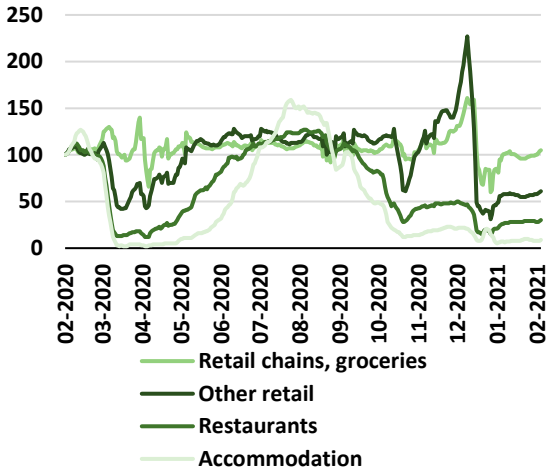
Source: Plutzer (2021).

The uncertainty surrounding the pandemic has pushed consumer sentiment onto a downward trajectory (Figure 2.6), with consumer barometer figures assessing the economic situation of the past 12 months falling 42 points below the previous year in January 2021 (SOSR, 2021). Consumers' views

regarding the short-term future remains bleak, as 63% of respondents expect the overall economic environment to deteriorate in the coming 12 months.

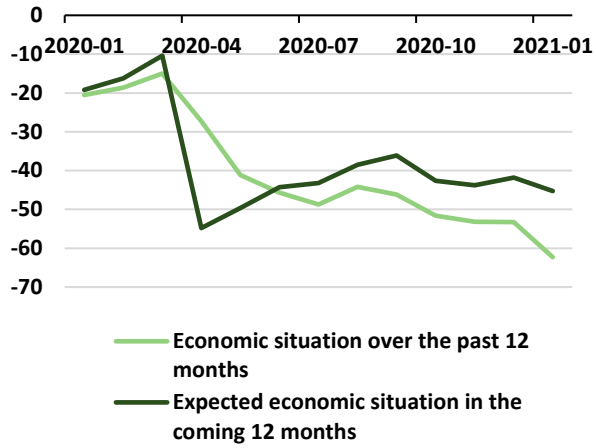
Daily revenues from all cash registers across the country collected by the Financial Administration reveal the winners and losers of this crisis. By and large, supermarket chains and e-shops have supported household consumption throughout the pandemic, keeping a relatively stable stream of income throughout (aside from some seasonal fluctuations around the holiday period in December). Meanwhile, as can be seen on Figure 2.5, restaurant and accommodation establishments have seen sharp falls in their revenue to virtually zero in both waves, with government restrictions painfully hitting the service sector (Dujava et al., 2021).

Figure 2.5: Daily revenues by sector (index Feb 11th 2020=100)



Source: IFP, eKasa.

Figure 2.6: Consumer barometer- overall economic situation (index, seasonally adjusted)



Source: SOSR. Note: Values represent the difference between the shares of optimistic and pessimistic answers, with partial answers having half the weight in the calculation. Values range from -100 (maximally pessimistic) to 100 (maximally optimistic).

The immediate effects of these lockdown measures on productivity growth are deemed to be predominantly negative, although there may be some positive implications associated with between-firm reallocation effects. At the within-firm level, a reduction in productivity in the short-term is anticipated, as many business operations face increased intermediate costs and declining efficiency associated with more stringent health and safety measures (including social distancing, more frequent disinfecting of the workplace, provision of protective equipment, etc.) (Bloom et al., 2021). At the same time, in some sectors, revenues have fallen less than hours worked, which suggests labour productivity (measured as sales per hour) could have actually grown in the second half of 2020 (Bloom et al., 2021).

From a between-firm perspective, it is important to note that the COVID-19 recession has particularly hit the labour-intensive service sector segments characterized by low productivity, such as tourism and hospitality (Figure 2.5), and relatively less productive firms within these sectors (Bloom et al., 2021). Consequently, the inter-industry shifts in the economy could actually lead to a productivity-enhancing reallocation of resources between firms, serving as a counter-weight to the negative within-firm effects. However, as Di Mauro and Syverson (2020) point out, the pandemic has reduced the possibility of resource reallocation across firms and countries, including cross-country barriers in labour mobility. Thus, the overall direction in which aggregate productivity trends are expected to move in the short-

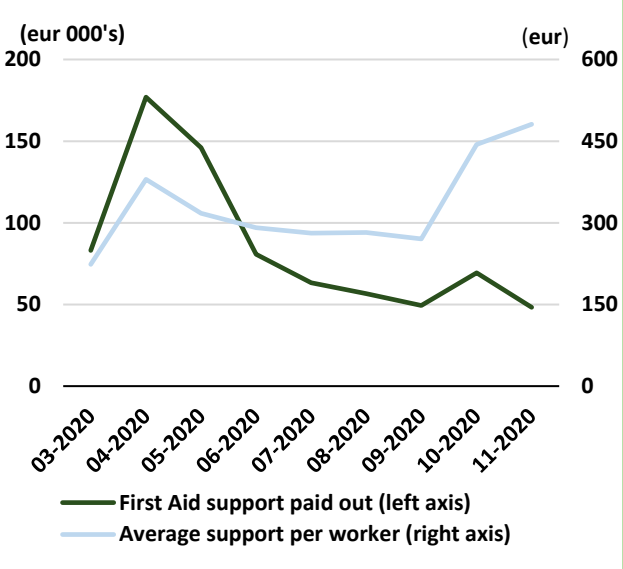
run remains ambiguous (but likely lean towards the negative side), while the welfare implications associated with the fall-out of the low-productivity service sector are deemed negative. Nonetheless, as these observed effects directly relate to COVID-19 containment measures, they are expected to wear off as soon as restrictions are gradually lifted.

Box 2.2: Fiscal measures in response to non-pharmaceutical public health interventions

The Slovak government has launched the First Aid income compensation schemes as well as rent subsidies to compensate the losses incurred by these sectors. From March to October, the extent of the First Aid scheme was approximately 659 million euros, and subsequently, under First Aid +, an additional 186 million euros was disbursed by January 2021 (Baliak et al., 2021). The average support paid out per worker was 330 euros in the 9-month period between March and November 2020 (Figure 2.7).

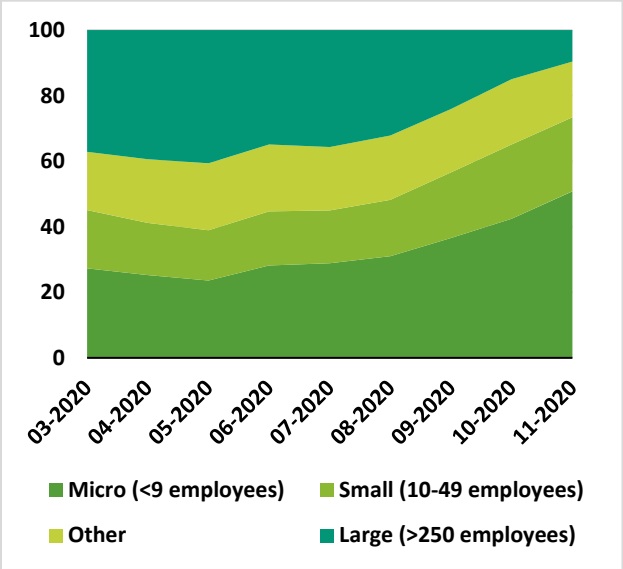
During the first wave of the pandemic, fiscal measures were largely targeted at the manufacturing industry and the largest employers with standard forms of employment contracts, which supported the sustainability of industrial production during the crisis and productivity within the economy (Figure 2.8). In particular, the introduction of kurzarbeit has effectively prevented an increase in unemployment - largely due to the acceptance on the part of the large companies such as Volkswagen, which are accustomed to similar schemes in Germany or Austria. Back in September 2020, the uptake of anti-pandemic fiscal aid by industry accounted for 38% of the total amount, while in November, this figure fell to 22%. During the first wave, small companies (with a maximum of nine employees) drew 36.5% of the total amount paid out, while in First Aid + their share increased to 50.8% (Baliak et al., 2021). The government has since decided to make the kurzarbeit scheme permanent and several other temporary policies have been extended. For example, the deferral of home loan repayments and benefits for families with members in need of care has been extended until the end of the state of emergency.

Figure 2.7: Disbursements under the First Aid program (in eur)



Source: Baliak et al. (2021).

Figure 2.8: Companies in the First Aid program by size (in %)



Source: Baliak et al. (2021).

2.2 Medium-term implications of restrictive measures on Slovak productivity and competitiveness

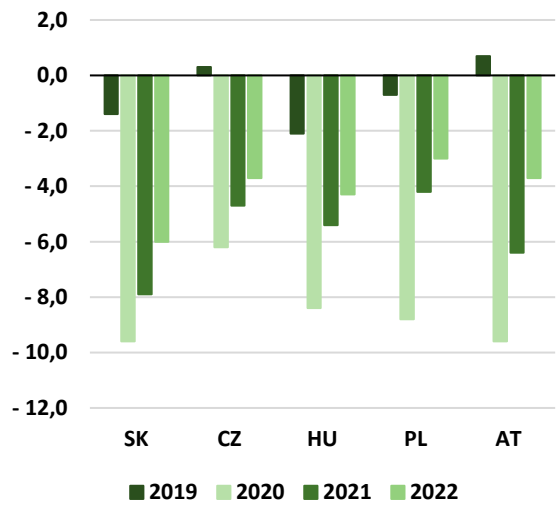
2.2.1 The burden of rising indebtedness

The extent to which pandemic aid programs threaten future financial stability and sovereign debt management is currently unclear. However, Di Mauro and Syverson (2020) warn of higher taxes that may inevitably result from the fiscal measures rolled out by the government, which have the potential of hindering capital and labour compensation and accumulation. In this regard, the macro burden brought upon by the pandemic represents a potential barrier hindering productivity growth over the medium-term.

Slovakia entered 2020 with a relatively stabilized national debt, which at the end of 2019 reached 48.3% of GDP. In 2020, however, the state of public finances deteriorated significantly as Figures 2.9 and 2.10 show. Stabilisation of public debt to GDP is expected over the medium-term, at around 65% of GDP.

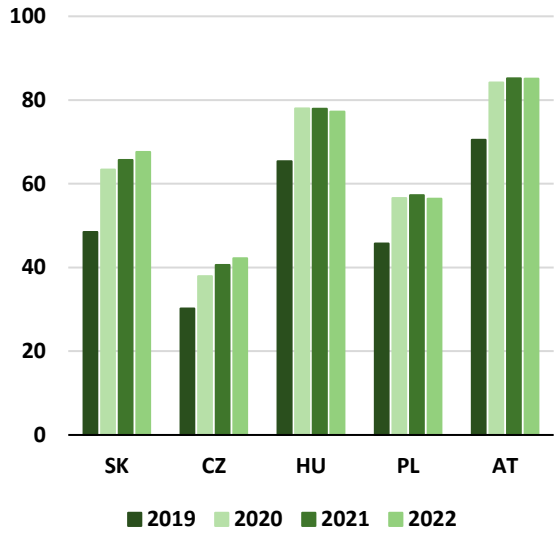
The general government deficit in 2020 reached 6.2% of GDP. The deficit is expected to decline as economic activity recovers and some emergency measures are phased out, which should stabilize the fiscal situation to some extent (Ministry of Finance, 2020). At the same time, the budget for 2021 includes a reserve of around 1.1% of GDP to cover potential needs due to the pandemic, as well as other expenditure on health care, education and transport infrastructure to boost economic recovery.

Figure 2.9: Development of the budget balance (in % of GDP)



Source: EC. Note: 2021 and 2022 are forecast values. Data from the Spring Economic Forecast.

Figure 2.10: Development of the public debt (in % of GDP)



Source: EC. Note: 2021 and 2022 are forecast values. Data from the Spring Economic Forecast.

It is important to note that while the deterioration in the budget balance was mainly driven by the COVID-19 pandemic and increased spending to reduce the impacts of the recession, the deficit would have nevertheless reached just above 3% of GDP even without a pandemic. Policy choices made at the

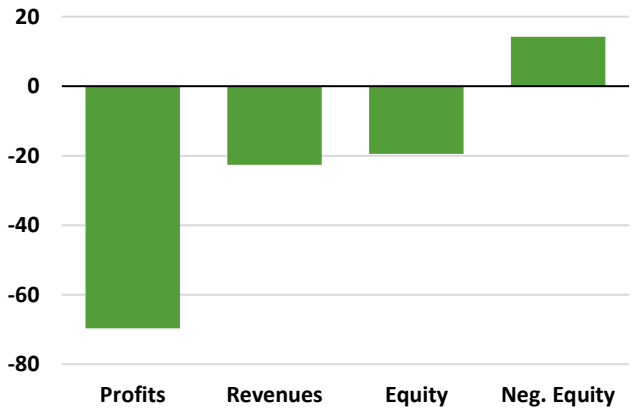
end of the political cycle in the first quarter of 2020, such as the rollout of the 13th pension, have placed a notable burden on public finances.

Múčka and Novysedlák (2019) analysed the safe level of the national debt in the pre-crisis period and, given the ageing population in the coming decades, consider debt above 40% of GDP as irreparable by budgetary measures at the level of individual years. According to the authors of the study, "the creation of a safety cushion would require an additional reduction of the debt ceiling to 27% of GDP by 2038" (Múčka and Novysedlák (2019), p. 2), which is about half the current level. Thus, the restoration of the sustainability of public finances emphasised in our 2019 Report continues to be a pressing issue limiting future growth potential. In this context, investment from the European Recovery Plan could also help revitalize the economy and reduce the long-term assumptions of declining average GDP growth, which is another important aspect of long-term fiscal sustainability models.

2.2.2 Insolvency of firms and debt overhang impeding recovery

Based on simulation results, during the year with COVID-19, Slovak firms' revenues dropped by 22.6% compared to a "business-as-usual" year. Smaller revenues lead to firms' profits shrinking by almost 70% compared to profits for the reference year. Consequently, the share of total distressed firms (with negative equity) exceeds 14% of otherwise viable firms (as firms in 2018 with negative Equity or Profits were excluded).

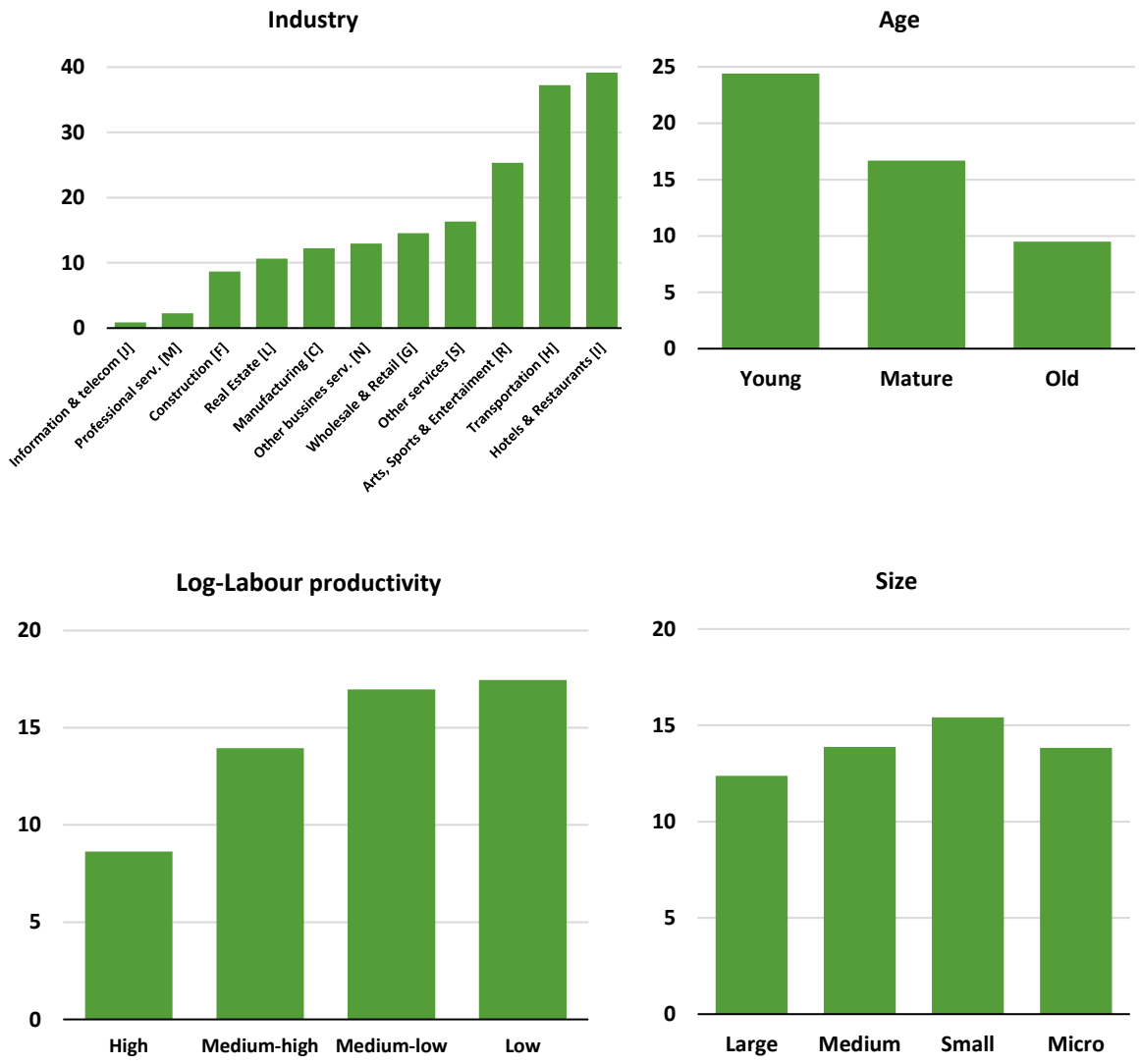
Figure 2.11: COVID-19's effect on main variables (% of business-as-usual year)



Source: Simulation results based on (Demmou, et al., 2021) methodology. Note: Data are filtered (only firms with recorded profits in 2018 are included).

The industry variation is significant here, as seen from Figure 2.12, where almost 40% of firms in the Hotels, Restaurants and Transport services sector are at risk of default without external intervention. In contrast, less than 1% of firms from Information and communication and around 2% of Professional, Scientific, and Technical services firms will not have sufficient equity buffer to absorb the loss of revenues. Also, the total shock will have a disproportionate impact on younger firms (almost 25% became distressed compared to old firms with less than 10%) and less productive firms (around two times more than high productive firms- around 17% of low and medium-low productive firms in comparison to 8.5% of highly productive firms). The firms' size factor seems to play less of a role in the share of distressed firms, but larger firms generally have a bigger buffer to absorb the shock.

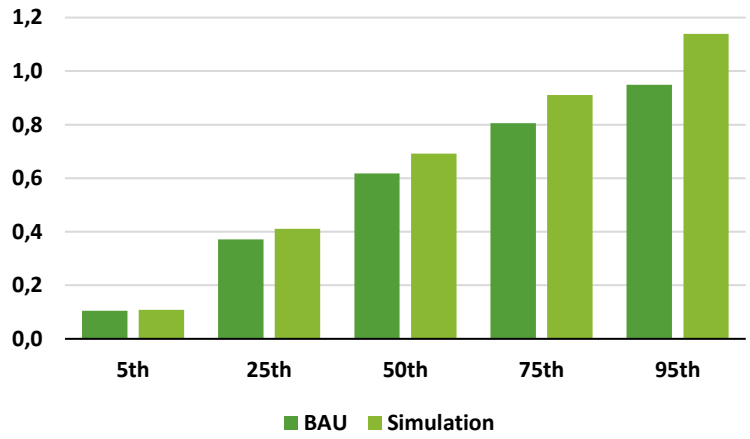
Figure 2.12: Share of distressed firms by industry, age, Log-Labour productivity and size (%)



Source: Simulation results based on (Demmou, et al., 2021) methodology. Note: Only firms with recorded profits in 2018 are included. Bars in charts correspond to: Industry A21 aggregates of ISIC Rev. 4. Age: Young (less than 5 years old), Mature (5-10 years) and Old (older than 10 years). Log-Labour productivity: quantiles of labour productivity. Size: Micro (less than 10 employees), Small (10-49 employees). Medium (50-249 employees) and Large (250+ employees).

Moreover, Figure 2.13 suggests that firms on the right tail of the leverage ratio distribution will be most affected. For the median firm, the COVID-induced increase of the liabilities to total assets ratio will increase by 7.5 percentage points. However, at the 95th percentile, the leverage exceeds the parity and the simulated increase of the leverage ratio is almost 20 percentage points, which should certainly be of concern.

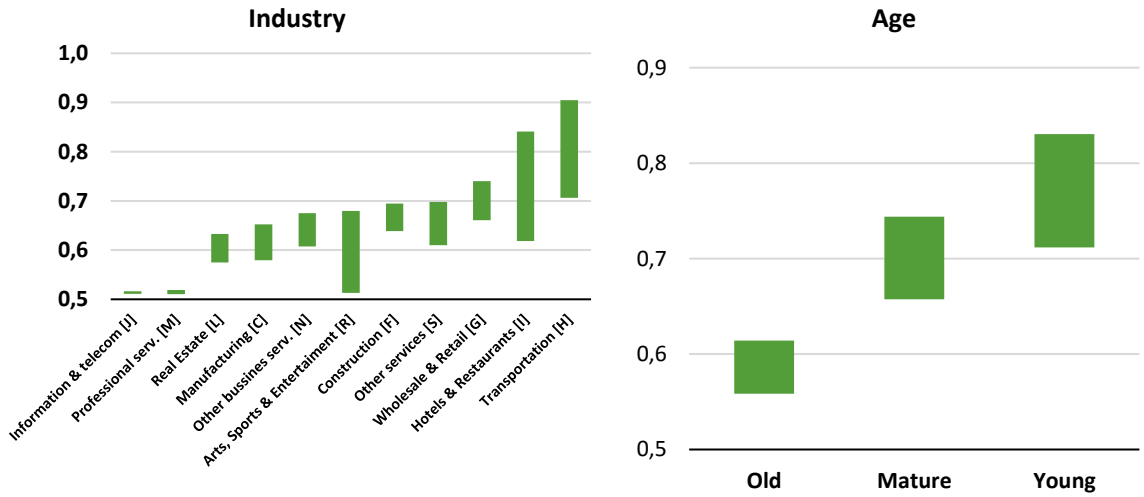
Figure 2.13: Liability to total assets ratio by percentile

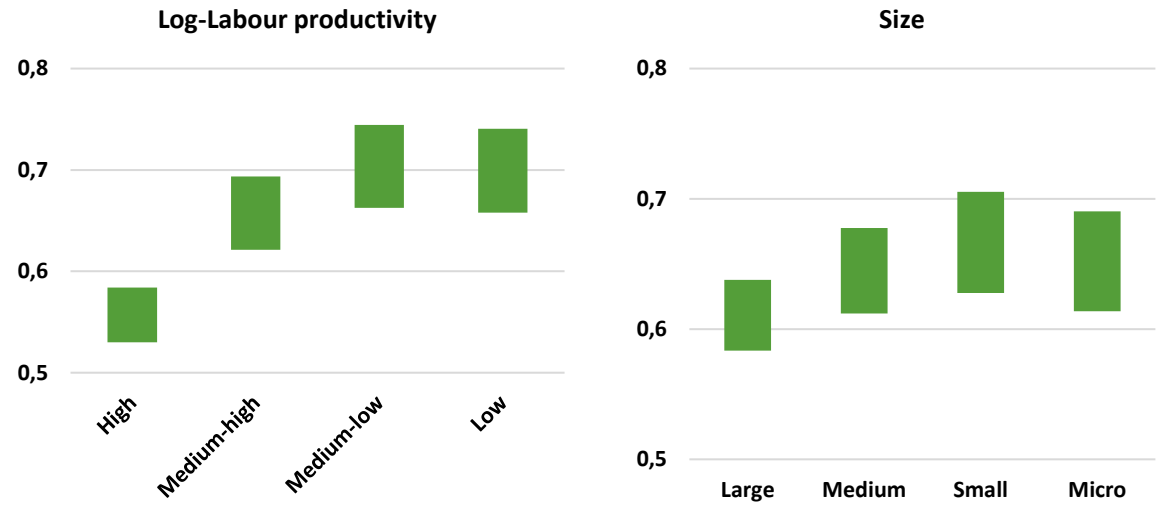


Source: Simulation results based on (Demmou, et al., 2021) methodology

Figure 2.14 splits the increase in the leverage ratio by various aspects. The industry perspective remains the most interesting. The increase in the leverage ratio for Hotels and Restaurants and Arts, Sports and Entertainment from relatively lower levels by around 20 percentage points to very high indebtedness ratios is worrying. Even before the beginning of the crisis, the transportation sector was highly indebted, but based on the simulation results, their position worsens and the leverage ratio is approaching unity. The increase of the leverage ratio based on the simulation will heavily affect the young, small and less productive enterprises. These characteristics are correlated with laggard firms, but small and young firms showed exceptional dynamism towards higher productivity groups. With the increased leverage ratio, cut revenues and profits, the risk of the "debt overhang" is growing at the same category of firms with the high growth potential and potentially curbing their future growth.

Figure 2.14 Increase in the leverage ratio by industry, age, labour productivity and size (in %)





Source: Simulation results based on (Demmou, et al., 2021) methodology.

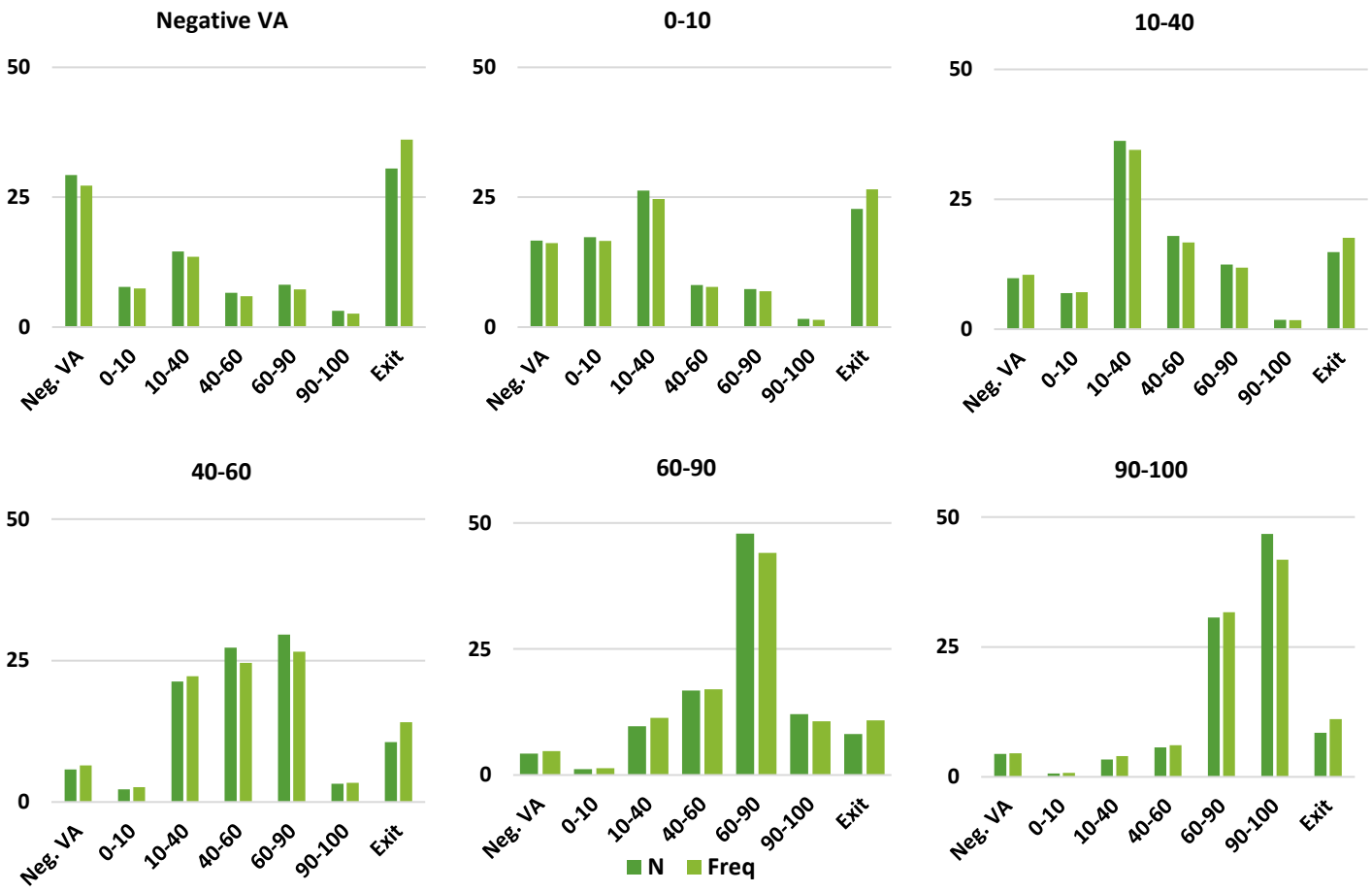
2.2.3 The zombification of the business environment

Another productivity risk related to the aftermath of the COVID-19 recession is the widespread creation of zombie firms[4]. Massive government interventions that do not differentiate between viable and non-viable firms may be artificially prolonging the lives of entities that would not have survived even under normal conditions. The debate on the possible zombification of the business environment predates the pandemic, however. The stagnating productivity growth and falling business dynamism witnessed across the Eurozone and much of the developed world over the recent years has stimulated greater interest in tracing its root cause, with the incidence of zombie firms cited as one of the key contributing factors in the matter (Adalet McGowan et al., 2017). The prevalence of such living-dead firms inevitably drags productivity downwards and blocks the efficient allocation of resources in the economy, as Caballero et al. (2008, p. 1943) demonstrate on the case of Japan that "zombie-dominated industries exhibit more depressed job creation and destruction, and lower productivity". Likewise, a study by Adalet McGowan et al. (2017) confirms that the more capital is sunk into zombie firms, the less investment and job creation is carried out by non-zombie firms, essentially creating a "zombie congestion".

In this context, understanding the dynamism in the bottom productivity distribution is vital for productivity analysis. Figure 2.15 summarises a firm's probability of transitioning from a current productivity decile to another in three years for the total Slovak sample (manufacturing and business services excluding finance). The transition dynamics are interesting from two different perspectives. For one, as shown in Berlingieri et al. (2020), younger and smaller firms in the bottom 40% of the productivity distribution have, on average, higher productivity growth and converge to the frontier faster.

[4] For the purposes of this Report, we take the definition of zombie firms from Adalet McGowan et al. (2017), as firms which have persistent problems meeting their interest payments.

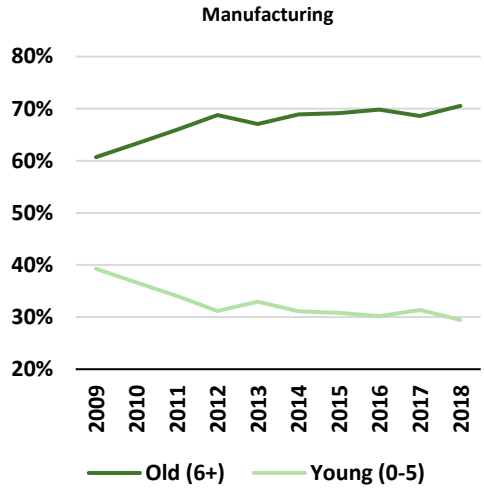
Figure 2.15: Transition probabilities between deciles of Log-labour productivity (in %, between year t and t+3)



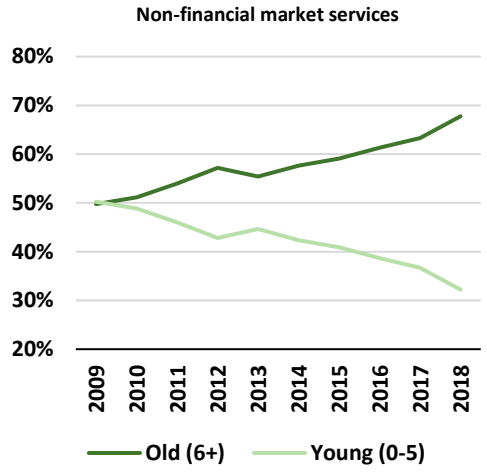
Source: OECD calculations. Note: Probabilities are calculated across A7 industries and years. N corresponds to number of observations in the dataset and Freq to weighted averages based on estimated Business registry weights.

The mix of laggard firms and start-ups and future exitors in this part of the distribution becomes evident here. We observe that especially firms with negative value added are most vulnerable and prone to exit the market within three years. The same is true for the bottom decile of the productivity (with a 20% probability of exiting). However, firms in the bottom decile have more opportunities to grow to the upper productivity category than any other group (more than 25%) than in the same group (approximately 19%). The probability of falling into the negative value added category is highest for the bottom decile. On the other hand, these figures show the most productive firms' high persistence in the top productivity decile. About 40 to 60% of the most productive firms stay at the top after three years

Figure 2.16: Share of firms by age group (in %)



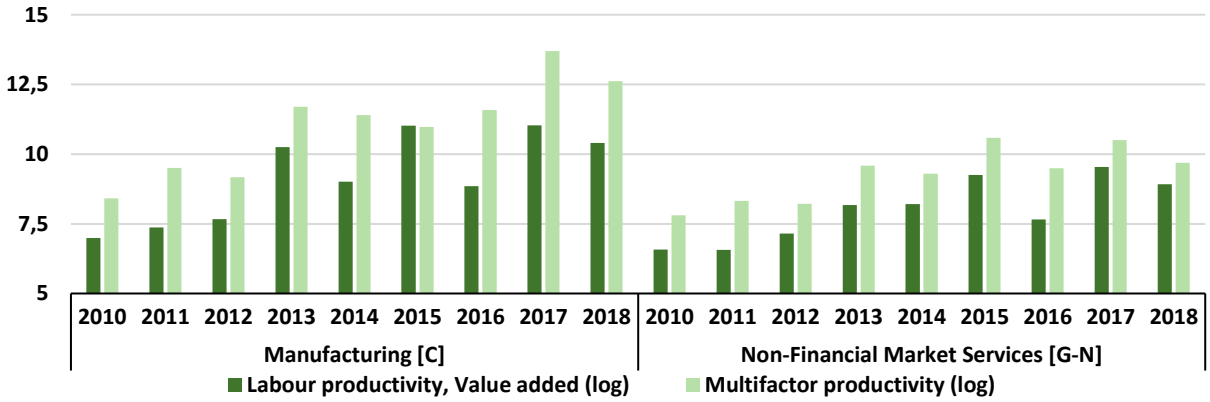
Source: OECD calculations.



Source: OECD calculations.

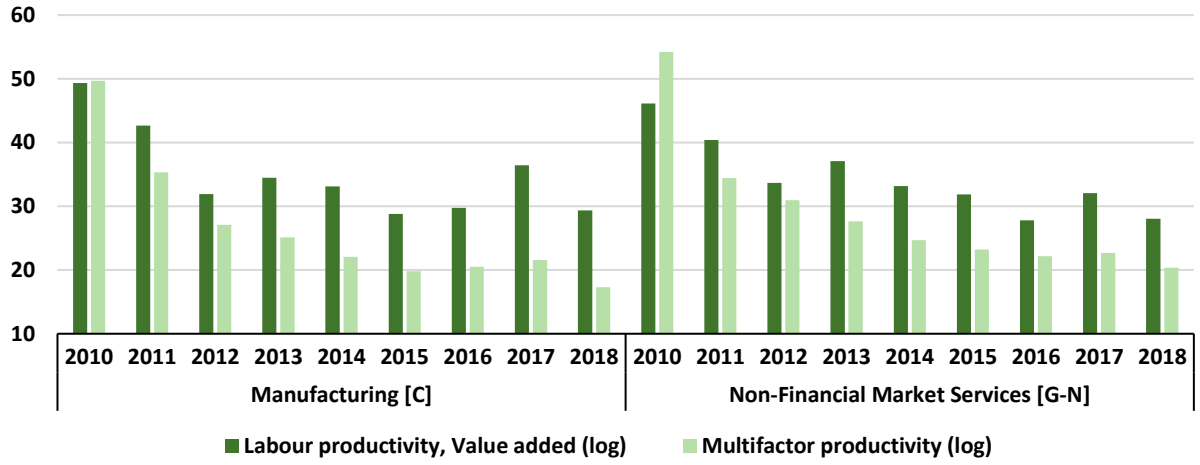
Additionally, as Figure 2.16 shows, the share of new firms in the market has been on a decline in both, the manufacturing and service sectors, suggesting bottlenecks in the business environment for new entrants existing well before the pandemic. Likewise, looking at the dynamism at the frontier (the 95th percentile of the productivity distribution), the evolution of the average age of firms appearing in the frontier for the first time shows that the average age has been increasing over time (Figure 2.17). What is more, a decreasing dynamism at the frontier can be seen from Figure 2.18, where the turnover rate dropped from around 50% in 2010 to around 30% for the labour productivity distribution and around 20% for the multi-factor productivity distribution.

Figure 2.17: Average age of firms appearing in the frontier for the first time



Source: OECD calculations based on MultiProd methodology.

Figure 2.18: Firms appearing in the frontier for the first time (share of total frontier firms in %)



Source: OECD calculations based on MultiProd methodology.

Hence, market interventions that help cushion the impact of the COVID-19 crisis for otherwise viable businesses in the short-run may also potentially create the risk of resource misallocation, reinforce barriers to creative destruction and hinder innovation in the years to come. For the revival of productivity growth going forward, Andrews et al. (2017) emphasize the importance of a policy environment that enables the exit and restructuring of laggard firms, and addresses the social implications of the resultant worker displacement. At the same time, it becomes vital to facilitate productivity-enhancing technological diffusion between frontier firms and inferior performers (Andrews et al., 2017). The re-design of the insolvency regime that aims to streamline corporate restructuring and reduce the financial burden associated with entrepreneurial failure was implemented by the 2019 amendment of the Commercial Code, although the effectiveness of its execution remains to be seen. Digitalisation of the insolvency regime proposed in the Recovery and Resilience Plan presents a further promising step in the right direction.

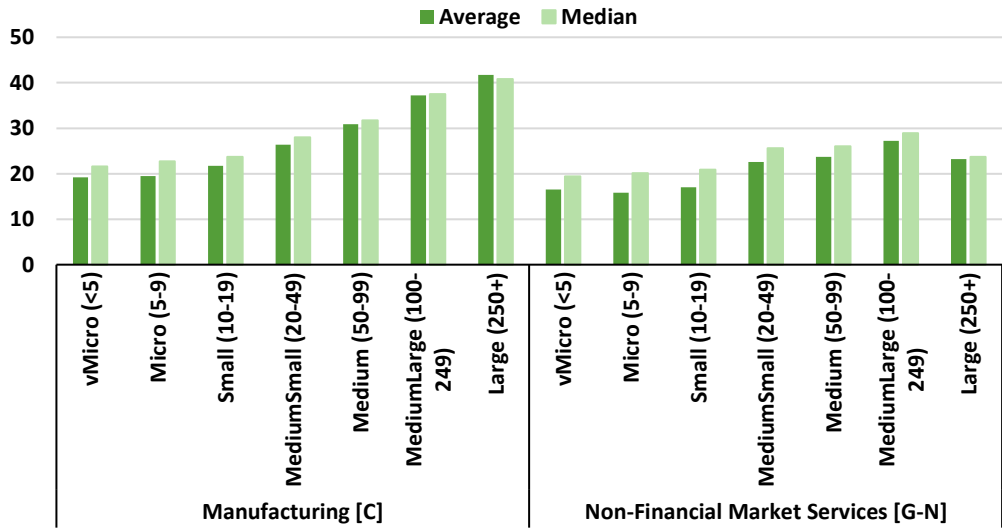
2.2.4 The fall of the small enterprise

While often referred to as 'the backbone of the economy', SMEs are particularly vulnerable in times of crises and many face the risk of extinction in the light of the COVID-19 recession. The lesser resilience of small businesses is primarily attributable to their smaller capital buffers for shock absorption. Given their scarcity of resources, barriers to accessing capital, and initial low levels of digitalization, SMEs particularly struggle to navigate these uncertain times, for instance in implementing changes to business operations and adopting teleworking (OECD, 2020). Moreover, the sectors that have been hit hardest by the pandemic are such in which the representation of SMEs is above the business economy average–in Slovakia, SMEs make up roughly of 80% of employment in the sectors worst affected by the pandemic, while the figure for the business economy overall is below 70% (OECD, 2020).

From a productivity perspective, however, average and median labour productivity (Figure 2.19) and multifactor productivity (Figure 2.20) are known to be positively correlated with firm size. The only exception is that the labour productivity of large firms in the service sector is below the level of two preceding size categories. This lower productivity can be explained by a high share of big enterprises

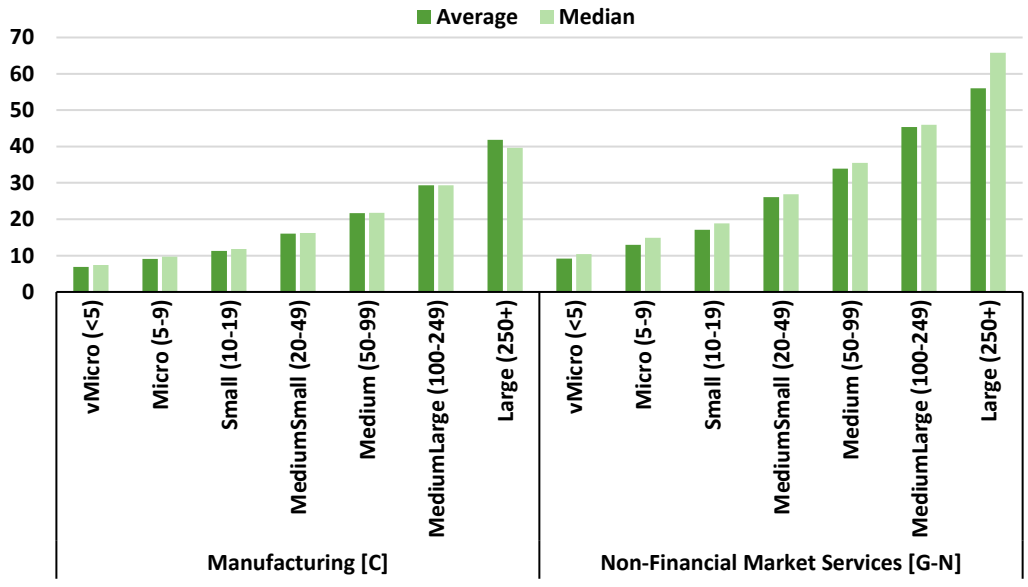
with lower labour productivity from the transportation sector, especially retail trade, land transportation, post and warehousing and support activities for transportation.

Figure 2.19: Average and median labour productivity by size class (in eur thousands)



Source: OECD calculations based on MultiProd methodology.Note: Based on exponential of average and median log productivity.

Figure 2.20: Average and median multifactor productivity, Wooldridge by size class (in eur thousands)

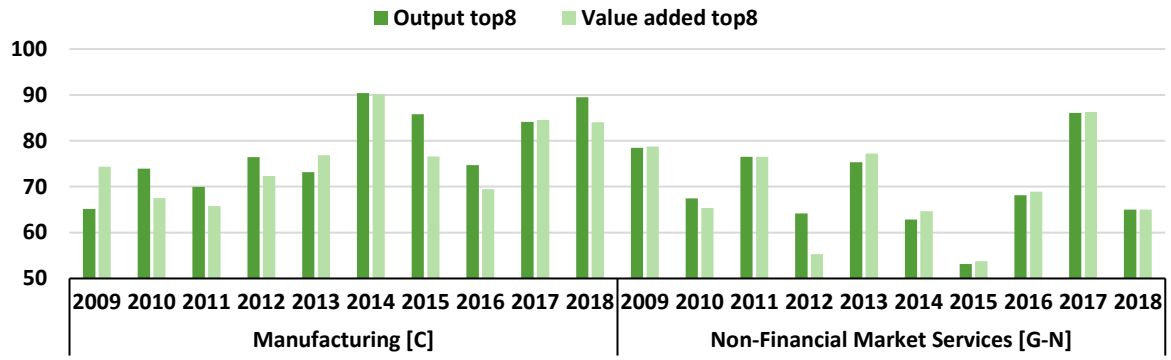


Source: OECD calculations based on MultiProd methodology. Note: Based on exponential of average and median log productivity.

In addition, as Figure 2.21 shows, top eight firms within each 4-digit industry sectors are responsible for producing, on average over the whole period, 77% of Output or Value Added in manufacturing, as well as 69% within business services. In this context, as Di Mauro and Syverson (2020) point out, it may also be the case that the reallocation of resources following the crisis may induce within-industry productivity gains through changes in the composition of the economy.

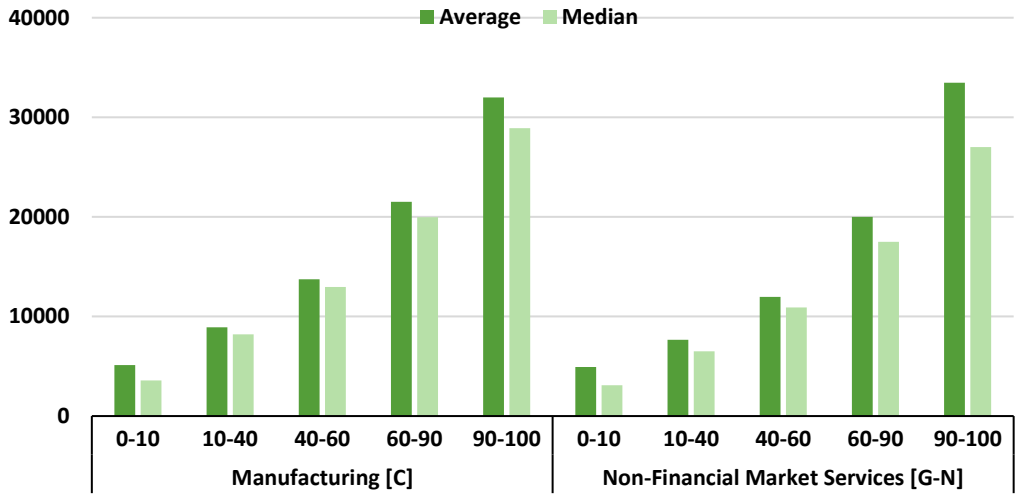
Yet, as the authors themselves note, it is not clear "whether such a broad-based shock will select much on productivity as opposed to other firm features (market power, rent-seeking ability, etc.) that could instead be detrimental to productivity growth" (Di Mauro and Syverson, 2020, para. 14). Rather, it is anticipated that the crisis will unevenly take a toll on employee earnings in smaller firms, and with larger and more productive firms generally offering higher wages to begin with (Figure 2.22), the 'large firm wage premium' is expected to further widen. Hence, this reality may also have non-negligible implications on income equality (Bell et al., 2020).

Figure 2.21: Mean concentration of top eight firms in 4-digit industry sector (in %)



Source: OECD calculations based on MultiProd methodology.

Figure 2.22: Wages by quantile of labour productivity (in eur, average over time)



Source: OECD calculations based on MultiProd methodology.

Furthermore, given the innovative potential and greater agility of startups, the uneven impact of the pandemic on small firms may also create a roadblock to innovation in the years to come. Therefore, as the economy moves forward towards the recovery phase, policies that serve to enhance the resilience of SMEs will be of particular importance, so as to avoid the high societal cost of losing possible future frontier firms.

2.3 Long-term implications of restrictive measures on Slovak productivity and competitiveness

2.3.1 The deterioration of human capital through school closures

The COVID-19 pandemic has caused the largest school closures in the past century. School attendance was replaced by distance learning (online or offline). This new configuration has made it more difficult for teachers to conduct their profession and for pupils to participate on education, the effectiveness of teaching has decreased, and the demands placed on parents have significantly increased (Burgess and Sievertsen, 2020; Ilzetzki, 2020). All these factors, without adequate compensating measures, will have grave and lasting consequences on the level of education attainment of today's cohort, on their future earnings and thus, on the economy overall.

In Slovakia, schools partially closed on March 9th 2020 and fully on March 16th 2020 (Ministry of Education, 2020) in reaction to the first discovered COVID-19 case, with the first wave of closures lasting until the end of May. While the situation appears comparable to neighbouring countries (Figure 2.23), greater differences in the number of missed in-person schooling days are likely to become apparent in 2021— Slovak schools remain partially closed at the time of writing in mid-April[5], unlike most EU countries that have refrained from shutting the school gates during the second wave of the pandemic. Opening of schools is an especially contentious issue due to the higher risk of infection of teachers (Vlachos et al., 2020), with 33% of Slovak upper-secondary teachers aged 50 and over (TALIS, 2018) and hence falling into the risk category.

By the end of the first wave, about 900 thousand pupils[6], a sixth of the overall Slovak population, had to switch to distance learning and the participation on education decreased. Upper secondary students were among the most affected by school closures, representing almost a half of all students (Figure 2.24). These have only returned to classrooms for a short period in June and again in September, but have since then been ordered to stay home again. Among the OECD countries, Slovakia belongs to the group with over 100 days of upper-secondary schools' closure, following Costa Rica and Colombia. Primary schools were closed for about 50 days. During the distance learning, some subjects, like mathematics and reading, were prioritised. However, the academic year has not been extended (OECD, 2021).

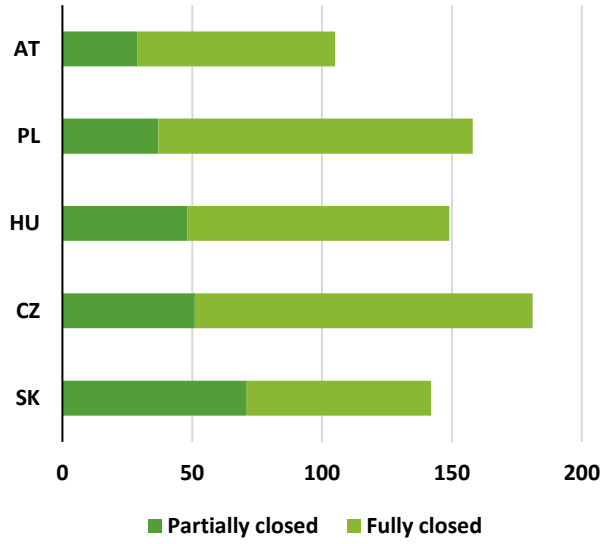
The main challenge of the education system during the COVID-19 pandemic lies in the fact that the system was neither built, nor prepared, for long-term teaching through remote access. According to TALIS (2018), only 45% of Slovak teachers who took part in the survey responded that they felt very well or well prepared to use information technology for teaching. In addition, 25% of school principals stated that their school did not have sufficient digital technologies for teaching. This problem is tackled in the Slovak Recovery and Resilience Plan, where the ambition is to digitalize 100% of schools by investing 187 million. euros in comprehensive basic infrastructure as well as digital school equipment, distribution and wireless connection by the end of 2024. However, additional compensatory measures such as tutoring/mentoring of students and teachers are needed to be able to work and attain school fully online. Additionally, 123 million euros are planned to be invested into the completion of school infrastructure, i.e. removal of two-shift operation, completion of missing primary school capacities and

[5] Kindergartens and primary schools (grades 1 to 4) were open on 12th of April 2021 after 4 months. Grades 5 to 9 and middle schools remain closed.

[6] UNESCO (2021). https://en.unesco.org/covid19/educationresponse

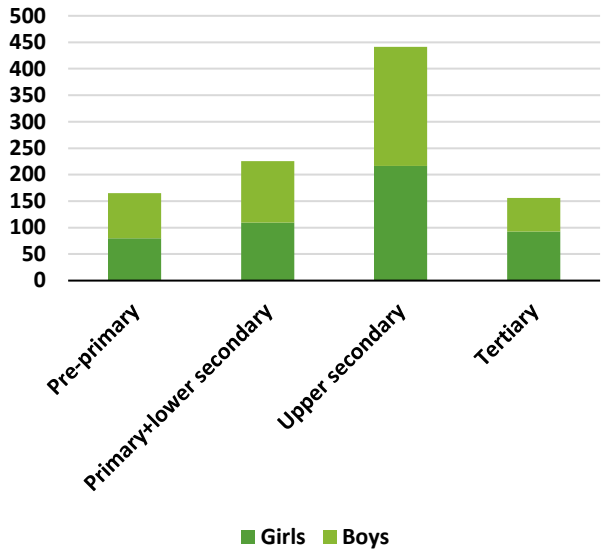
libraries in the second quarter of 2026. Moreover, another 135.4 mil. euros are dedicated for expenditure costs covering the completion of the necessary capacities of kindergartens (MF SR, 2021).

Figure 2.23: Number of days with partial or complete school closures in 2020



Source: UNESCO. Note: Czechia did not count Easter holidays as "holidays", but as closed due to the COVID-19 pandemic. In other countries, the Easter holidays lasted 5 working days.

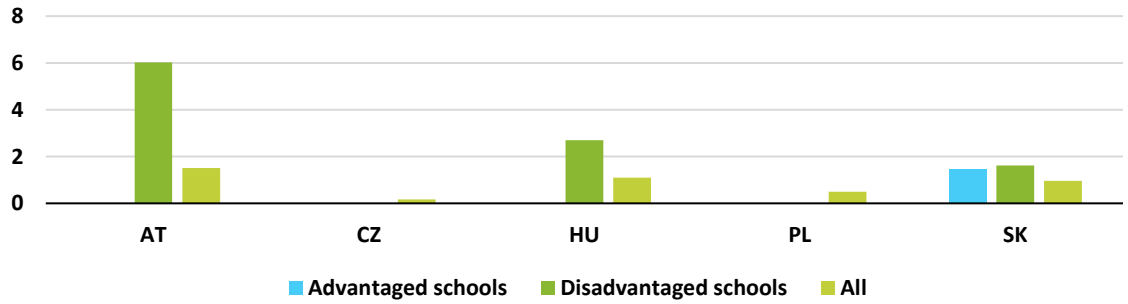
Figure 2.24: Numbers of students affected due to school closures (in thousands)



Source: UNESCO.

When we take a deeper look into how the schools perceive shortages in their digital devices by socio-economic status of their students, Slovakia falls behind its neighbours in perception of shortages in digital devices even at schools with advantaged students. Figure 2.25 shows that there is no significant difference for Czechia and Poland, but shows a considerable difference between advantaged and disadvantaged schools[7] in Austria and Hungary. Slovakia seems to have relatively negligible differences between the categories, which suggests shortages of technical equipment irrespective of the socio-economic characteristics of the school pupils.

Figure 2.25: Share of schools perceiving shortages in their digital devices by socio-economic status of their students in 2018 (in %)



Source: OECD (2019).

[7] The socio-economic status of students is calculated as a weighted average of all students in a school. Schools were distributed to the categories based on their mean value of student's socio-economic status, where the top quartile of the school distribution is classified as advantaged and the bottom quartile as disadvantaged.

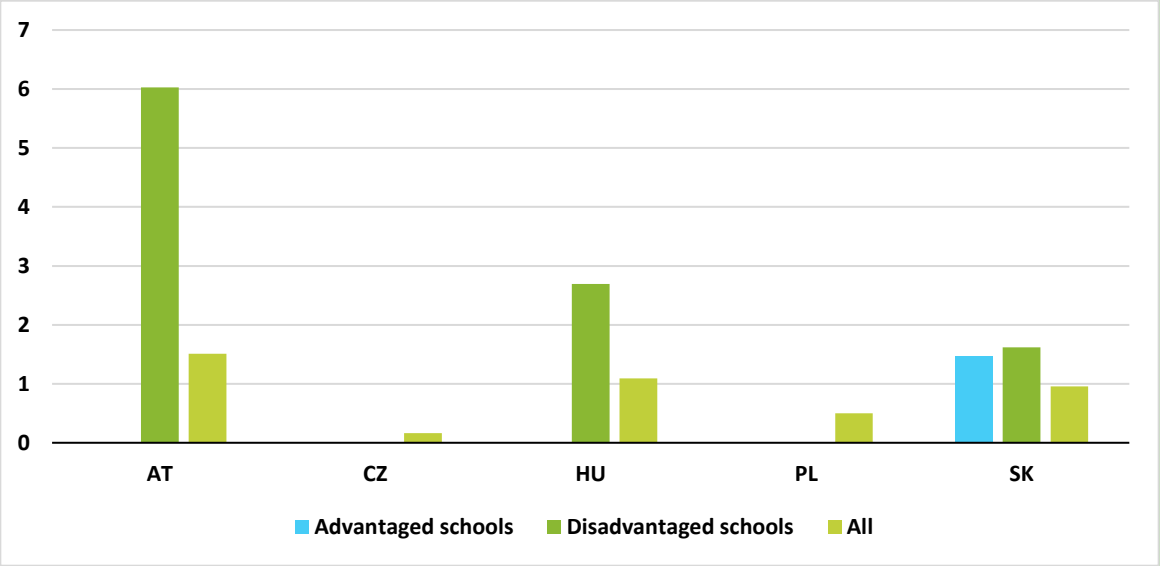
Box 2.3: Availability of digital devices to students based on PISA ICT questionnaire

The ICT questionnaire shows the share of students enrolled in the education system at the age of 15, by country, and have at least one ICT device available for use at home or at school. These indicators can provide insights into the digitalisation of students' educational environment.

Overall, the share of students without access to ICT at home or at school is very low and decreasing over time for all countries in the sample. However, they may be some potential hidden determinants. For example, considering the socio-economic status of the student's household. Figure 2.26 shows that disadvantaged students in Slovakia have a higher probability of not having an ICT device at their disposal at home compared to V4 countries and Austria.

When comparing the situation with digital devices at school, around 3 % of Slovak disadvantaged students do not have access to digital devices at school, but the situation in Poland is worse, at over 6 %.

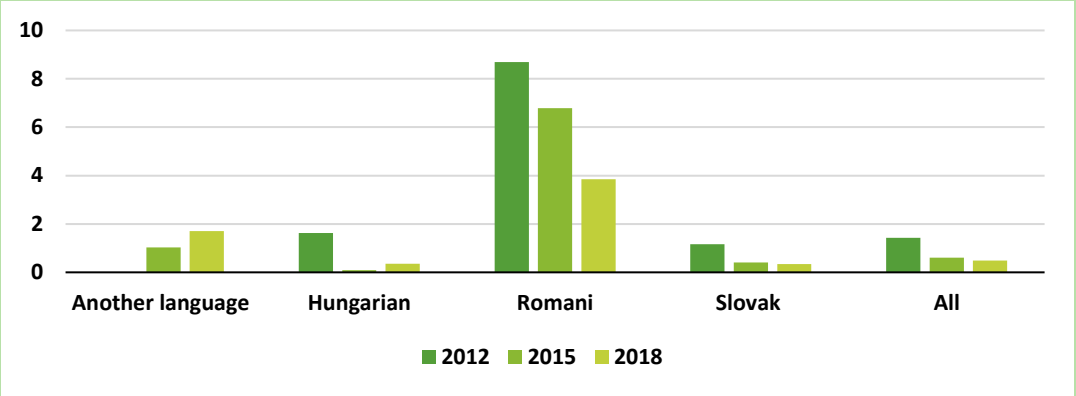
Figure 2.26: Share of 15-year-old students without access to ICT devices at home by socio-economic status in 2018 (in %)



Source: OECD (2019).

Based on this preliminary analysis, the most predetermining factor of the availability of ICT devices in Slovakia is the spoken language at home. Students belonging to households where Romani is the language spoken at home (Figure 2.27) have about eight times higher probability of not having access to the ICT devices or around three times higher likelihood to answer that they do not have access to the ICT devices at school compared to the general population.

Figure 2.27: Share of 15-year-old students without access to ICT devices at home by language spoken at home (in %)



Source: OECD's PISA ICT questionnaire (2012, 2015 and 2018)

It is not only schools who perceive shortages in digitalisation. While a minimum of schools felt the lack of ICT during 2018, the pandemic showed that we are not ready for online learning at all. Based on a questionnaire, Ostertágová and Čokyna (2020) revealed that almost 52 thousand pupils did not have access to education last year (they did not attend classes due to insufficient technological infrastructure or they did not react to the assigned tasks) and 128 thousand pupils were not taught online. As many as 8.2% of primary and lower secondary school pupils and 5% of upper secondary school students did not participate in the learning process. These numbers are even more alarming for pupils with special needs, and those from disadvantaged social backgrounds— as many as a quarter of children attending primary and lower secondary schools with a high proportion of pupils from socially disadvantaged backgrounds were not involved in distance learning at all. In the case of upper-secondary schools with a similar representation of students, almost 14% of children were absent from the learning process due to COVID-19 restrictions.

The limited access of marginalized groups to education brought about by the pandemic risks the exacerbation of existing socio-economic disparities in the Slovak society, further limiting socio-economic mobility. Although online education appears to be the most ideal way to replace mainstream teaching in the context of a pandemic, it is important to realize that only 82% of the Slovak population has internet access (see Section 2.3.2 on Digitalisation of the work life for more details). Compared to 95% of children from ordinary households, only 52% of children from poor, and 40% of children from Roma households have access to online teaching and study materials. While in these cases, some form of offline teaching was also used, (for example by sending assignments and worksheets), this form of teaching showed lower effectiveness than online teaching, presenting a significant barrier to knowledge acquisition (Ostertágová and Čokyna, 2020). A more detailed description of digital devices available to students can be found in Box 2.3.

In addition to affecting children's education and social skills, school closures also have a significant impact on their future economic situation and earnings. Moreover, this loss affects not only our children, but the overall economy, which as a result of reduced school attendance, will progress with a less skilled workforce, leading to lower economic growth. According to the Hanushek and Woessmann (2020), each additional year of schooling is associated with an increase in one's lifetime income of 7.5 to 10% on average. More conservative estimates of the effects of schooling on income

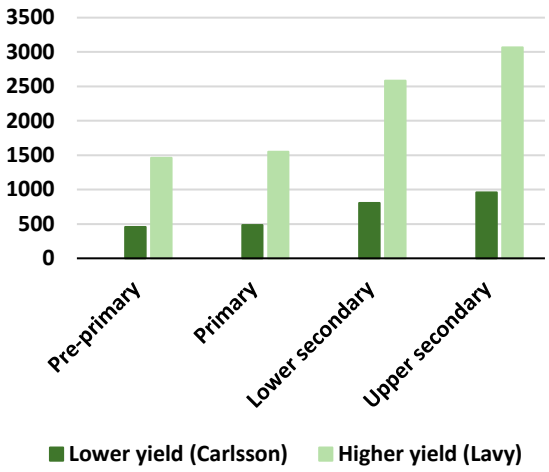
for Slovakia suggest that, as a result of the schools' closures in 2020, future wages of children in primary and secondary education could fall by 0.4 to 1.2% throughout their working life (Hellebrandt, 2021). Table 2.1 shows that these losses amount to 0.4 to 1.4 billion euros, which represents 0.45% to 1.45% of GDP (Hellebrandt, 2020) for the first wave of the pandemic. The second wave, which has not shown its full strength by the end of 2020, contributed to additional 0.15 to 0.5 billion euros of losses. In terms of GDP, this equates to a decline by 0.15% to 0.5% over the life of the generation. Altogether for the two waves, in 2020, an average loss of income per student is estimated between 683 euros and 2189 euros in present value terms, with the largest effect left on upper secondary school students (Figure 2.28). Across the affected population of students, the loss ranges from 0.6% to 1.9% of GDP in terms of forgone income, and additional 0.5% to 1.5% of GDP in terms of forgone taxes (Hellebrandt, 2021).

Table 2.1: Loss of revenues and taxes due to the pandemic (in % of GDP)

	Present value of lost income*	Present value of lost taxes*
1st wave	0.45 - 1.45	0.35 - 1.13
2nd wave	0.15 - 0.49	0.12 - 0.38
2020 combined	0.61 - 1.94	0.47 - 1.52

Source: calculations of Hellebrandt (2021). Note: The lower bound represents Carlsson methodology with lower yield and upper bound represents Lavy methodology with higher yield.

Figure 2.28: Average loss of income per student (in eur)

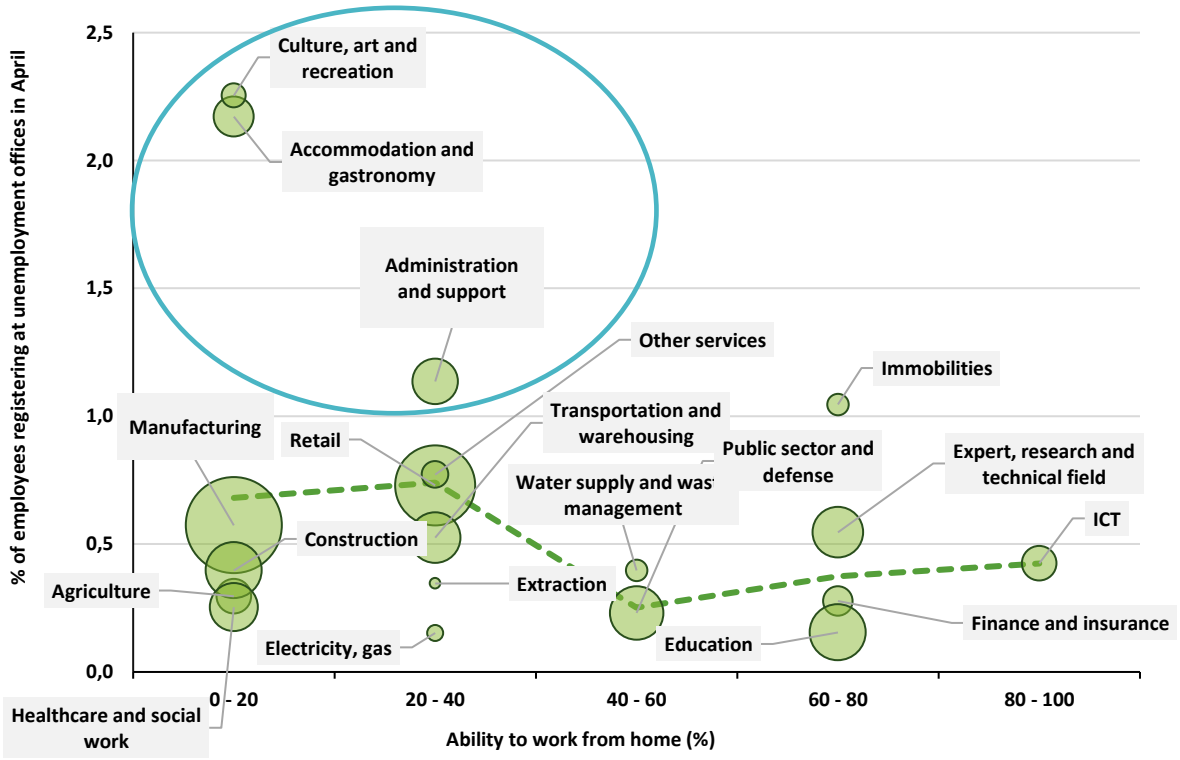


Source: calculations of Hellebrandt (2021). Note: The lower bound represents Carlsson methodology with lower yield and upper bound represents Lavy methodology with higher yield.

2.3.2 Digitalization of the work life

The rapid implementation of home office arrangements due to the pandemic has undeniably accelerated the digital transformation of the work life, and it is unlikely that the new normal will see a return to the daily office life of the pre-COVID era. Naturally, the ability to work from home depends on the employee's tasks, whether they can be performed from home or require on-the-job presence. Moreover, the composition of tasks is country and industry-specific. Most jobs that were lost as a result of the non-pharmaceutical interventions were in sectors such as culture, accommodation and gastronomy, where the possibility to work from home is low (Figure 2.29). On the other hand, least jobs were lost in finance and insurance, ICT and research sectors of the economy. People with the opportunity to work from home were, on average, younger, more educated, having fewer children, higher wages and more flexible working hours (Dujava and Peciar, 2020). Hence, it becomes apparent that the COVID-19 recession has primarily put the socially disadvantaged population at risk of work displacement.

Figure 2.29: Registrations at unemployment agencies and ability to work from home by sector in April 2020 (in %)

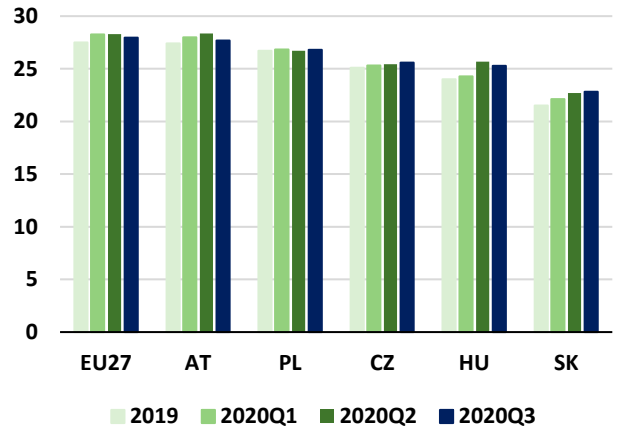


Source: Dujava and Peciar (2020). Note: Green dotted line represents the average for each category based on the possibility to work from home.

The impact of the digitalization of work life in the long run presents an important productivity-enhancing opportunity, yet, the reaping of these benefits will not be without challenges. On one hand, the fact that more jobs can be now performed from home leads to overall higher participation in the labour market and lower claims of state benefits. Moreover, businesses may anticipate lower production costs as they increasingly move away from brick and mortar structures to telecommuting and e-commerce, and economize on business travel through the widespread adoption of online meetings. On the other hand, for these productivity gains to materialize, the need for permanent changes in the organization of business processes, reskilling of workers and implementation of managerial innovations arise. Moreover, the potential of working from home still depends on internet access of households (see Box 2.4).

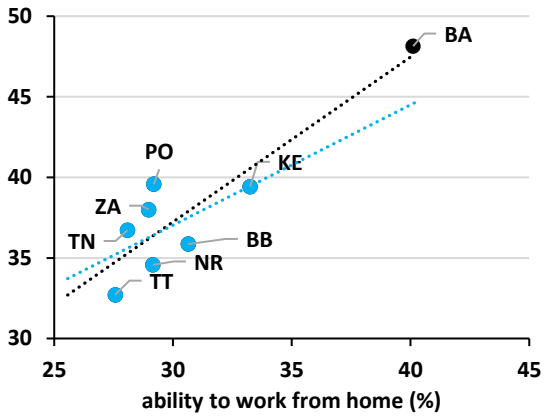
Figure 2.30 shows the potential share of workers who can work from home in international comparison, but does not consider firms' and employees' preparedness and ability. Indeed, Slovakia ranks 9th from the bottom in terms of the human capital dimension of the EU Digital Economy and Society Index (DESI), and has the lowest share of jobs that can be performed from home compared to the neighbouring countries, at around 23%, revealing the unpreparedness of our economy for the digitalization megatrend.

Figure 2.30: Share of jobs that can be potentially performed from home (in %)



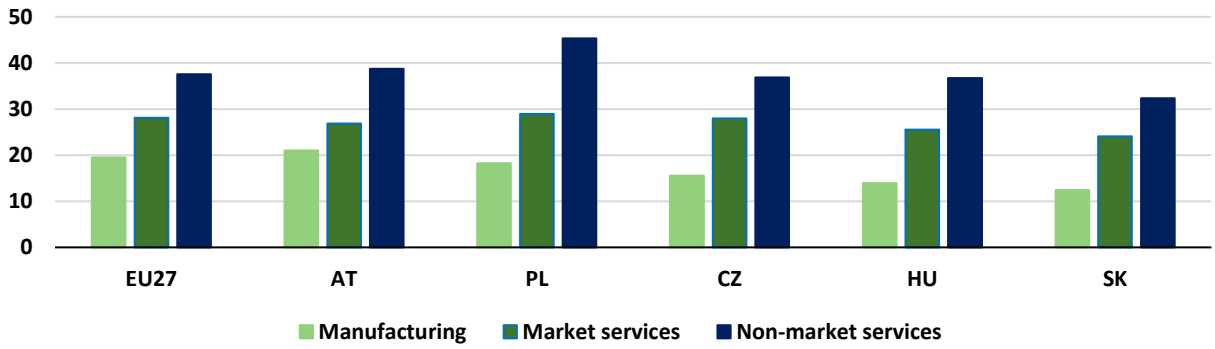
Source: (EC, 2021)[8]. Note: EU27 corresponds to a weighted average of the 27 EU member states.

Figure 2.31: Decrease in work attainment by region in the 12th week of 2020 (in %)



Source: Dujava and Peciar (2020) based on Google Community Mobility Report. Note: black dotted line represents the trend including Bratislava region, blue dotted line excludes the capital city region.

Figure 2.32: Share of jobs that can be potentially performed from home by industry in 2019 (in %)



Source: European Labour Force Survey. Note: EU27 corresponds to a weighted average of the 27 EU member states.

When looking at the regional distribution, however, there are significant differences (Figure 2.31). The Bratislava Region features a potential of 40% jobs that can be performed from home, whereas the more industry-oriented regions of western and central Slovakia (Trenčín and Nitra Regions) have around 28% of possible home office jobs. These regions were also hit hard by the COVID-19 pandemic, probably due to the nature of the work environment (concentration of workers in assembly halls, factories). Figure 2.32 shows that only 12% of jobs in the manufacturing sector had the potential to be performed from home, whereas 32% of services do not require on-site presence. These results are again worst in the regional comparison with V4 countries and Austria.

As Bughin et al. (2018, p.26) point out in reference to the Solow Paradox, "the information age is everywhere, except in the productivity numbers". Going forward, the challenge lies not only in implementing new technologies, but also in changing the digital mind set of the workforce (Savic,

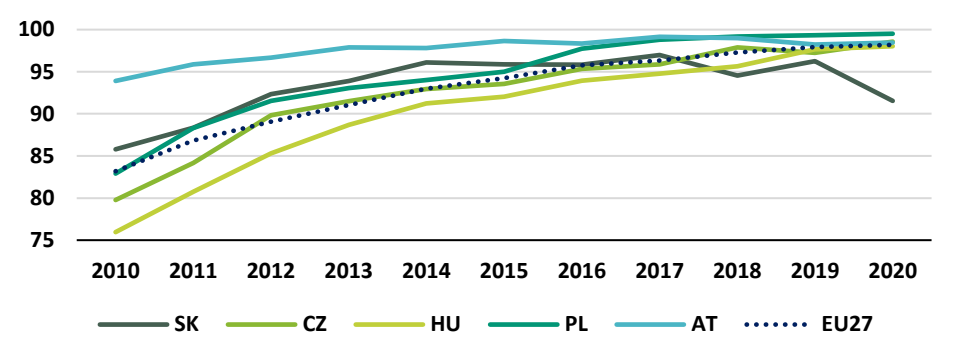
[8] Due to the limited availability of recent data by 3-digit occupations, estimates for the first three quarters of 2020 are based on 1-digit occupations, using constant weights of 3-digit occupations within 1-digit from 2019.

2020). In turn, as digitalization gains momentum across various sectors of the economy, the productivity benefits will have the capacity to outweigh the costs arising from restructuring of traditional business operations.

Box 2.4: Internet access

Internet connectivity is a fundamental pre-requisite to the digital transformation towards a knowledge-based economy. Figure 2.33 provides a general overview of internet accessibility of all households with dependent children and their potential to work or study from a distance by country over time. Internet accessibility of Slovak households with children has been falling in the last three years. This trend contradicts expectations and evolution in other countries, as well as that of the total Slovak population. Slovakia started off as one of the leading countries in digitalisation of households and was gradually surpassed by all its neighbours, falling deep behind the EU average.

Figure 2.33: Share of households with Internet access at home and dependent children (in %)



Source: Eurostat's ICT usage in households and by individuals' database. Note: EU27 corresponds to a weighted average of the 27 EU member states.The decline we observe in 2020 for Slovakia is due to a change in the sample composition.

Figure 2.34 divides internet users by degree of urbanisation. In 2020, the data show an apparent anomaly in Slovakia, where the level of access in cities (eight metropolitan regions in Slovakia) was below the level in the rural regions (more than 50% of the population lives in grid cells with less than 300 inhabitants per km^2). The results are more consistent for 2019, where Slovakia features 77% internet users in rural areas and 87% of cities, which are still the lowest numbers in the region. On the other hand, data suggests that income plays less of a role in the internet accessibility of Slovak households (Figure 2.35). For example, in 2020 the interquartile difference is the smallest in the region, whereas in 2019 it is on the level of EU average. Lower and upper-income households are defined as the first and third quartile of the income distribution.

Figure 2.34: Share of households with Internet access at home by a degree of urbanization in 2019 (in %)

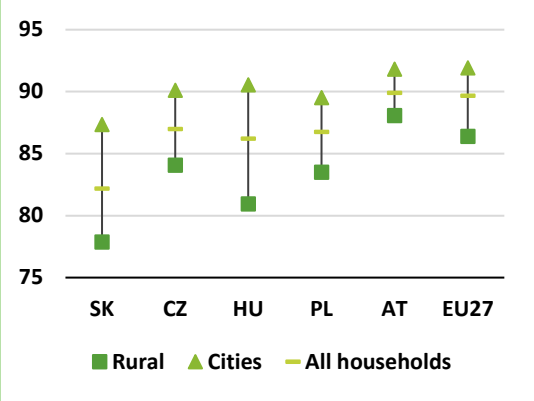
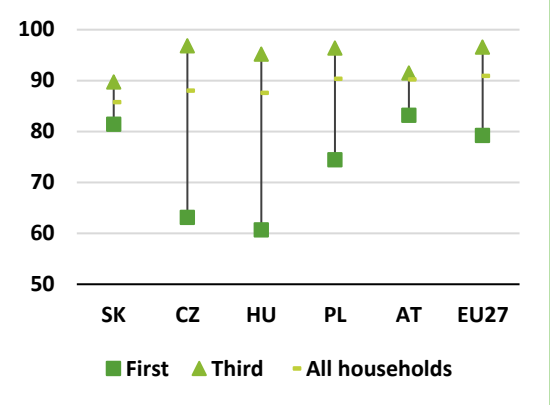


Figure 2.35: Share of households with Internet access at home by income quartile in 2020 (in %)



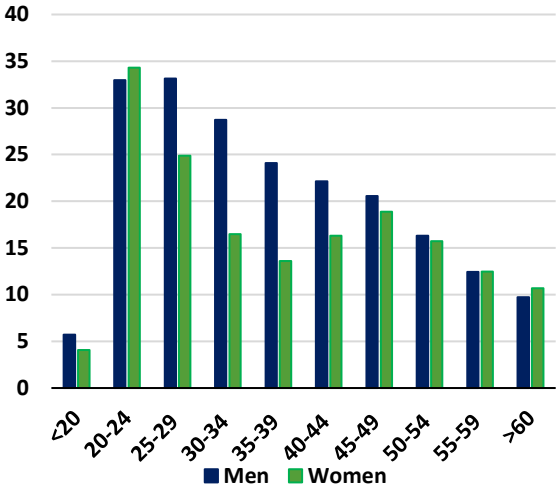
Source: Eurostat's ICT usage in households and by individuals' database. Note: EU27 corresponds to a weighted average of the 27 EU member states.

2.3.3 Gender equality

Women stand on the frontline of tackling the pandemic. They have seen an unprecedented rise in their workload, being majorly employed as healthcare and social-care workers. Indeed, over 80% of the workforce in the healthcare, social services and education sectors consist of women (UN Women, 2019). Consequently, a lot of them face higher health risks stemming from the nature of their work and see big challenges to work-life balance with closed schools (EC, 2021a; Blasko, 2020). Furthermore, women are expected to be particularly vulnerable in the labour market hit hard by the COVID-19 crisis, due to their overrepresentation in lower paid sectors such as hospitality, retail and in-person services that were closed due to the restrictions put in place (Alon et al., 2020).

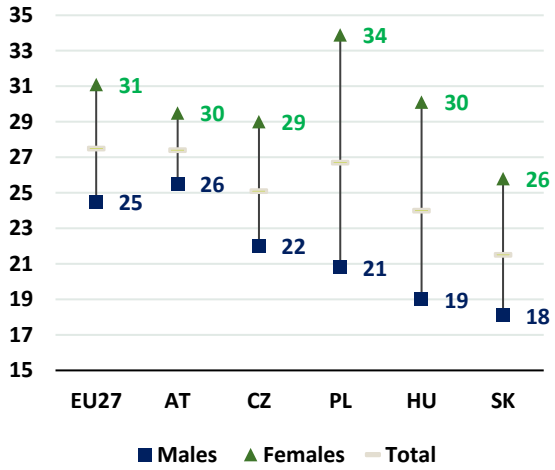
However, in the first wave of the pandemic in April 2020, more men in Slovakia registered for unemployment benefits at the labour offices than women (Figure 2.36). The biggest difference is seen in the age group of 30 – 34 years, where the unemployment of men rose by 29%, but only by 16% for women. One possible explanation is that there is a predominance of women in education, which means that these women could generally work from home (Dujava and Peciar, 2020). The dominant representation of men in manufacturing, which was particularly affected in the first wave, might also be a contributing factor. In addition, data from the Social Insurance Agency show that 77 thousand women entered the pandemic beneficiary scheme in May 2020 compared to 44 thousand men, which slowed down the unemployment rate for women aged 25 to 45 (Dujava and Peciar, 2020). Moreover, Slovakia has a particularity in the share of jobs that can be performed from home by gender (Figure 2.37) – it has the lowest share for men from the V4 countries and Austria, well below the EU27 average. This leads us to another possible explanation for women losing jobs less than men: effectively combining household chores and taking care of children while working from home at the same time.

Figure 2.36: Gender difference in monthly increases of persons registered at job offices (in %)



Source: IFP, UPSVaR (April 2020)

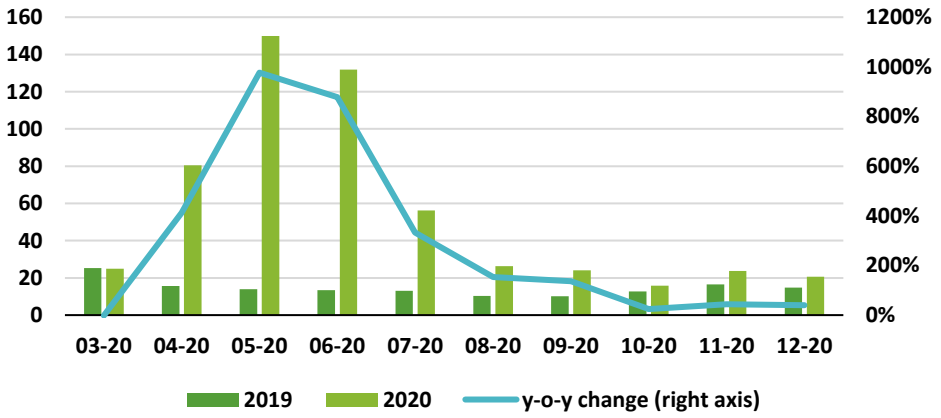
Figure 2.37: Share of jobs that can be potentially performed from home by gender in 2019 (in %)



Source: European Labour Force Survey. Note: EU27 corresponds to a weighted average of 27 EU member states as of 2020.

In April 2020, women accounted for 65% of total nursing benefits paid out under the pandemic scheme (Figure 2.38) (Domonkos et al., 2020). When looking at the year-on-year change, we see that benefits in the first wave of the pandemic rose by 976% at the maximum, however, during the second wave they were much lower, at around 40% (Baliak et al., 2021).[9]

Figure 2.38: Nursing benefit recipients in 2019 and 2020 (in thousands and %)



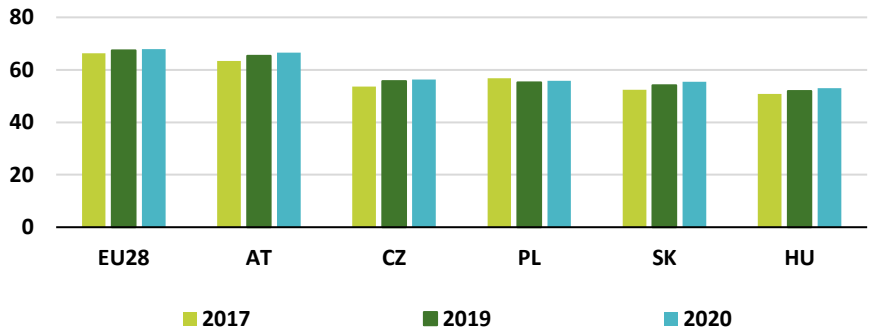
Source: Baliak et al. (2021).

EC (2021b) reported that women spent, on average 62 hours per week taking care of children (plus 23 hours of housework) compared to 36 hours for men (plus 15 hours of housework). Thus, the COVID-19

[9] The justification behind this is not straightforward, but can be attributed to several factors: greater fear of the pandemic at the beginning, rigid labour market that only gradually transformed to home-office friendly, as well as the partial opening of schools in the second wave of the pandemic.

recession largely affects the work-life balance of women. Such multitasking leaves a mark on the possibility of career progression of women, especially those with children, as they perceive being more heavily affected by the COVID-19 crisis than men (Yildirim, 2020; Huebener et al., 2021). Moreover, single mothers are particularly severely impacted, as they outnumber single fathers by a large margin (Alon et al., 2020). Hence, the gender gap may potentially widen with the number and age of children at a household (Cluver et al., 2020).

Figure 2.39: Gender Equality Index



Source: EC.

Undoubtedly, a lesser participation of women in the labour market as a result of the COVID-19 recession would be detrimental to productivity in the long run. While there have been slight improvements in greater female representation in political decision-making and educational attainment (EIGE, 2020), gender equality in Slovakia leaves a lot to be desired even in a non-pandemic world. Overall, the Gender Equality Index shows that Slovakia scores 12.4 points below the EU27 average and ranks 25th, which puts it among the worst performing EU member states (Figure 2.39). The biggest gender gap is seen in unpaid care work that women dedicate to caring for children, grandchildren, or people with disabilities. Further inequalities are perceived in income, power and economic decision-making.

While some positive steps have been taken by the Slovak government to facilitate the non-discrimination and equal treatment of women (for instance through the formulation of the National strategy for gender equality for years 2014-2019), the glass ceiling for females in the workplace remains firmly in place. Despite higher educational attainment, career growth prospects and access to higher positions continue to be rather closed off to women (UN Women, 2019). UN Women (2019) attribute Slovakia's poor standing in terms of gender equality to numerous factors, with the traditional value system regarding gender roles playing a key role. Another possible contributing factor might be the significantly smaller share claimed by the urban population on total population in comparison to the EU-27 average. In this context, the pandemic has exacerbated the unequal distribution of childcare duties, without providing women with supportive measures to reconcile their personal and professional lives.

Yet, on the flip side, there is also an opportunity arising from the COVID-19 recession to progress in achieving the goal of gender equality— the sole fact that men change their working environment to home increases the likelihood that they also take on child care responsibilities (Alon et al., 2020). Moreover, the greater adoption of flexible working hours and work from home arrangements by firms

has the potential of bringing in more mothers with young children into the labour force. Hence, as childcare facilities and schools gradually open up, the possibility of transforming the workplace and society into a more inclusive one arises, arguably bringing about productivity enhancements.

3. Innovation in Slovakia

Slovakia has a long tradition in the automotive industry, which currently accounts for 13% of country´s GDP, and has brought significant foreign investments. However, this industry is facing many challenges due to technological advancements in car sharing, electric mobility and driverless cars (Deloitte, 2021). The uncertainty in the market demand has been reinforced by the COVID-19 pandemic, which caused a 6% drop in the revenues from car sales and has changed buyers´ behaviour – fewer people are buying cars than originally expected (McKinsey and Company, 2020a). Moreover, the Slovak car industry employs a significant number of employees, but also faces high risk of automation, with almost 30% of jobs at stake (OECD, 2020).

Even though there have been calls to transform Slovakia from an "assembly line" to an innovative economy, there has not been a significant improvement in innovation environment since 2012 (EC, 2020b). Slovakia is considered a moderate innovator by the European Innovation Scoreboard, mainly lacking in citations in international publications, innovative products and processes, available funding, and cooperation between the private and public sector. This is a result of insufficient funding and exaggerated bureaucracy connected to funding of research and development (R&D) that would potentially elevate the country's potential for innovation. There are many quality research teams and motivated academics in Slovakia, however, the issue is that intended supporting mechanisms to fund their projects rarely translate from words to actions (EC, 2020b). Financing available to research centres is mainly provided from state funds and is highly insufficient. Even though considerable funds have been provided by the European Commission to support innovation, Slovakia has been underperforming in making these funds available to universities and other research projects, hence losing the resources.

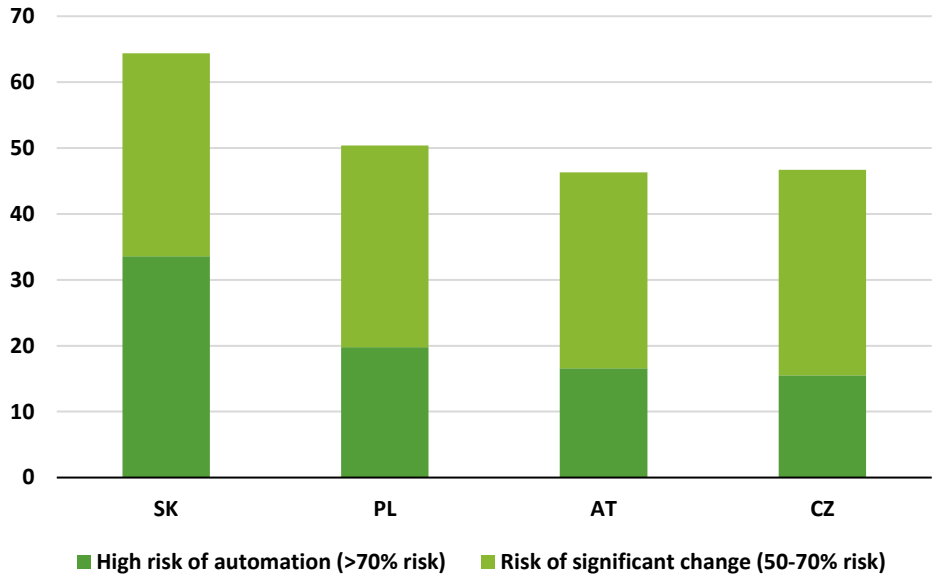
To support innovation, in 2015 Slovakia invested into building University Science Parks and Research Centres, equipped with high quality instruments and technology (Výskumná agentúra, 2018a, b). The goal was to provide the necessary infrastructure for start-ups and support collaboration between the public and private sector. However, the intended cooperation between private and public sector was prohibited by the national legislation, due to state aid (public sector providing an advantage for a private company). Because of its high maintenance costs and lack of funding for research, the infrastructure has subsequently proved to be more of a burden to universities, which were financially responsible for it without any commercial potential. Consequently, despite its potential, the goal of building up R&D infrastructure has not been fulfilled. This was not a result of Slovakia lacking personnel and technology, but because universities' ability to cooperate with private sector and monetize their equipment was prohibited and carry out their projects.

The low levels of provided funding and lack of financial incentives to improve have resulted in low quality of research outputs and extensive brain drain not only abroad, but also from public into the private sector. Academic institutions and private companies have often not been able to secure funding in Slovakia in spite of their R&D activities being of high quality. State funding and venture capital are both virtually non-existent options, causing many innovative companies to seek funding abroad. Furthermore, 19% of higher education students study abroad as compared to the 2% average in OECD countries (OECD, 2020). This research also shows that these students rarely return back home, because their investment into education abroad is not paid back by returning to Slovakia as compared to other countries, where the graduates are usually able to secure better paid jobs in both academic and private sector.

3.1 Automotive Industry

The automotive industry has a long tradition in Slovakia and currently accounts for 13% of Slovakia´s GDP (SARIO, 2021). Overall, 50% of industrial production is concentrated here. In 2020 the automotive industry directly and indirectly employed over 275 000 people, and in 2019 it accounted for more than one third of total exports of Slovakia (SARIO, 2021). It also represents a significant source of foreign direct investment as well as industrial innovation. Mainly due the strategic geographical position in Central Europe, Euro currency and low cost labour force, Slovakia received substantial investments with several large deals at the start of the transition in 1990. Slovakia has also become the leader in car production per 1000 inhabitants (SARIO, 2021).

Figure 3.1: Risk of automation (in %)



Source: OECD.

However, car industry is no longer as profitable nowadays as it was in the past, with fewer purchases of new cars across the world and with the increasing demand for ecologically sustainable travel. Moreover, employment in industrial jobs poses a big risk with 33.6% of jobs being at a high risk of automation, and 30.8% of jobs being at a significant risk of change (OECD, 2020). A report by PwC (2018) considers Slovakia to be the country with the largest share of automated jobs within the EU, estimating that up to 58% of jobs in industrial production, 43% in wholesale and retail or 42% in the construction sector could be automated. OECD (2018) mentions Western Slovakia as the most extreme example of high number of jobs that would be easily automated, at around 40%, mainly due to the high share of jobs with work activities that are repetitive, manual and easy to automate. It is mainly the automotive industry, which, together with its network of suppliers, dominates industrial production, but even many jobs in shared service centres are similarly easily automated. Additionally, Slovakia is one of the countries with the highest number of young people in the NEET category (not in employment, education or training), combined with its low emphasis on retraining programs and transferable skills in education the likelihood of successful adaptation to technological change is extremely low. According to OECD (2020), COVID-19 is likely to accelerate the automation of work activities. The share of jobs at risk ranges from 62% in the Bratislava Region to 70% in Western Slovakia.

It is therefore questionable whether the investments into automotive industries in Slovakia are still beneficial in ensuring country´s competitiveness on the market. Given changing market needs, it might be necessary to restructure the market to address these needs. Moreover, the current rate of car sales might in the future be affected by car sharing, which has been growing annually by 30% on average.

Electric mobility, driverless cars, automated factories and ridesharing are all threats to the traditional car sales models. These potential threats have been further reinforced by the COVID-19 pandemic, which will keep more households from investing into new cars in the times of crisis. For example, as a direct result of the uncertainty caused by COVID-19 pandemic, more than 40% of German consumers will keep their current vehicles for longer than they originally expected, fewer new cars were bought in 2020, and the number of second-hand car sales has almost doubled (McKinsey and Company, 2020b). Overall, in 2020, the profits from global automotive sector have declined by approximately 100 billion dollars, representing a drop of roughly 6% of total profits in only two years' time. On the other hand, the forecasts for the automotive vary to a great extent, some expecting and annual rise in sold cars by 2%, others expecting a 30% increase by 2030. However, all predictions seem to be consistent in believing that the industry will be driven mainly by car sharing, and that its future is uncertain as a result of dependency upon multiple new technologies and developments.

In spite of the previous success of the automotive industry at bringing foreign direct investments into Slovakia and lowering the unemployment rate, the industry is subject to great change from technological advancement. The level of uncertainty renders the automotive industry unreliable in ensuring continuous growth and competitiveness for Slovakia. Moreover, this industry mostly employs low-skilled workers, rather than using local R&D – most of the R&D for car manufacturers based in Slovakia is conducted outside the country. As such, the automotive industry has not been a driver of innovation in the country, however, it retains the highest level of financial support from the Slovak government, at the expense of smaller, potentially more sustainable innovative companies (Baláž & Berger, 2007).

3.2 Human Resources in Research and Development

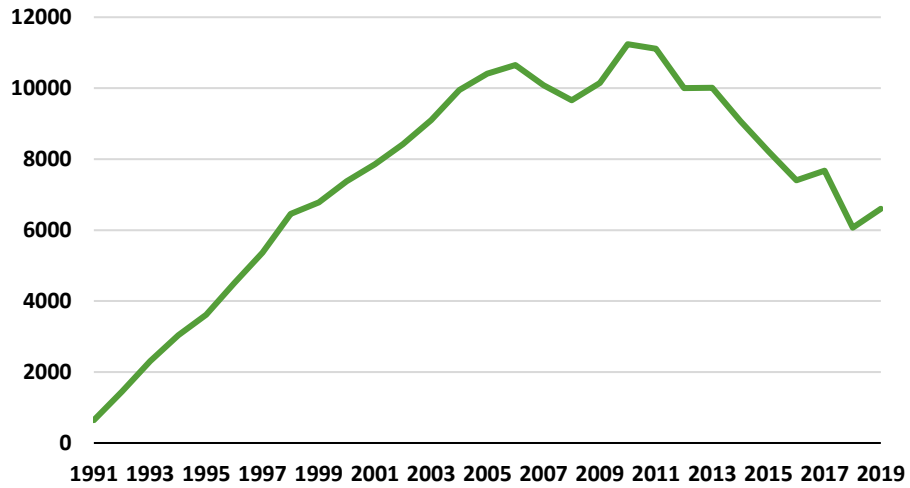
Funding in R&D has two important dimensions. First, funding provides the necessary infrastructure to carry out high quality research, and thus the possibilities to innovate or create prototypes. Secondly, sufficient funding is crucial for supporting human resources and ensuring that the best researchers do not leave the country. Low levels of available financing in Slovakia have impacted the quality of research outputs by the Slovak academics and researchers, who are not being incentivized enough to exert additional effort into creating high quality publications, develop international cooperation, or stay in the public sector. As a direct result, the quality of Slovak research facilities and universities has been decreasing, rendering it more difficult to attract high-quality research and innovation teams into the country.

3.2.1 Brain Drain

The lack of provision of competitive funding has caused Slovakia to be subject to extensive brain drain: 19% of higher education students are enrolled in another country as compared to the 2% OECD average (OECD, 2017). Even though national statistics show an increase in the ratio of international students studying in Slovakia per university, this has been caused to a large extent by the decrease in the number of Slovak students studying in the country (OECD, 2017). Simultaneously, since the

outbreak of the Crimea conflict, there has been a rising number of Ukrainian students studying in Slovakia. Even though the share of foreign students has been increasing, Slovakia is doing very little to retain graduates in the country to pursue careers in innovation or in public institutions. The number of doctoral students in Slovakia has decreased by almost 50% between 2010 and 2019 (Statistical Office of the Slovak Republic, 2020).

Figure 3.2: Number of doctoral students

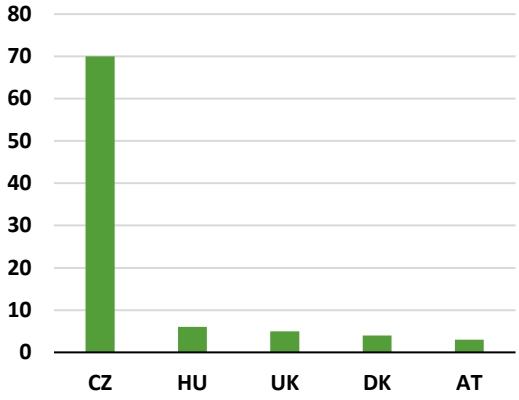


Source: SOSR.

Moreover, the average age of researchers employed in the public sector has been rapidly increasing. One of the reasons causing this phenomenon is the brain drain of young researchers abroad, another is the problematic process of admitting foreign researchers into Slovakia and integrating them (CVTI, 2016).

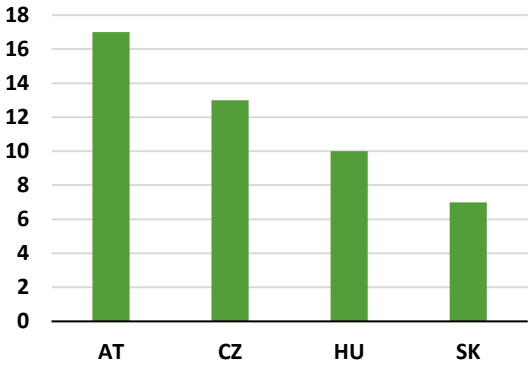
Private companies offer much more favourable financial compensation to their employees, and their innovative products are often very highly regarded on the market, causing Slovakia to suffer from yet another type of brain drain – from public to private sector (ÚHP, 2020b). In the long run, the academic community in Slovakia might become completely non-existent, rendering it impossible for Slovakia to ever become an innovative competitive country, and effectively tackle the ongoing automation.

Figure 3.3: Slovaks studying abroad by destination country in 2019 (in %)



Source: UNESCO.

Figure 3.4: International students at domestic universities in 2019 (in %)



Source: UNESCO.

Box 3.1: Quality of Higher Education Institutions

Low quality of research in Slovakia is both the cause and result of further brain drain. None of the top Slovak universities appear in the TOP 1000 in the list of top higher education institutions in the world.

Table 3.1: University key statistics

	Overall Score	Teaching	Research	Citations	Industry Income	International Outlook	Number of students per staff	Student ratio of female to males	Number of FTE students	% of international students
Comenius University Bratislava	10.7 – 22.1	22.2	13.1	22.3	34.6	52.0	9.9	66:34	21 141	13
Technical University of Košice	10.7 – 22.1	20.8	12.5	10.2	44.0	27.6	12.0	28:72	9 110	13
Slovak University of Technology in Bratislava	10.7 – 22.1	22.5	12.4	9.8	37.1	27.8	11.3	32:68	11 194	4
Slovak University of Agriculture in Nitra	10.7 – 22.1	17.7	8.4	9.7	36.2	37.5	12.8	54:46	5 707	3

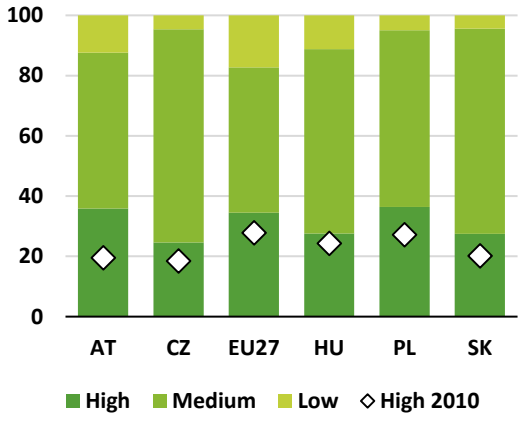
Source: Based on data collected for the 2021 The Times Higher Education World University Ranking.

3.2.2 Human capital skills distribution (education attainment approach)

This section compares the skills distribution of total employment by country, time, and industry. Skills are defined according to the ISCED 2011 classification from 2014, or ISCED 1997 classification for the years 2008 to 2013. The low skills category corresponds to levels 0 to 2, i.e. below lower secondary education with the equivalent of 8 to 10 years of consecutive full-time education; medium skills to levels 3 and 4 or secondary education; while the high skills category corresponds to levels 5 to 8 in ISCED 2011 and 5 to 6 in ISCED 1997 i.e. tertiary education.

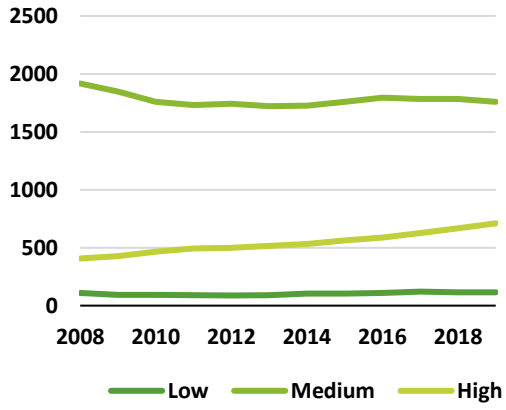
The Slovak labour market shows signs of upskilling where the number of working persons with tertiary education over the last 12 years almost doubled. Figure 3.8, on the other hand, shows the skills composition of industries. Not surprisingly, higher demand for high skilled workers is originating from services, especially in information and communication, financial and insurance and professional, scientific and technical services.

Figure 3.5: Employment shares by education attainment in 2019 (in %)



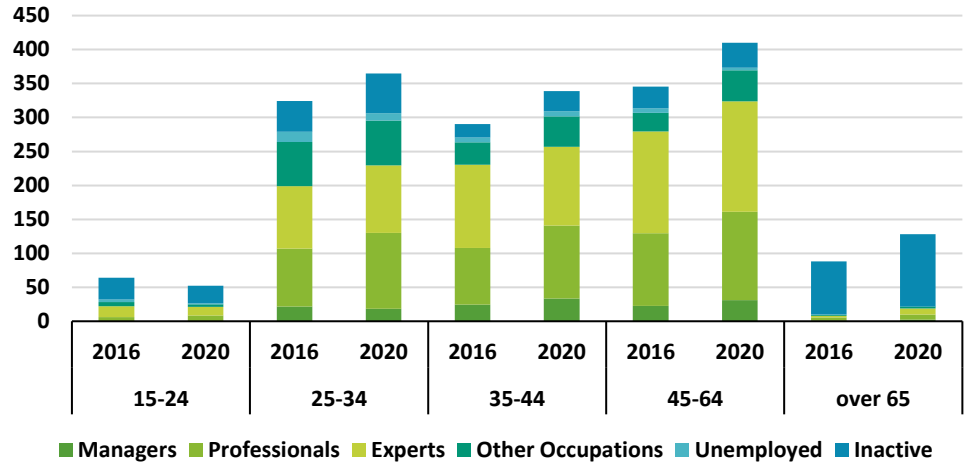
Source: European Labour Force Survey. Note: EU27 corresponds to a weighted average of the 27 EU member states.

Figure 3.6: Employment by education attainment in Slovakia in 2019



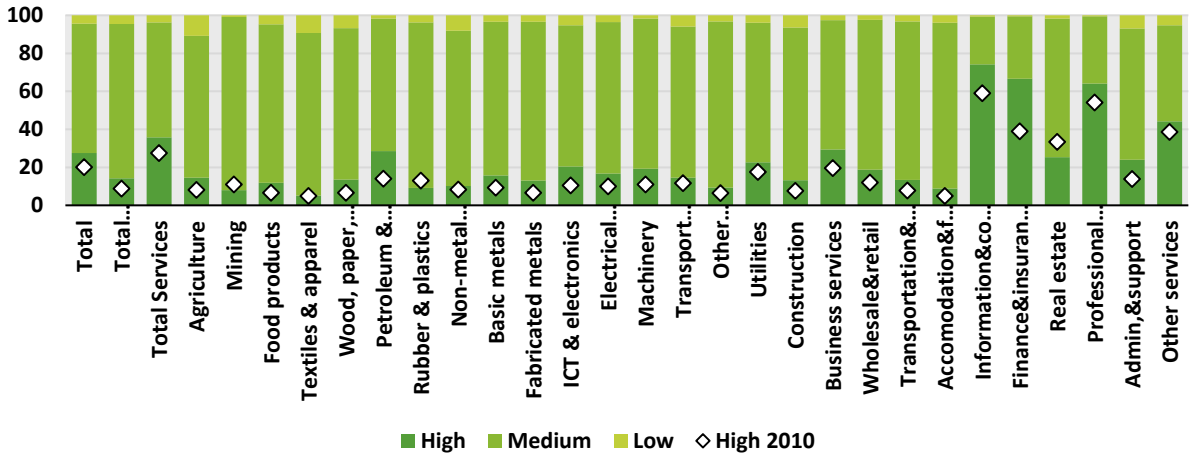
Source: European Labour Force Survey.

Figure 3.7: Human resources in science and technology (in thousands)



Source: SOSR.

Figure 3.8: Employment shares by education attainment and industry in 2019 (in %)



Source: European Labour Force Survey.

3.3 European Innovation Scoreboard

Slovakia's relative performance in the European innovation scoreboard has not changed significantly since 2012, and the country is regarded as "modest innovator" together with Hungary and Poland, while Czechia is a "moderate innovator" (European Commission, 2020).

Box 3.2: European Innovation Scoreboard

Part of the evaluation of innovation environment within a country is also assessment of the current condition, which might either support or hinder innovation.

Table 3.2: European Innovation Scoreboard Country Specific Information

	SK	EU
GDP per capita (PPS)	21,800	29,100
Average annual GDP growth (%)	3.31	1.84
Employment share manufacturing (NACE C) (%)	24.6	16.6
Employment share services (NACE G-N) (%)	34.1	41.4
Foreign-controlled enterprises – share of value added (%)	19.9	11.1
Enterprise births (10+ employees) (%)	1.6	1.1
Total Entrepreneurial Activity (TEA) (%)	12.4	6.7
FDI net inflows (% GDP)	n/a	2.6
Top R&D spending enterprises per 10 million population	0.0	16.2
Buyer sophistication (1 to 7 best)	3.0	3.7
Ease of starting a business (0 to 100 best)	n/a	76.5
Basic-school entrepreneurial education and training (1 to 5 best)	1.9	1.9
Govt. procurement of advanced technology products (1 to 7 best)	3.1	3.5
Rule of law (-2.5 to 2.5 best)	n/a	1.1
Demography Population size (millions)	5.4	446.2
Average annual population growth (%)	0.14	0.14
Population density (inhabitants/km2)	11.7	108.6

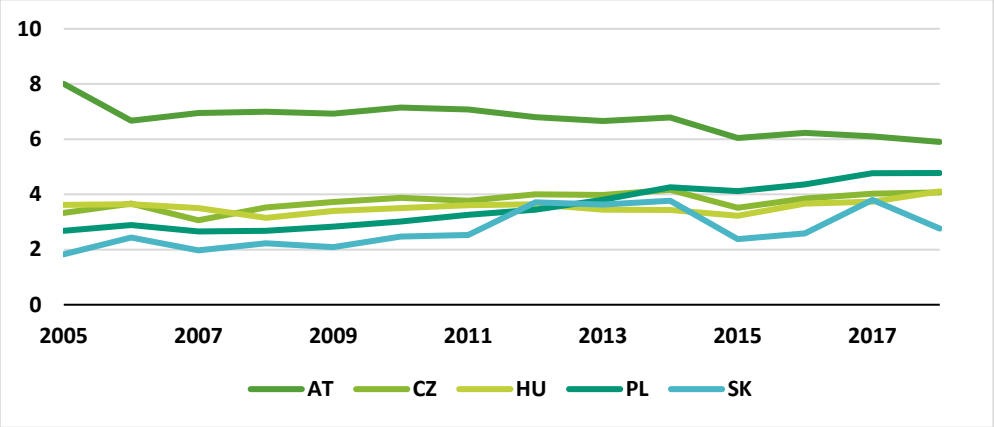
Source: European Innovation Scoreboard.

Slovakia is still lacking in private-public co-publications, as well as mutual funding of projects, meaning cooperation between the two sectors remains at very low levels (OECD based on Elsevier, 2019). Furthermore, publications are rarely published with international cooperation, and are also only rarely cited. Lack of innovative products and processes is also reflected in the low number of patents, design and trademark applications, despite its industrial orientation (European Innovation Scoreboard, 2020). Higher education institutions have extremely high level of application success, with the number of accepted applicants rising from 76% in 2010 to 90% in 2019. Subsequently, many higher education graduates are overqualified for their jobs. The 2020 European Innovation Scoreboard identified priority areas to boost innovation performance such as increasing the gross domestic expenditure on R&D (% of GDP) to 1.2% from the current 0.9%, and increasing the tertiary educational attainment (% of population aged 30 – 34) to 40.0% from current 39.8%.

Box 3.3 Publications

The first indicator shows the share of a country's publications (based on the authors' institutional affiliations) that appear in the global top 10% most cited publications. This indicator can be taken as an indicator of the quality of scientific papers. The indicator is based on fractional counts, which compares the top 10% of cited publications by ASCJ fields.

Figure 3.9: Share of national scientific publications that appear in the world's 10% top-cited publications (in %)



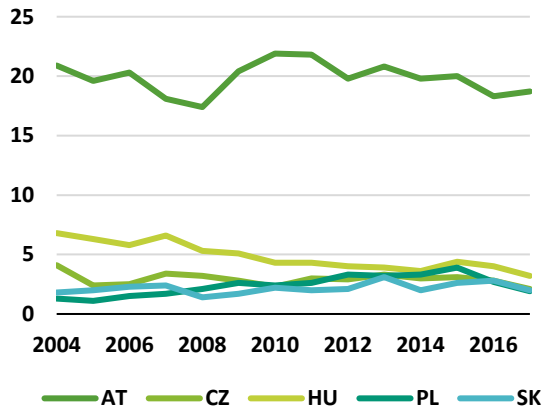
Source: OECD calculations based on Elsevier (2019).

3.2.3 Patents

Tracking the number of applications and granted trademarks and patents represents the level of intellectual assets possessed in the country. Usually, medium and highly technological companies will have higher R&D expenditures, as well as number of patents, which signify unique technological progress and development (World Intellectual Property Organization, 2009). Patents can be understood as stimulators for diffusing innovation, promoting products and also for monetizing research and development outcomes by creating a monopoly in a given field (World Intellectual Property Organization, 2009). Data on patent applications come from the OECD's Patents Statistics database. All the patent-related data are based on the number of patents filed under the Patent Co-operation Treaty (PCT) at the international phase. The year refers to the priority date (i.e. the date of filing a patent application), which is the time information closest to the actual date of invention; while the country dimension refers to the applicants' country of residence: an indication of the country that benefits most from the patent filing. To compare the number of patents by country, we expressed them in relation to either per capita (total R&D personnel in full-time equivalent) or in the monetary value of Intramural R&D expenditures (GERD), in purchasing power parities (PPPs) per patent.

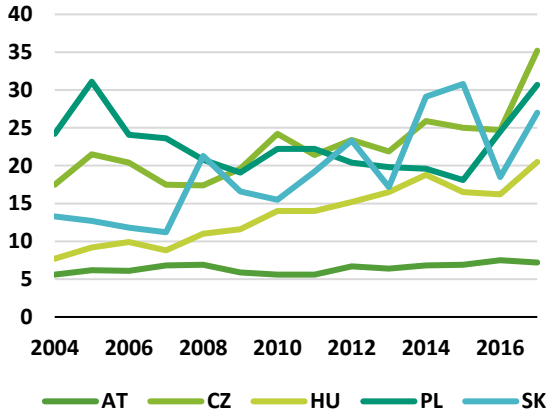
Figure 3.10 shows that Austria is a leader in the region in terms of R&D personnel patent applications productivity with approximately 20 applications per 1000 full-time equivalent R&D personnel. Slovakia, on the other hand, with the same number of R&D personnel, files around 2 applications. The difference becomes more remarkable when we consider only researchers (approximately 32.6 vs. 2.7 patents per 1000 researchers FTE). Not only is Austria the leader in R&D personnel productivity but also in cost-effectiveness. On average, one patent application in Austria costs almost 3 times less in millions of PPS than in the Slovak Republic, see Figure 3.11.

Figure 3.10: Number of patent applications under PCT per thousand R&D personnel



Source: OECD's Patent statistics database with Eurostat's R&D personnel database.

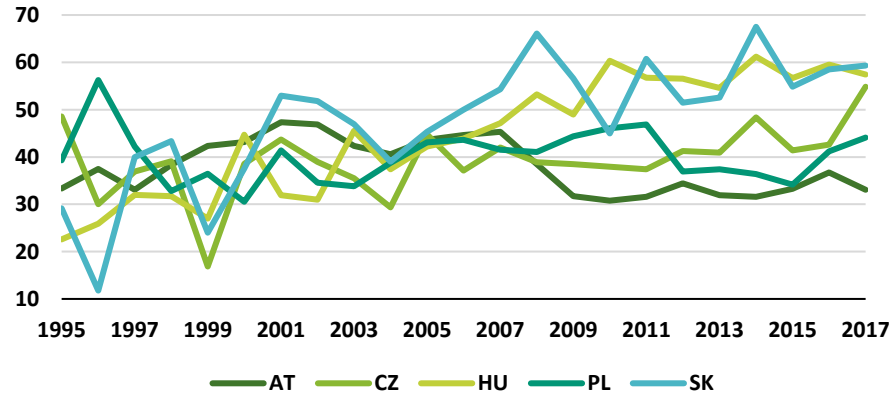
Figure 3.11: GERD per patent application (in mil. PPS)



Source: OECD's Patent statistics database with Eurostat's Intramural R&D expenditure (GERD) database.

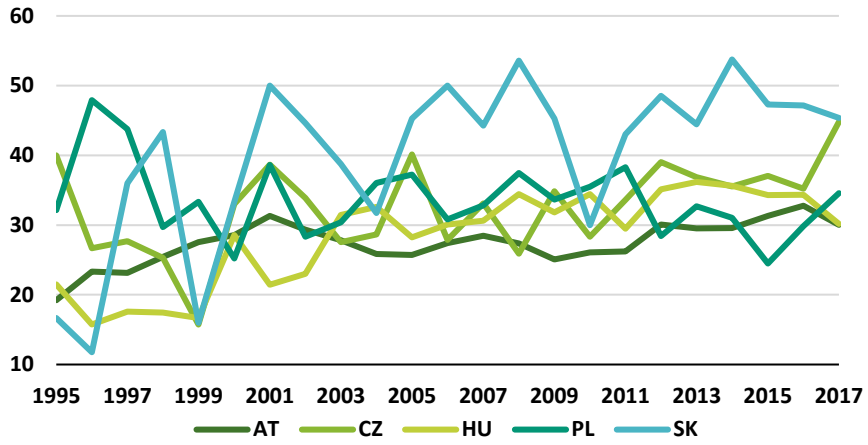
In 2017, Slovakia was a leader in the region in international invention collaboration with the highest share of patents owned by foreign residents (59.3% Figure 3.12), the highest share of co-invented patents (45.3% Figure 3.13) and second-highest share of ownership of patents invented abroad (26.8% Figure 3.14).

Figure 3.12: Share of patents invented domestically owned by foreign residents (in %)



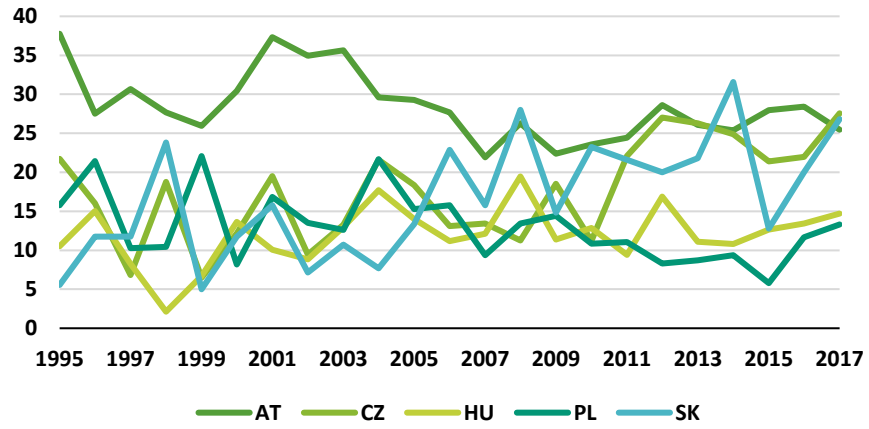
Source: OECD's Patent statistics database.

Figure 3.13: Share of patents with foreign co-inventors (in %)



Source: OECD's Patent statistics database.

Figure 3.14: Share of patents owned by the domestic residents that were invented abroad

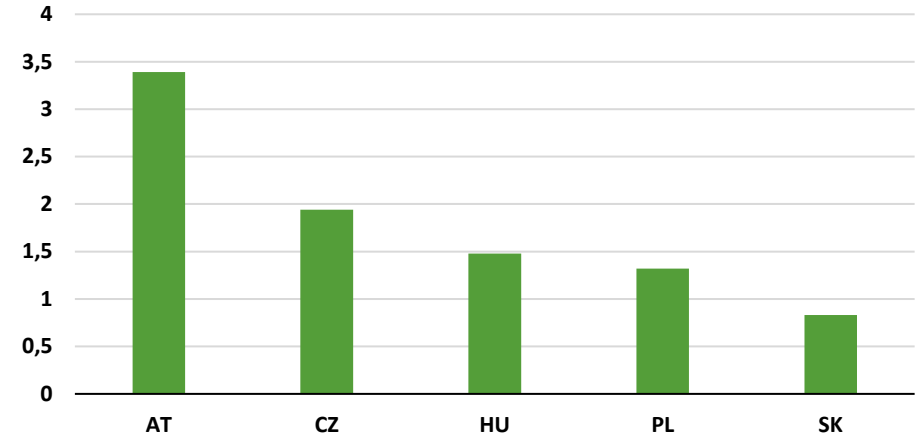


Source: OECD's Patent statistics database.

3.3 Funding of Research and Development

Both research and innovation have been long under-funded in Slovakia. This has led to low attractiveness of these sectors, as well as low quality of research outputs and underperforming innovative companies. Compared to other V4 countries and Austria, Slovakia has been investing a considerably lower percentage of GDP into research and development. This figure remained at 0.83% in 2019, in spite of the "Learning Slovakia" strategy published in 2016, which aimed to increase public spending on higher education to 1.2%. Average share of GDP invested into research and innovation across EU countries is 2.14%.

Figure 3.15: Percentage of GDP invested in research and development in 2019 (in %)



Source: Eurostat.

3.3.1 State Funding

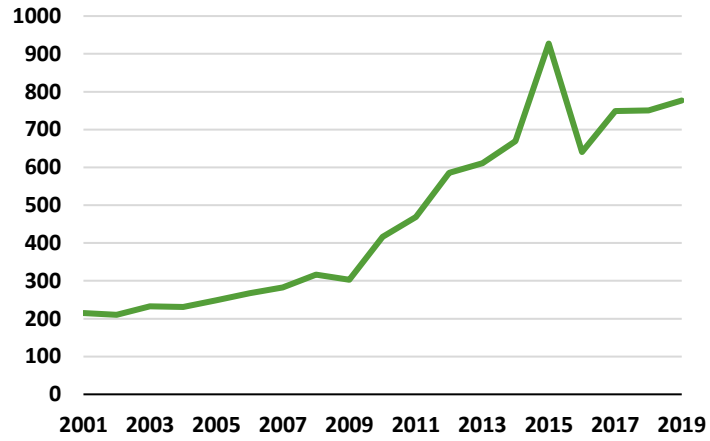
State funding of research and innovation represents almost 80% of total available funding for public institutions (i.e. higher education research centres). This has continued to be the case even after the inflow of European structural and investment funds (ESIF) – the main source of foreign investments was the European Commission), since each investment from the EU requires a certain portion of the expenses to be covered by state funds. In 2015 the total expenditure went up to 927 milion. euros. This spike occurred mainly due the construction of University Science Parks and Research Centres all across Slovakia, which were mainly funded via ESIF (Operational Programme Research and Development). However, in 2016 the level of foreign investments decreased back to under 15% of total available financing. In 2019, the total amount of resources invested into research and development was a little over 776 million euros. On average though, the level of gross domestic expenditure on research and development has been gradually increasing from 300 million euros in 2009 to almost 800 million euros in 2019.

University Science Parks and Research Centres built in 2019 aimed to connect public institutions and the private sector (Cedzová and Rybanská, 2020). The main idea was that the state would provide high quality (and often rather expensive) equipment to carry out high quality research, which would be rented out to private companies (Výskumná agentúra, 2018a). The Parks and Centres were also aimed to serve as incubators for start-ups and provide students with first-hand experience research work funded by private companies. Ministry of Education, Science, Research and Sport of the Slovak Republic, which was in charge of the project, introduced the project in two phases, where the first phase was meant to provide infrastructure, and the second phase was planned to provide the means to carry out research. However, the second phase was never implemented, causing the universities to remain bound to maintain the high-cost Parks and Centres out of their own budgets. Moreover, the cooperation with the private sector was prohibited during the first five years of the Parks and Centres opening. As a result, the first-class infrastructure has not yielded any results in boosting innovation, and is now becoming obsolete due to universities´ inability to finance maintenance and technological progress (Cedzová and Rybanská, 2020).

Cooperation between the private and public sector is hugely limited due to unfavourable legislation set in place. For example, state aid legislation restricts cooperation of public and private sectors, where such cooperation might create a market advantage for the private company. Even though Slovakia has largely invested into improving public infrastructure and to create innovation hubs and incubators within the higher education institutions, these cannot be rented to private companies within the first five years of existence. By the end of this period, however, most of the infrastructure will have become obsolete or the public institutions tasked with its management will not have had enough resources to support such expensive equipment (Cedzová and Rybanská, 2020).

Furthermore, administrative burden associated with public organizations is extremely disadvantageous for private companies, which, due to rapid innovation, have to introduce their products on the market in the shortest possible time, so as to ensure success. If private companies do make use of public infrastructure, they are obliged to share ownership of the product with the public sector institutions. This means the product will be subject to administrative processes such as public procurement, causing inability to produce and sell their product flexibly, and thus diminishing the possibility of successfully introducing the product on the market (Cedzová and Rybanská, 2020).

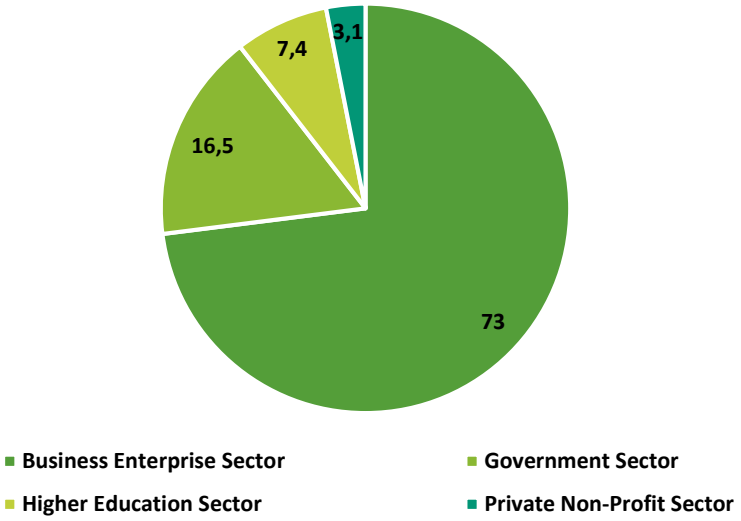
Figure 3.16: Gross domestic expenditure on research and development (in mil. eur)



Source: SOSR.

Slovak research and development is concentrated into business enterprise sector, which comprises of 73% of all workplaces. The private sector is followed by higher education sector, which represents only 17% of all R&D workplaces. The private sector is followed by the government sector, which represents 7%, and the higher education sector, which represents 7% (Statistical Office of the Slovak Republic, 2021).

Figure 3.17: Organizations in research and development in 2018 (in %)

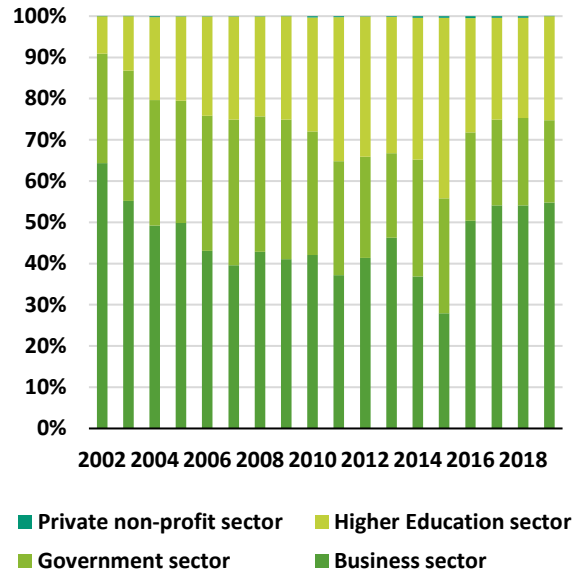


Source: SOSR.

The business sector is eligible to apply for public funding of its projects, as well as for resources available through the European framework. However, possibilities for acquiring venture capital within Slovakia are limited, as there are very few incubators or innovation hubs available (OECD Entrepreneurship Financing Database, 2019). Hence, we can often observe SMEs and start-ups setting up their business abroad instead.

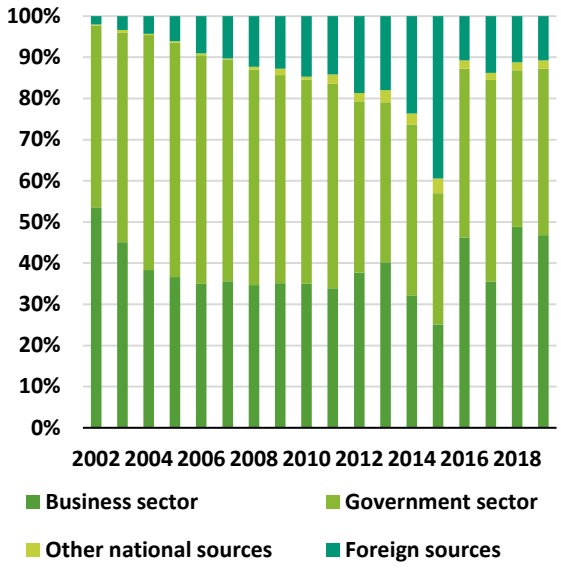
Figures below show research and development expenditure divided by the sector of organization where R&D is performed and also by the sector of the source of funds. When considering R&D expenditure by sector of R&D performance, we can observe that the biggest share of total R&D investments was in the business enterprise sector. The government sector used to have R&D expenditure about 30% of the total R&D investments, which has, however, shrank to 20% since 2015. The development of R&D expenditure in the higher education sector reflects the absorption cycle of ESIF in Slovakia. The higher education sector enjoyed the highest contributions in 2015, which is also when foreign resources represented the biggest proportion of investment in Slovak R&D. In any other year, resources provided by foreign institutions represented only about 10% of overall R&D budget.

Figure 3.18: Expenditure on research and development by sectors (in %)



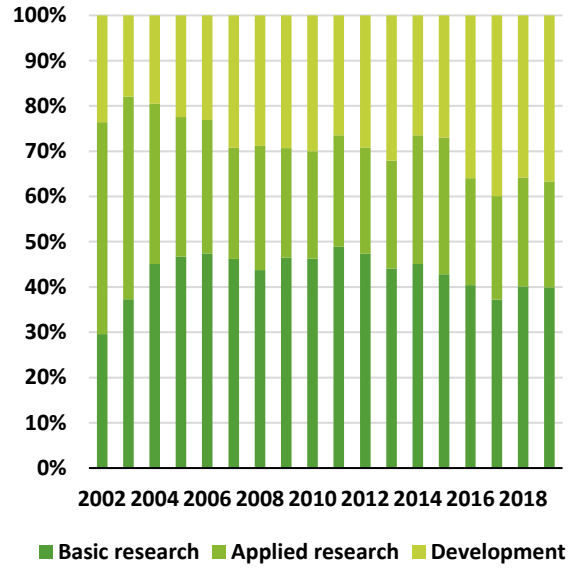
Source: SOSR.

Figure 3.19: Expenditure on research and development by source of funds (in %)



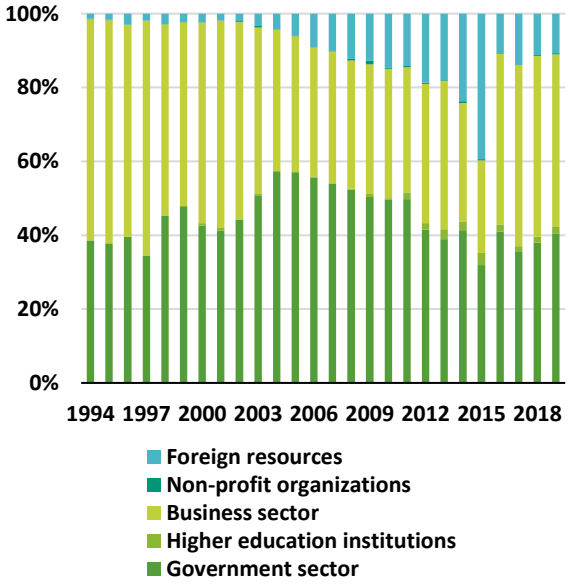
Source: SOSR.

Figure 3.20: Expenditure on research and development based on the activities of research and development (in %)



Source: SOSR.

Figure 3.21: Expenses on research and development based on financial resources (in %)



Source: SOSR.

The data from Slovakia show that the business sector is the main sector focusing on research and innovation. The exception was the year 2015 when Slovakia received substantial funds from the European Union as part of the Operational Programme Research and Development. However, 6 years after this contribution was made, there has been no significant improvement in the innovative environment in Slovakia. According to SOVVA, the investments into R&D have been too low to bring significant improvement in innovation activities. Moreover, provision of available funding is extremely

fragmented among multiple institutions, with a huge administrative burden connected to it. As a result, it is even more difficult for applicants to participate in funding schemes.

3.3.2 European Funding of R&D in Slovakia

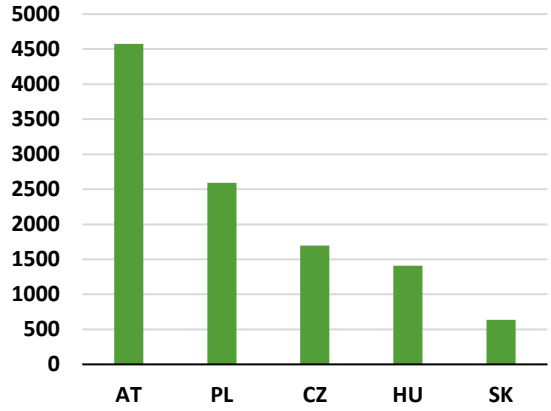
Structural and investment funds are allocated on national basis, with each European member state managing their finances individually, in accordance with a partnership agreement with the EU. The partnership agreement between the European Commission and Slovakia for 2014 – 2020 outlines main objectives for Slovakia for this time period. Examples of such agreements are increasing the percentage of GDP invested into research and innovation from 0.8% (2012) to 1.2% (2020) or improving Slovak business environment by reducing administrative burdens for businesses.

Funds which are made available via the partnership agreement are further redistributed among agencies in Slovakia. These agencies are then responsible for achieving set objectives – by presenting funding opportunities, evaluating applicants and finally, providing the funds. Such agencies in Slovakia are, for example, the Research Agency (Výskumná agentúra) – responsible for Operational Programme Research and Development (OP R&D, 2007 – 2013), and later Operational Programme Research and Innovation (OP R&I, 2014 – 2020). Overall, OP R&D is regarded as a successful project, granting funding in 42 calls for applications (including funding of Centres of Excellence, University Science Parks and Research Centres, or the JEREMIE initiative) with a total contribution of 1.53 billion euros from the EU. On the other hand, OP R&I received an allocation of more than 3.6 billion euros from the European Union, from which Slovakia managed to contract only 1.5 billion euros (less than 50%) (Výskumná agentúra, 2020a). However, some of these funds were reallocated into Operational Programme Integrated Infrastructure, and as such can still be used in the future. Other redistributive strategies include the RIS3 programme, which was supposed to make the EU funds available to Slovak regions, but was deemed unsuccessful in their efforts.

The failure of allocating funds in Slovakia is not caused by lack of high-quality research, development and innovation projects. Multiple small businesses in Slovakia which have received Seals of Excellence from the European Commission – a merit granted to projects of high quality, have not received funding from the European Commission directly (usually from Horizon2020), but are highly recommended for national funding. Most of these innovative companies (Everifin, Autech, Maindata, Leitner Technologies, etc.), in spite of receiving multiple Seals of Excellence, have not received any funding from Slovak authorities (ERA Portál Slovensko, 2020). As a result, these innovative companies will most likely relocate to different European countries, which will provide them with the necessary funds to enter the market and Slovakia will lose some of its greatest potential to innovate.

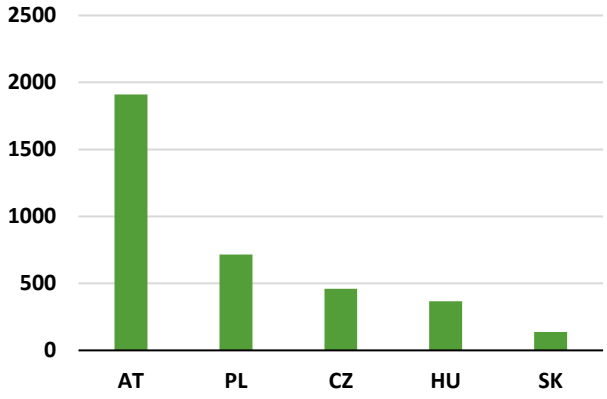
Horizon2020 is a follow-up to the 7th Framework programme, provided by the European Commission to ensure EU´s global competitiveness via supporting research and innovation. Horizon2020 has so far been the most ambitious European framework, providing nearly 80 billion euros over the period of 7 years (2014 – 2020) (European Commission, 2021). It was planned as an initial support to encourage further private investments into R&D in the future.

Figure 3.22: Participation in Horizon2020 in 2014-2020 (number of projects)



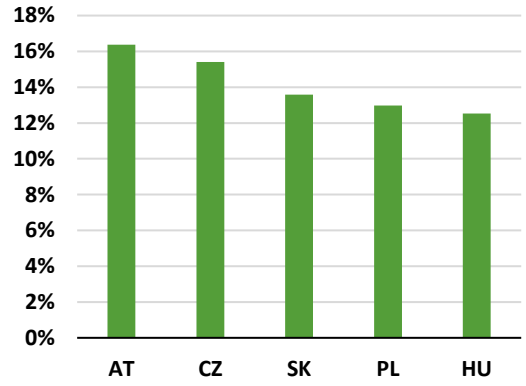
Source: Horizon2020.

Figure 3.23: Net EU contribution in Horizon 2020 projects in 2014-2020 (in mil eur)



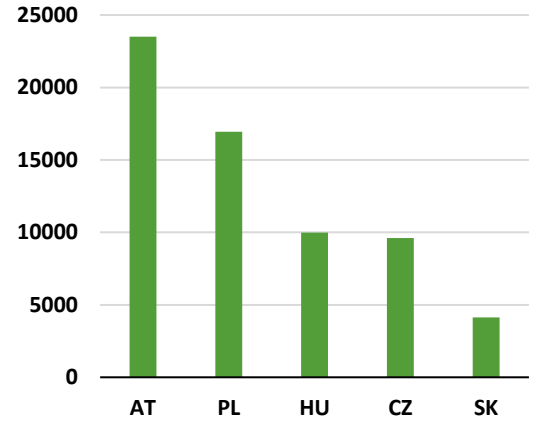
Source: Horizon2020.

Figure 3.24: Success rate of eligible applications in 2014-2020 (in %)



Source: Horizon2020.

Figure 3.25: Number of applications submitted in 2014-2020



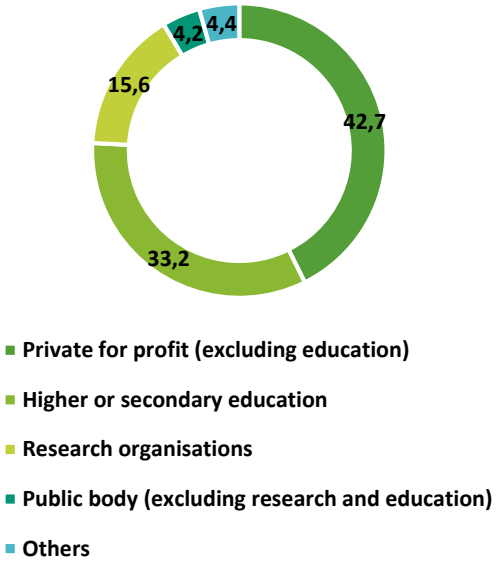
Source: Horizon2020.

The programme does not specify the amount provided for individual countries; instead, it evaluates applications based on individual merit. Even though Slovakia has participated in the programme, the number of submitted applications is below the average of the V4 countries and Austria, and far below the average of other EU member states. The EU net contribution made to Austria was over 1.7 billion, compared to 129.6 million euros in Slovakia, 647 million in Poland, 346 million in Hungary, or 459 million in Czechia. However, the success rate of Slovak projects (13.58%) was comparable to the success rate of both Austria (16,37%) and Czechia (15.4%). This evidence suggests that Slovakia's low amount of resources contracted from the Horizon2020 programme was not a result of poor quality of projects, but rather of small quantity of applications.

Horizon2020 does not specify the type of organization that can be the recipient of funding. In Slovakia 42.7% of overall received funding was received by private companies. Another 33.2% was allocated into higher or secondary education. This means that over the period of 7 years only around 40 mil. euros were invested in projects submitted by higher education institutions to support their research

and innovation activities. Finally, the public body and the public sector succeeded in receiving 15.6% of the overall contributions. Generally, these amounts are extremely low, and combined with the low level of national funding, they do not provide a good basis for research and innovation in Slovakia.

Figure 3.26: Share of EU net contribution in Horizon2020 projects by recipient type in 2014-2020 (in %)

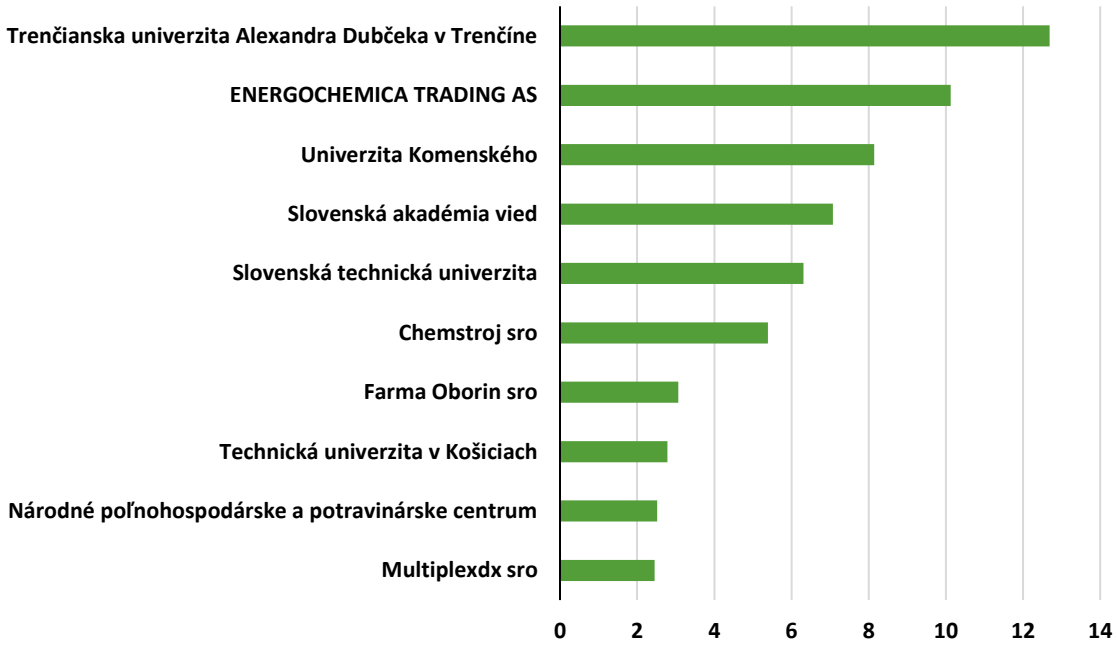


Source: Horizon2020.

Some applications and projects attracted more funding than others. The highest funding in Slovakia was received by Trenčianska univerzita Alexandra Dubčeka in Trenčín - a total of 12.69 mil. eur. Second highest rated recipient was a private company, Energochemica Trading A.S., which received over 10 mil. eur.

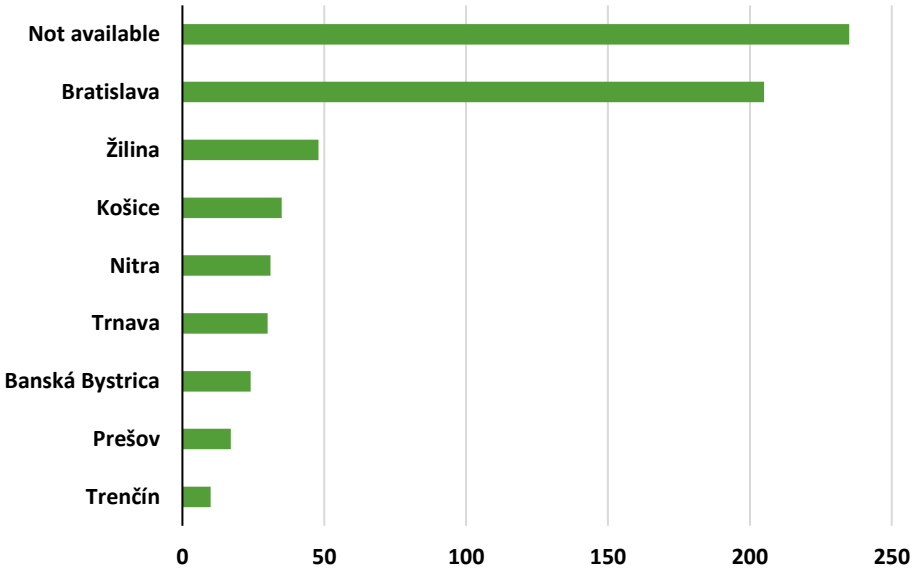
When looking at regional distribution, we can observe that Trenčín has had the smallest number of successful projects carried out within the Horizon2020 scheme. However, their overall net contribution was the third highest, as they managed to secure funding for some of the costliest projects. Otherwise, Bratislava is leading in the number of projects and the number of overall contributions, while Prešov secured less than 1.7 million eur.

Figure 3.27: Successful applications by recipient in 2014-2020 (in mil. eur)



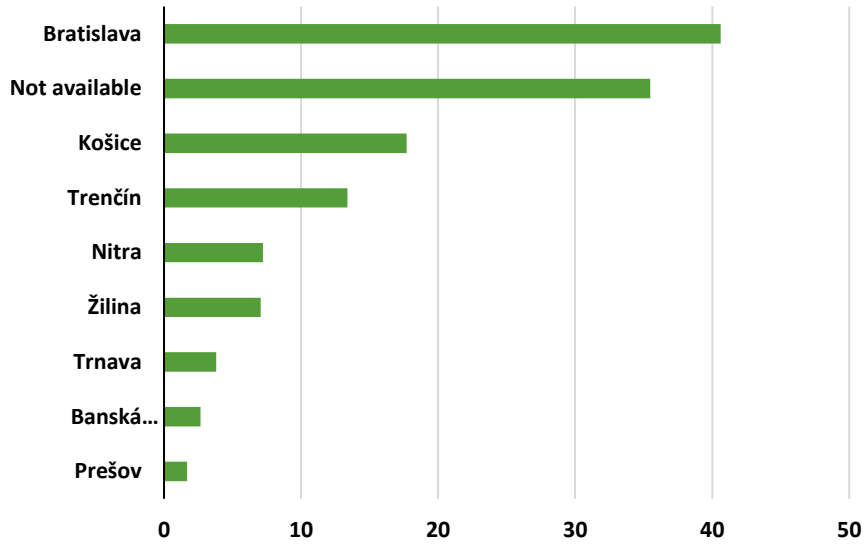
Source: Horizon2020.

Figure 3.28: Participation in Horizon2020 by Region in 2014-2020 (number of projects)



Source: Horizon2020.

Figure 3.29: Net EU contribution in Horizon 2020 projects by region in 2014-2020 (in mil. eur)



Source: Horizon2020.

The new framework created for innovation support is Horizon Europe with 85 billion euros available for innovative projects.

3.3.3 Venture Capital

Venture capital (VC) investment is becoming one of the key factors for small and young enterprises with high growth possibilities to reach their potential. The VC financing is an important element of stimulating innovation, but the data quality and availability for analysis is the main concern. The quality and availability of aggregate data on venture capital have improved considerably in recent years; international comparisons, however, remain complicated because of two main challenges:

- The first difficulty comes from the lack of a standard international definition of venture capital. While there is a general understanding, the definition of the types of investments included in venture capital varies across countries and regions. In some cases, differences are purely linguistic; in others, they are more substantive.
- The second problem relates to the diverse methodologies employed by data compilers. The completeness and representativeness of venture capital statistics with respect to the venture capital industry of a country will differ depending on how data were collected.

The indicators in this section are based on two sources:

- OECD Entrepreneurship Financing Database, where venture capital is made up of the sum of early stage (including pre-seed, seed, start-up and other early stage) and later stage venture capital. As there are no harmonised definitions of venture capital stages across venture capital associations and other data providers, original data have been re-aggregated to fit the OECD classification of venture capital by stages. OECD VC data

for Europe correspond to the aggregation of investment data according to the location of the portfolio companies, regardless of the location of the private equity firms. Data for Europe includes only venture capital investments (seed, start-up and later stage) by formal fund managers including private equity funds making direct private equity investments, mezzanine private equity funds, co-investment funds or rescue/turnaround funds. Investments by business angels, incubators, infrastructure funds, real estate funds, distress debt funds, primary funds-of-funds or secondary funds-of-funds are excluded.

- Dealroom proprietary data on the number and size of VC deals include pre-seed, seed, angel, series funding, growth funding, late-stage funding, and other, less conventional sources of funding such as media for equity and product crowdfunding. They exclude mergers and acquisition, initial public and coin offerings, and investments on more mature and established firms. The investment amount only captures the equity amount that is invested by formal fund managers and not the value of the entire financing round. Growth capital or buyout investments in current or formerly venture capital-backed companies are also not included.

The data availability for Slovakia does not allow us to provide the detail on various stages of VC financing. As it is possible to see from Table 3.3, there are approximately 5 VC deals per year.

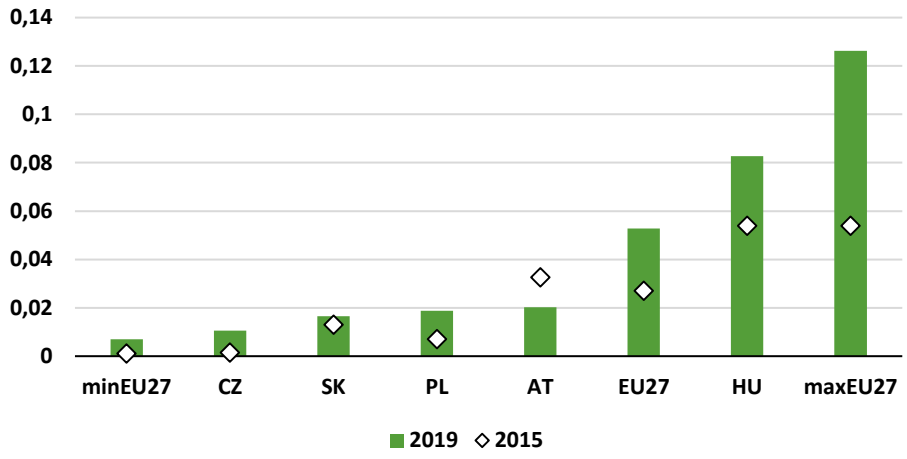
Table 3.3: Number of start-ups in the Dealroom dataset over period of 2015-2019

Country	*Start-ups*	*of which: received at least 1k Euro funding*
AT	590	149
CZ	339	57
HU	337	141
PL	1721	229
SK	99	24

Source: Dealroom dataset. Note: Number of start-ups correspond to firms founded in the country since 2015.

Figure 3.30 contains VC funding shares on GDP based on the OECD Entrepreneurship Financing Database. The amount of VC funding available for Slovakia and its neighbouring countries, except Hungary, is significantly smaller than in other parts of Europe. The overall size is less than half of the EU27 average.

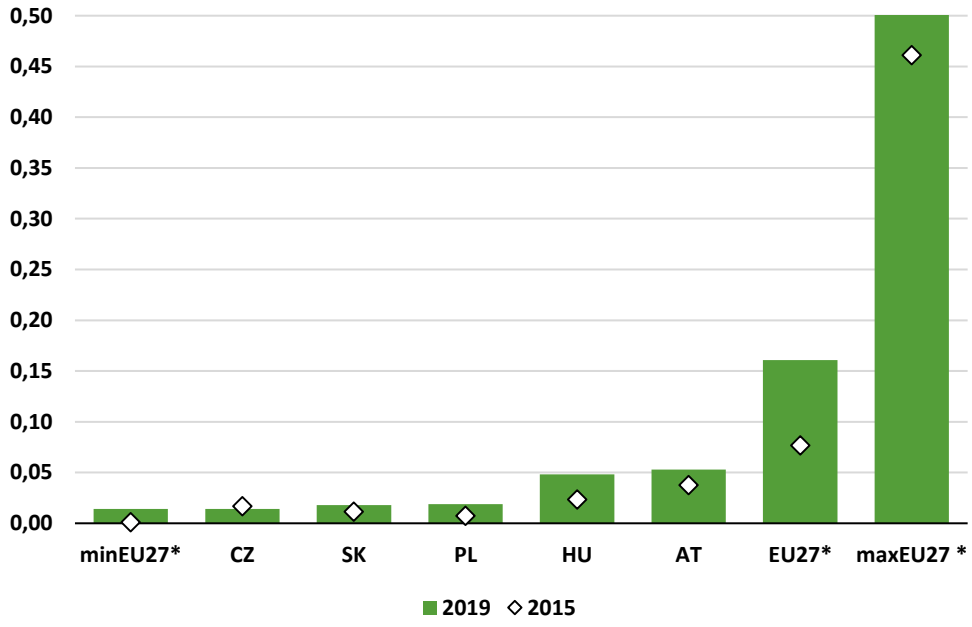
Figure 3.30: Venture capital financing share on GDP (in %)



Source: OECD Entrepreneurship Financing Database. Note: EU27 corresponds to weighted average of 27 EU member countries as of 2020. *EU27 data do not include Croatia, Cyprus and Malta plus Slovenia for 2019.

The differences become even more pronounced when using a different source of dedicated start-up data, the Dealroom dataset, which seems to have better coverage for Slovakia. Based on this dataset, Slovak firms in 2019 received nine times less VC funding than the EU27 average and compared to the best-performing country in this indicator, Sweden, more than 30 times less. But also, quite significantly lags behind other post-communist (Baltic) countries like Lithuania (0.32% VC share on GDP) or Estonia (0.3% VC share on GDP).

Figure 3.31: Venture capital financing share on GDP (in %)

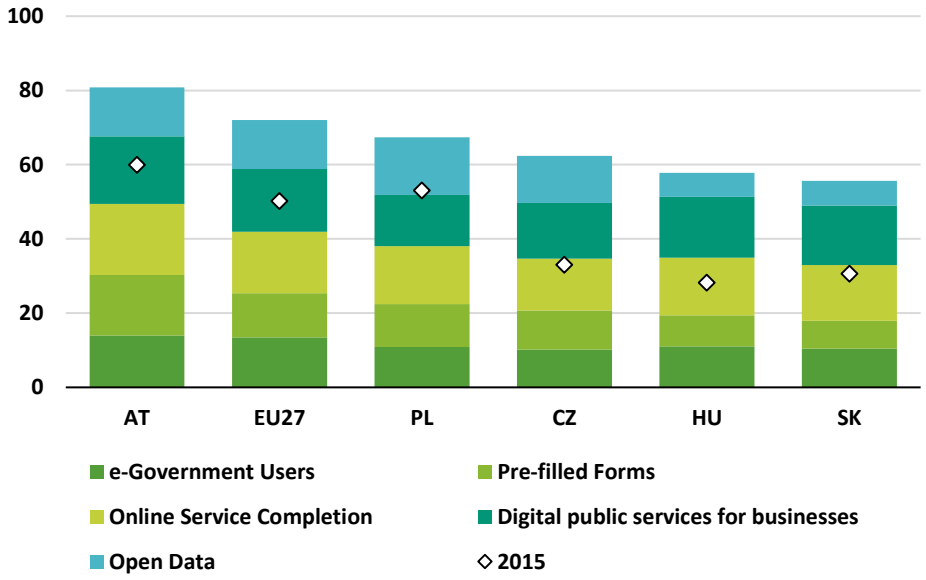


Source: Dealroom dataset. Note: EU27 corresponds to weighted average of 27 EU member states as of 2020. *EU27 data for 2015 do not include Cyprus.

3.4 E-Government

Digitalizing governmental institutions can reduce the time necessary for administrative tasks and is therefore extremely important in supporting smaller businesses. Slovakia has been underperforming in making administrative services available online, as well as in internet coverage across the country. The DESI index and especially its e-Government sub-dimension provides a complex evaluation of the e-Government performance. The index evaluates five categories from a perspective of individuals and businesses interacting with government and government data openness. Each item has an equal weight in the final index with a maximum value of 20. In 2020, the DESI index for Slovakia revealed limitations mainly in the categories of users, forms, and data openness. In the rest of the section, we will look at development in these categories in more detail.

Figure 3.32: e-Government sub-dimension ranking of the Digital Economy and Society Index in 2020 (in %)



Source: EC, (2020c). Note: EU27 corresponds to a weighted average of the 27 EU member states as of 2020.

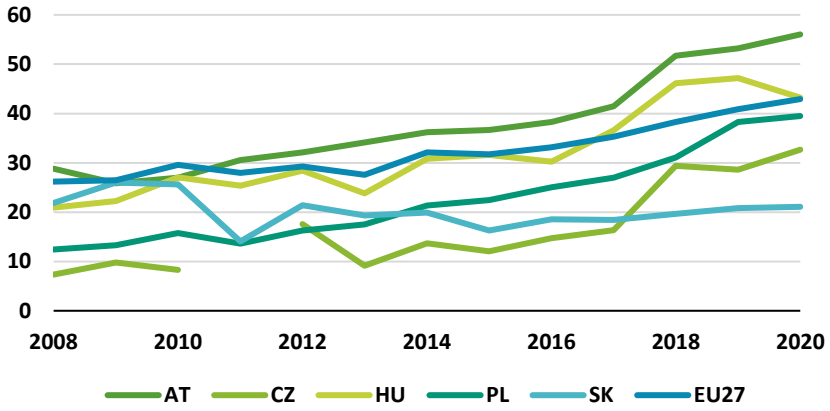
From the Eurostat's "ICT usage in households and by individuals" survey, we can obtain a more extended time series for both the e-Government users and the number of individuals submitting forms electronically. The OECD team filtered out individuals who did not use the Internet in the last year, assuming that they do not have the means or skills to use e-Government services. In Slovakia, both indicators' trends are not favourable. Compared to its neighbours, users' shares are either deteriorating or stagnating, which contrasts with other V4 countries, Austria and the EU average that have a growing trend.

The OECD's Open, Useful, Reusable Government Data index can reveal existing gaps in open government data policy and provide insights for future recommendations. The three pillars of the data index are based on the International Open Data Charter principles.[10] The first pillar, data availability, is based on the first two principles: open data by default; timeliness and comprehensiveness of open data. The second pillar looks at data accessibility, usability, comparability and interoperability. The third pillar encompasses data transparency and engagement with other governments, citizens and entrepreneurs. Each category has the same weight in the final index with a range from 0 to 33 points. Compared to its neighbours, the Slovak government scores lower in data availability. The government

[10] https://opendatacharter.net/principles/#open-by-default

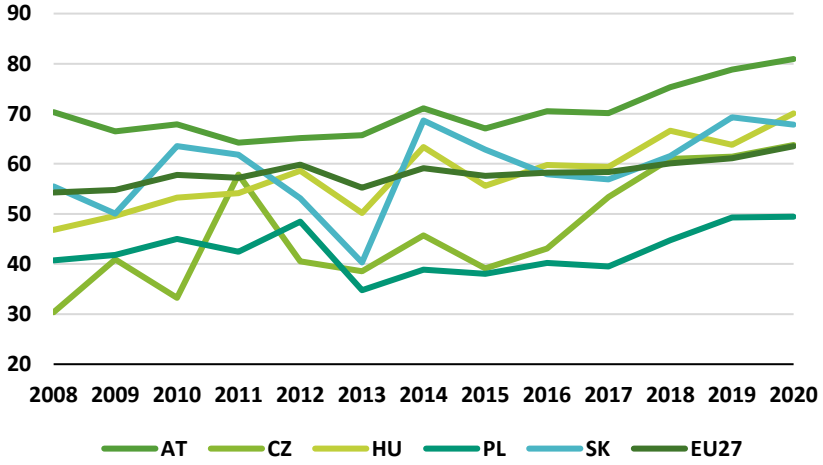
is also less pro-active in promoting the re-use of data both within and outside. When diving into this index's subdimensions, the lower rankings consistently stem from stakeholders' engagement for data release, quality and completeness, and the government's data literacy programmes. Other gaps are apparent in the implementation phase of the first pillar. Another potential issue is a low level of monitoring of the data re-use's impact, although it improved over time.

Figure 3.33: Individuals submitting completed forms to public authorities on the Internet, last 12 months (as a percentage of total individuals who used the Internet over the last 12 months)



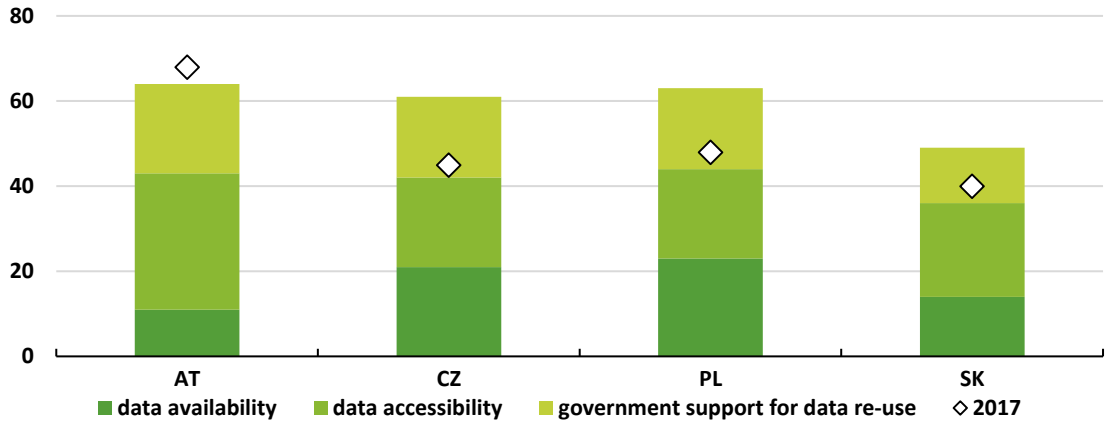
Source: Eurostat. Note: EU27 corresponds to a weighted average of the 27 EU member states as of 2020.

Figure 3.34: Individuals using the Internet to communicate with public authorities over the last 12 months (as a percentage of total individuals who used the Internet over the last 12 months)



Source: Eurostat. Note: EU27 corresponds to a weighted average of the 27 EU member states as of 2020.

Figure 3.35: Open Government data index in 2019 (in %)



Source: OECD's Open, Useful, Reusable Government Data OURdata index.

A country´s potential to innovate and to adopt innovations has become a decisive factor of its competitiveness on the global market. The ability to innovate has been closely linked to the eradication of economic, societal and environmental problems. However, Slovakia is still falling behind the EU average in this regard.

The underlying issue is lack of financing opportunities in Slovakia. However, this is not to say the available finances are necessarily insufficient. Slovakia falls behind in contracting finances that are made available via the ESIF, even if these are allocated specifically to the state. As a result, academia is stagnating with the quality of research and teaching, because it becomes problematic to attract high-quality researchers, due to universities´ inability to provide them with further funding.

Moreover, compared to other EU countries, investment into innovative business is low from both the public sector and VC groups. Mostly, there is insufficient support (financial and institutional) mainly for medium and small enterprises, thus making it difficult to motivate innovative start-ups to remain in the country. Potential innovators choose to establish their business abroad, contributing to the continuing brain drain, which is affecting the economy and the ability of the country to be competitive on the market.

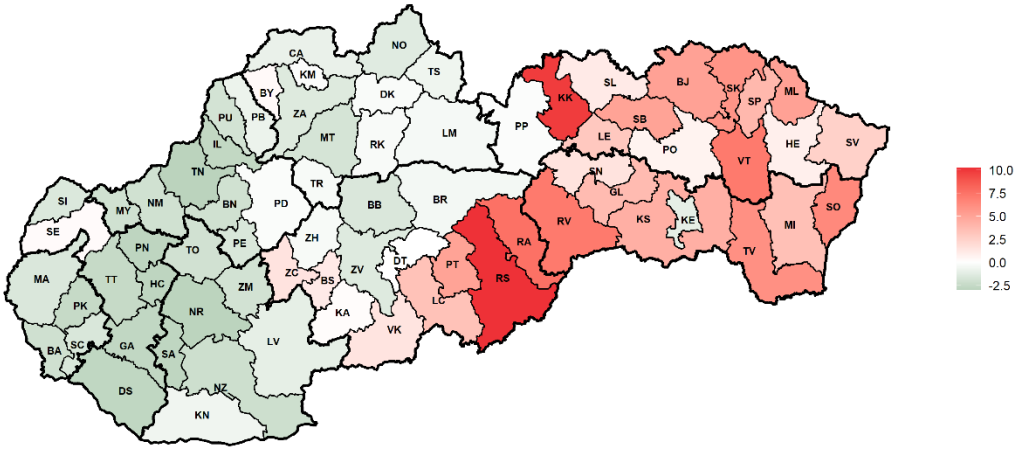
Enhancing financing opportunities by improving finance management in Slovakia could create an environment that would be favourable to not only academic research, but would also motivate the rise of the number of local innovative companies, leading to the overall improvement of Slovakia's productivity and competitiveness.

4. Regional disparities and regional policy in Slovakia

4.1 Regional unemployment and labour mobility

T Slovakia displays large regional differences in terms of the registered unemployment rate. Notice on Figure 4.1 that two clusters emerge among the Slovak districts. Districts located in the western and northern parts of Slovakia exhibit an unemployment rate below the national unemployment rate. On the other hand, districts located in south-eastern part of the country have high unemployment rates. Regional disparities have an impact on national productivity as high unemployment in some regions with a simultaneous shortage of labour force in others may lead to insufficient allocation of resources in the whole economy (Mičúch and Solčanská, 2018).

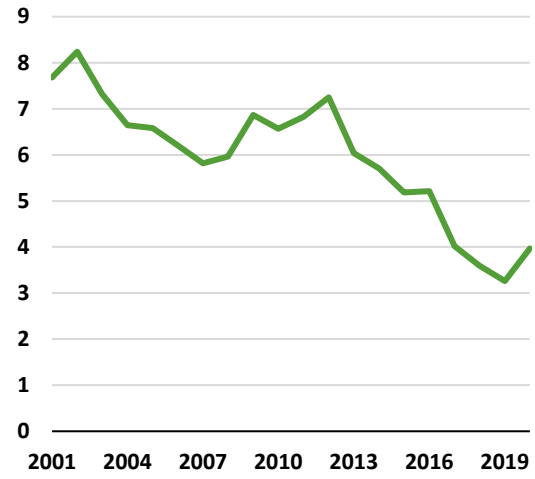
Figure 4.1: Difference between regional and national registered unemployment rate in Slovak districts in 2020 (in percentage points)



Source: UPSVaR.

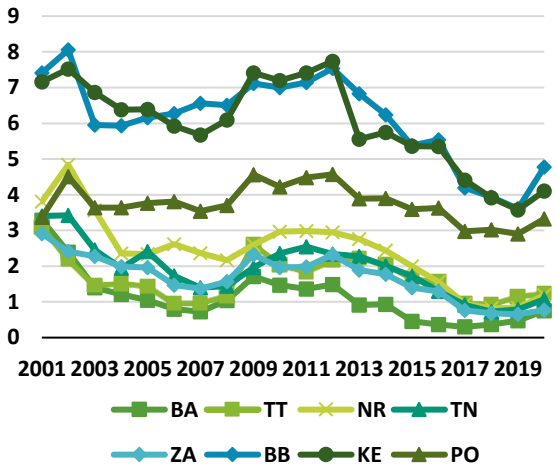
Good times help to decrease the disparities between Slovak districts. Figure 4.2. displays the convergence process in the unemployment rate among Slovak districts. In the long run, we can observe a decrease in regional differences, reaching the lowest point in 2019. Yet, the development of the convergence process in Slovakia is vulnerable to the business cycle of the economy, as it was dampened by the Great Recession and the subsequent recovery. Similar trend of reduction in districtual disparities can be seen within Slovak Regions, with an exception of the Prešov Region (Figure 4.3***Figure 4.3***). An interesting case is the Nitra Region, which exhibited the third highest disparities in the early 2000s, but due to an inflow of FDI now belongs to the Regions with the lowest disparities. In the case of the Košice and Banská Bystrica Regions, the high variation in unemployment rates may be caused by differences between the urban and rural districts, where the latter belong to the districts with the highest unemployment rates.

Figure 4.2: Development of districtual disparities in registered unemployment rate in Slovakia measured by standard deviation



Source: UPSVaR.

Figure 4.3: Development of districtual disparities in registered unemployment rate within Slovak Regions measured by standard deviation

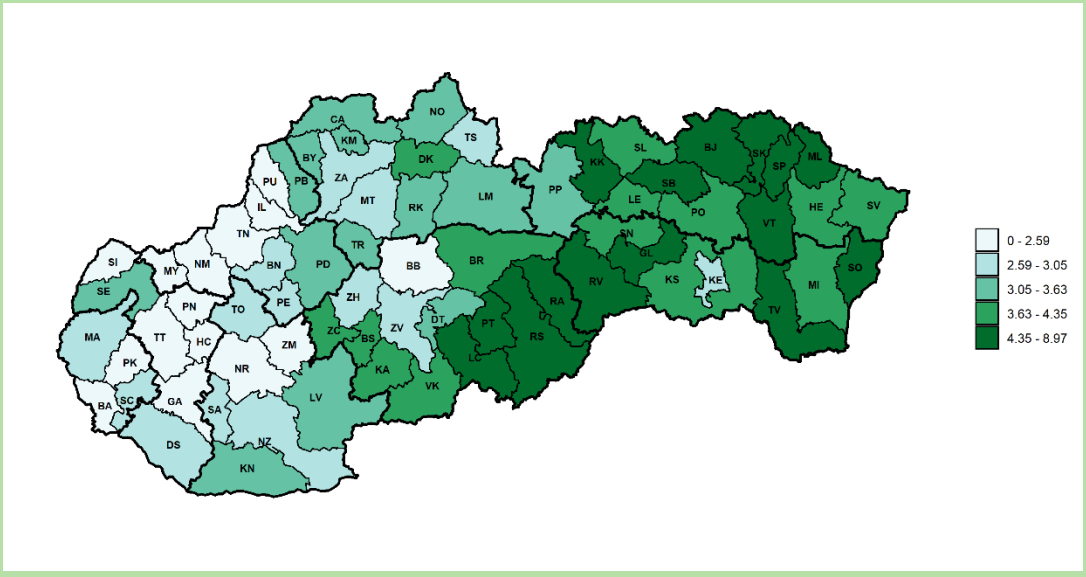


Source: UPSVaR.

Box 4.1: The COVID-19 recession and regional unemployment

The COVID-19 recession hit the regions unequally. Notice on Figure 4.4 that the regions with the highest increase in unemployment rate belong to the lagging regions. This led to a slight increase in disparities within Slovakia as well as within Slovak Regions (Figure 4.2 and Figure 4.3).[11] It is therefore imperative in the future to make regions less vulnerable to the business cycle.

Figure 4.4: Difference between districtual unemployment rates in 2020 and 2019 (in p.p.)

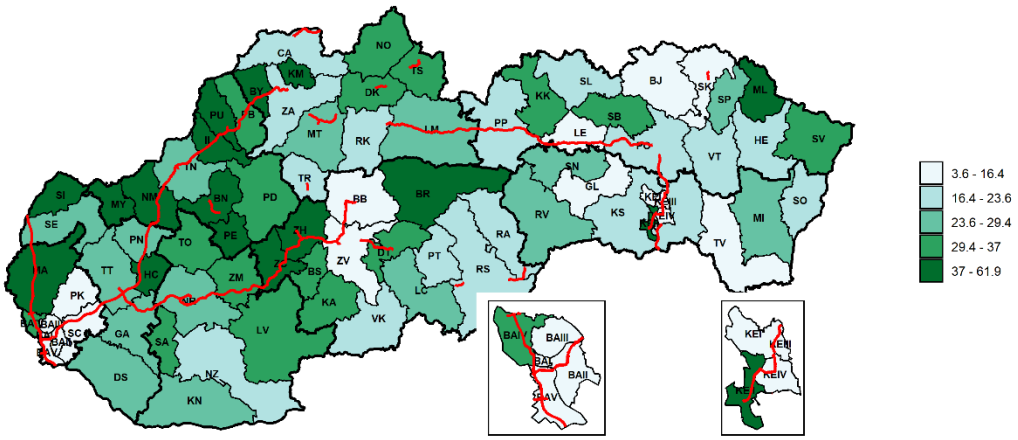


Source: UPSVaR.

[11] IFP (2021) show that the less developed regions display a lower vaccination rate. Hence, these districts are more prone to another wave of COVID-19 infections and non-pharmaceutical interventions, what may result in a further increase in regional disparities.

Resilience to the business cycle is associated with the economic structure of local economies. The relationship between the dynamics of the business cycle and development of regional disparities are found in several European countries. Bande et al. (2018) offer an explanation that more developed regions have a higher share of dynamic industries that are less affected by shocks and benefit from better technology and agglomeration effects. Figure 4.5 depicts the share of manufacturing sector on total employment on district level. Districts with a higher share of manufacturing are located mainly in the northwest part of Slovakia. Particularly, this manufacturing cluster includes the automotive industry, which forms the backbone of the Slovak economy. Although the specialization in manufacturing improved the development level of the districts in the northwest, this makes them more vulnerable to automation process in the future, as was noted in Chapter 3. On the other hand, the districts in the southeast of the country have a larger variety in their sectoral structure: urban districts are characterized by the prevalence of services, while some of the lagging regions have a larger share of persons employed in less productive sectors.[12]

Figure 4.5: Share of persons employed in manufacturing on total persons employed in a district in 2019 (in %) and highway network (in red)



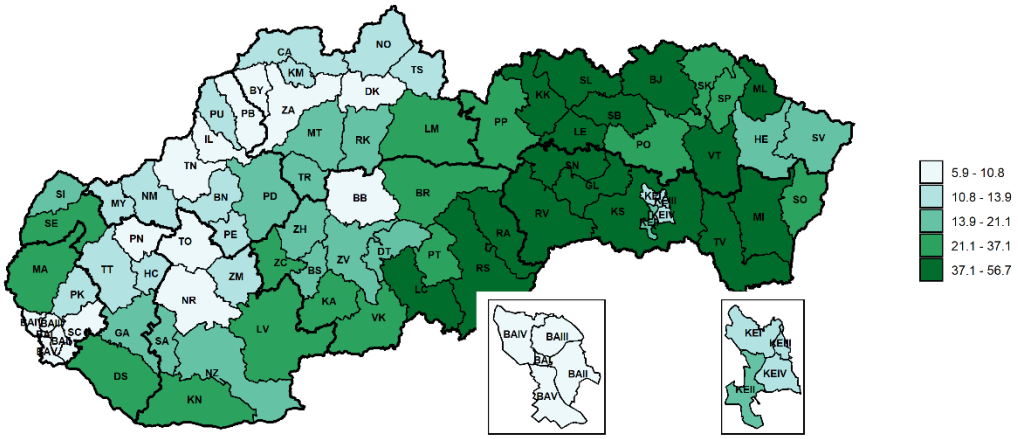
Source: Trexima and CDB.

East Slovakia has a less educated labour force. Figure 4.6 depicts the registered unemployed with primary education as their highest attained education as a proxy of educational level in a district. Observe once again a significant difference between the east and west parts of Slovakia. A significant portion of the marginalised Roma community (MRC) lives in districts with high unemployment rates. The participation of the MRC as well as their performance lags behind the general population (ÚHP, 2019), what might be one of the factors behind the disparities in attained education. Bednarik et al. (2019) compute that if the employment of the MRC would reach the level of the general population, Slovak GDP would increase by additional 12% by 2060. Thus, social integration of the MRC could help especially the districts in the east of Slovakia in catching up. To achieve that, it is crucial to increase the

[12] Detailed sectoral structures based on employment are in the appendix (Figure A.1, Figure A.2, Figure A.3, Figure A.4, Figure A.5, Figure A.7, Figure A.8 and Figure A.8)

participation of MRC in education from an early age. It is therefore helpful that the Slovak Recovery and Resilience Plan plans to implement measures that could make education more inclusive.[13]

Figure 4.6: Registered unemployed with primary education level as the highest attained education in 2020 (in % of all registered unemployed)



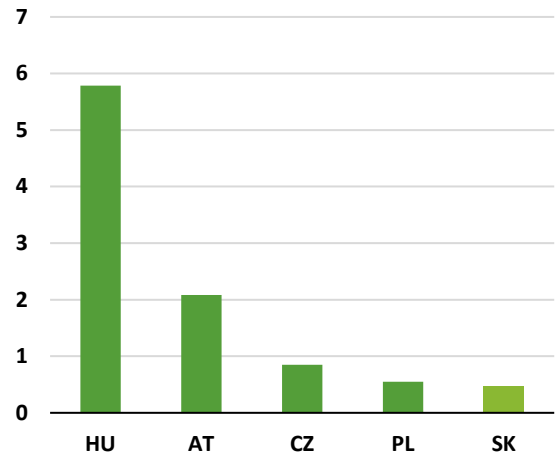
Source: UPSVaR.

Mobility of the labour force is another factor behind the regional disparities in the unemployment rate. Interregional mobility in Slovakia is quite low (Figure 4.7). Greater mobility could reduce the excess labour supply in the lagging regions and relieve the shortages in the west part of the country. In fact, Kubala and Peciar (2019) note that 40% of job vacancies in September 2019 in the western districts required only the attainment of the primary education level. That means that basically a significant portion of the unemployed from the east of Slovakia could have found a job in the west, if they were willing to move.

Developments in the housing market have a negative impact on labour mobility in Slovakia. According to Andrews et al. (2011) there is a negative relationship between home ownership and mobility of the labour force. The reason is that owning a dwelling induces higher transaction costs into moving to a different region. Ownership of a dwelling is high in Slovakia, with only Hungary having a higher level of ownership among nearby countries (Figure 4.8). This could be a consequence of privatisation of state and municipal-owned houses along with costly rents (ZBHS, 2016; Kubala and Peciar, 2019).

[13] An example is a state supported expansion of the Omama project, discussed in NPB (2020).

Figure 4.7: Annual flows between TL3 regions of country in 2015-2018 (in % of total population)[14]



Source: OECD. Note: Data refer to yearly flows of the population from one TL3 region to another TL3 region of the same country.

Figure 4.8 Distribution of type of ownership in 2019 (in %)

Source: Eurostat.

Several measures are needed to make rents more affordable. The construction of dwellings has slowed down in the last couple of years, accelerating the growth of real estate prices (Figure 4.9 and Figure 4.10). Kubala and Peciar (2019) recommend to redirect the investments made by the State Housing Development Fund from renovations to construction of new dwellings to increase the supply of dwellings. OECD (2020e) notes that often the tax system favours owning a dwelling to renting one, what could be changed by phasing out of various tax benefits provided to home owners. Increased transparency and liquidity in form of expediting price maps on street level, providing standard contracts for the sale of dwellings and shortening cadaster registration period could help to curb real estate and rental prices.

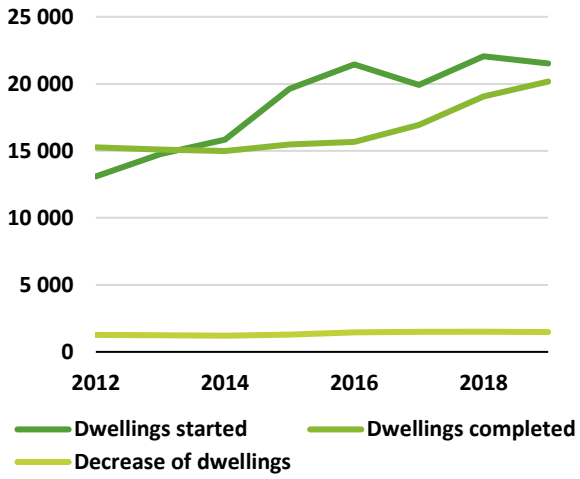
Mobility of the labour force is also influenced by the accessibility of regions. According to the transport performance index, developed by Dijkstra et al. (2019), Bratislava and its metropolitan area belongs to regions that are performing above EU average, while the rest of the country belong to the worst performers in the EU.[15] Notice on Figure 4.5 that while the industrial northwest is connected to the Trans-European Transport Network (TEN-T), the accessibility of the districts in the east is lagging behind.[16] This may be caused by a sluggish and cost inefficient construction of the highway network. Kovalčík (2017) recognized the lack of prioritization as one of the problems. Simultaneous work on several segments with a lack of prioritization resulted in an inefficient use of resources. An improvement here is the introduction of the methodology to determine the prioritization of investments in infrastructure published in autumn 2020 (ÚHP, 2020a).

[14] TL3 is a subnational classification of OECD. TL3 regions in Slovakia are the eight self-governing Regions of Slovakia (OECD, 2016).

[15] The index is calculated as a ratio of population of destinations that are reachable within 90 minutes of driving and population of destinations located within 120 km radius from a 1 km^2 grid.

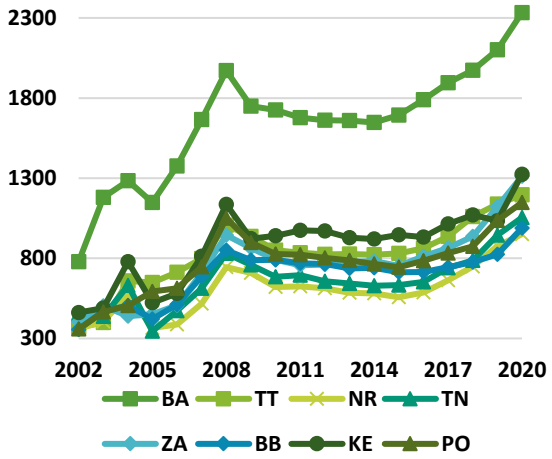
[16] In fact, Habrman and Žúdeľ (2017) note that a better accessibility helped these districts to overcome the shock of transformation into a market economy.

Figure 4.9: Dwelling construction



Source: Statistical office of the Slovak Republic. Note: decrease of dwellings denotes the number of demolished dwellings.

Figure 4.10: Development of real estate prices by regions (in eur/m^2)



Source: NBS.

The construction of a new highway should not be regarded as a panacea. The relationship between the increase in economic activity and the proximity of the highways stimulates public discussion on this issue. Yet, the results of previous studies (Habrman and Žúdeľ (2017), Mičúch and Tvrz (2015), Mikloš (2016) and Baláž et al. (2018)) are inconclusive. Fidrmuc et al. (forthcoming) use the opening of a new highway, the R1 from Trnava to Banská Bystrica, as a quasi-experiment to see the effect of constructing a new highway on unemployment rate of the municipalities in vicinity of the highway.[17] The highway was connected to the TEN-T network in two parts: Trnava-Nitra (R1) in 2000 and Nitra-Banská Bystrica (PR1BINA) in 2011. Notice on Figure 4.11 that while the highway reduced the unemployment rate in the municipalities in the vicinity of R1, it had the opposite effect on the municipalities near the PR1BINA segment. A possible explanation might be that building highways alone does not improve the economic situation of a region.[18] The opening of the R1 segment coincided with a period of economic policy aimed at attracting FDI. Shortly after the opening of this section, Peugot-Citroën decided to settle outside of Trnava. Hence, the improved infrastructure might have bolstered the spillover effects via production linkages in the region. On the other hand, the PR1BINA section was opened after the Great Recession, during a period with a rather passive economic policy.

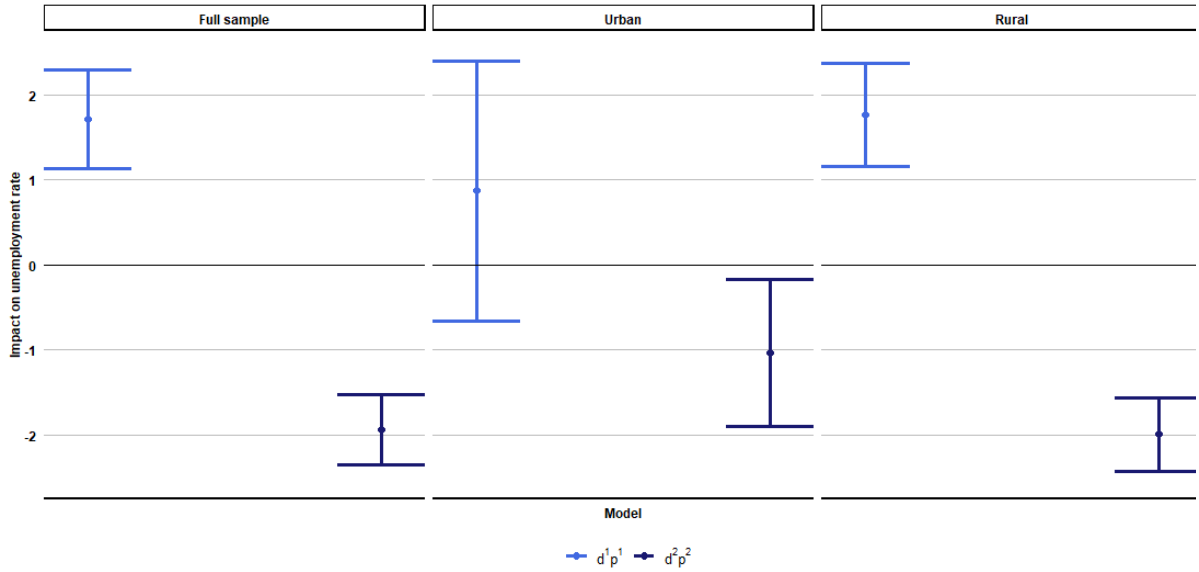
The results point out that building highways should not be considered as the main solution to the problem of regional disparities in Slovakia. Undoubtedly, Slovakia needs to build highways to increase the accessibility in the eastern part of the country. Yet, in order to attract investment and reduce

[17] Technically, the highway was designed as an expressway, however, the practical meaning of this differentiation has become obsolete.

[18] The contrary of this argument is appealing to decision makers, as, due to its tangibility, construction of a highway in a region with economic problems might please the voters more than a basket of reforms, the effect of which takes time to show its effect.

unemployment, construction of highways needs to be complemented by a complex regional policy. Furthermore, the cost efficiency of planned segments should be also considered.

Figure 4.11: Impact of a new highway on unemployment



Source: Fidrmuc et al. (forthcoming). Note: The figure displays the coefficients of interest and their confidence intervals, detailed results are in the appendix (Table A.1). d^1p^1 and d^2p^2 correspond to the impacts of R1 and PR1BINA respectively.

Box 4.2: Methodology applied in Fidrmuc et al. (forthcoming)

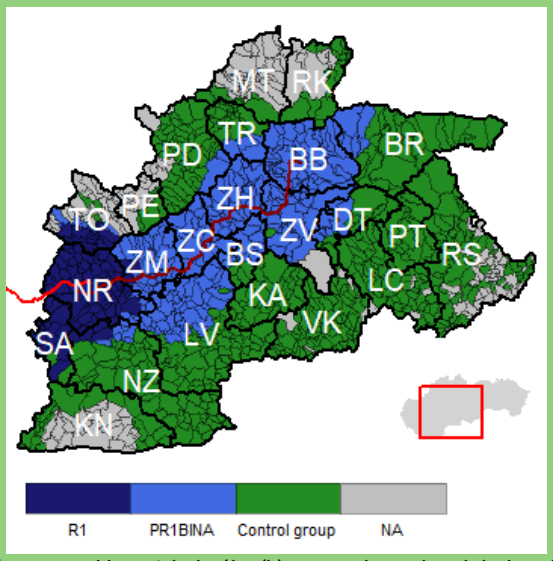
For the evaluation of the impact of a new highway on unemployment rate, the authors compare the municipalities in vicinity of the highway to the more distant ones using data from 1996 to 2019. The authors define proximity as the distance below 30 kilometres from the centroid of the municipality to the nearest exit of Trnava-Nitra segment (d_{it}^1) and Nitra-Banská Bystrica section (d_{it}^2) by roads other than highways. Figure 4.12 displays the treatment and the control groups of the analysis with the grey area on the figure representing municipalities that were excluded either due to the closeness to other highways or having extreme unemployment rate values. The method of difference in differences applied in the analysis has the following form:

$$u_{it} = \beta_0 + \delta_1 d_{it}^1 + \delta_2 d_{it}^2 + \delta_3 p_{it}^1 + \delta_4 p_{it}^2 + \delta_5 d_{it}^1 * p_{it}^1 + \delta_6 d_{it}^2 * p_{it}^2 + \sum_{j=1}^{J} \beta_{ijt} x_{ijt} + \alpha_i + \tau_t + \varepsilon_{it} \quad (1)$$

where y_{it} represents the unemployment rate in a given municipality. The first row represents the two treatment groups (d_{it}^1, d_{it}^2) and treatment periods (p_{it}^1, p_{it}^2), with the interactions denoting the impact of the highway on the municipalities in its proximity. Moreover, x_{ijt} denotes J socio-economic control variables (population density, average age of population and migration balance). The last line consists of individual and fixed time effects (a_i and τ_t) and the residuals (ε_{it}). The analysis was conducted on the full

sample as well as separately on urban and rural municipalities. This differentiation was inspired by the "inconsequential unit approach" that is used in some studies to deal with potential endogeneity (Redding and Turner, 2015).

Figure 4.12: Municipalities surrounding the R1 route



Source: CDB and Open Street Map (processed by Michal Páleník). Note: the red and dark red lines represent the R1 and PR1BINA segments, respectively.

4.2 Regional policy

Slovakia is a strongly centralised country. Observe on Figure 4.13 that the Slovak subnational expenditure and revenue, as proxies of fiscal autonomy within a country, are lagging behind the EU as well as neighbouring countries. The subnational responsibilities are split between the eight self-governing regions and 2 927 municipalities without a hierarchical structure.[19] The revenue of the subnational governments depends on earmarked grants from the national level, with local taxes on property (municipalities) comprising only a small portion of their revenue as well as a small portion of overall tax revenue (OECD, 2014).[20] Moreover, Slovak municipalities are fragmented, leading to further inefficiencies. Černenko et al. (2017) point out that 90% of Slovak municipalities have less than three thousand inhabitants (Figure 4.14). They show that municipalities with less than 250 inhabitants spend more than half of their budgets on administrative costs and due to low wages cannot attract employees of higher quality or provide adequate services.

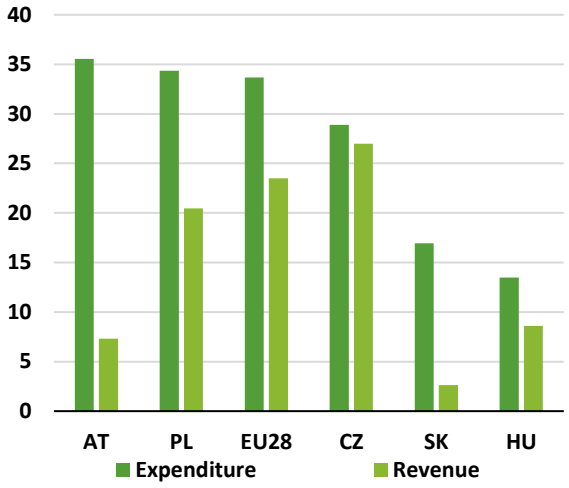
A reform of the subnational self-governing entities is desired. OECD (2014) note that increasing the autonomy on the subnational level by reducing earmarked transfers might help the subnational governments to better address the local preferences and needs. Merging less effective municipalities

[19] The municipalities are responsible for pre-school and primary education (wages and expenditure), social welfare, housing, economic development and local utilities (water, waste collection); while the regions are responsible for secondary, professional and vocational education, health, social welfare, transport and regional economic development.

[20] A full list of taxes that make up the revenue of subnational entities is listed in the Law of local taxes ("Zákon o miestnych daniach a miestnom poplatku za komunálne odpady a drobné stavebné odpady", 582/2004 Z. z.), available at: https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/582/.

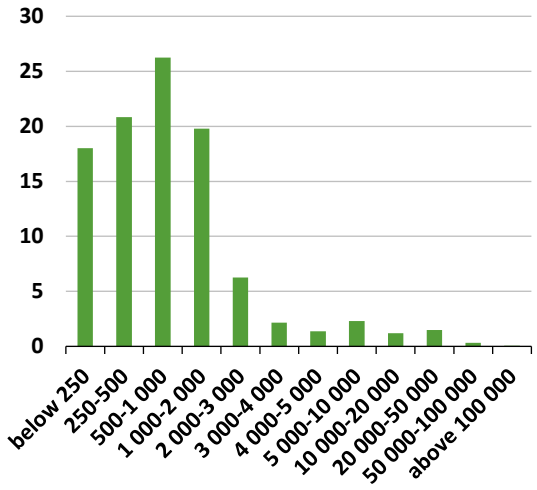
could also help to improve the subnational level. Černenko et al. (2017) calculate that this could lead to savings up to 316 million euros. Consequently, municipalities could increase the quality of services provided to their inhabitants and investments into the development of the municipalities, such as construction of kindergartens or elderly care facilities. Also, some of the savings could be used in increasing the salary of the officials, what could attract higher-skilled employees.

Figure 4.13: Subnational expenditure (in % of total public expenditure) and subnational tax revenue (in % of public tax revenue)



Source: OECD (2020).

Figure 4.14: Municipalities categorised by number of inhabitants (in % of all municipalities)



Source: Černenko et al.(2017).Note: the boroughs of Bratislava and Košice are excluded, resulting in the total number of 2920 municipalities.

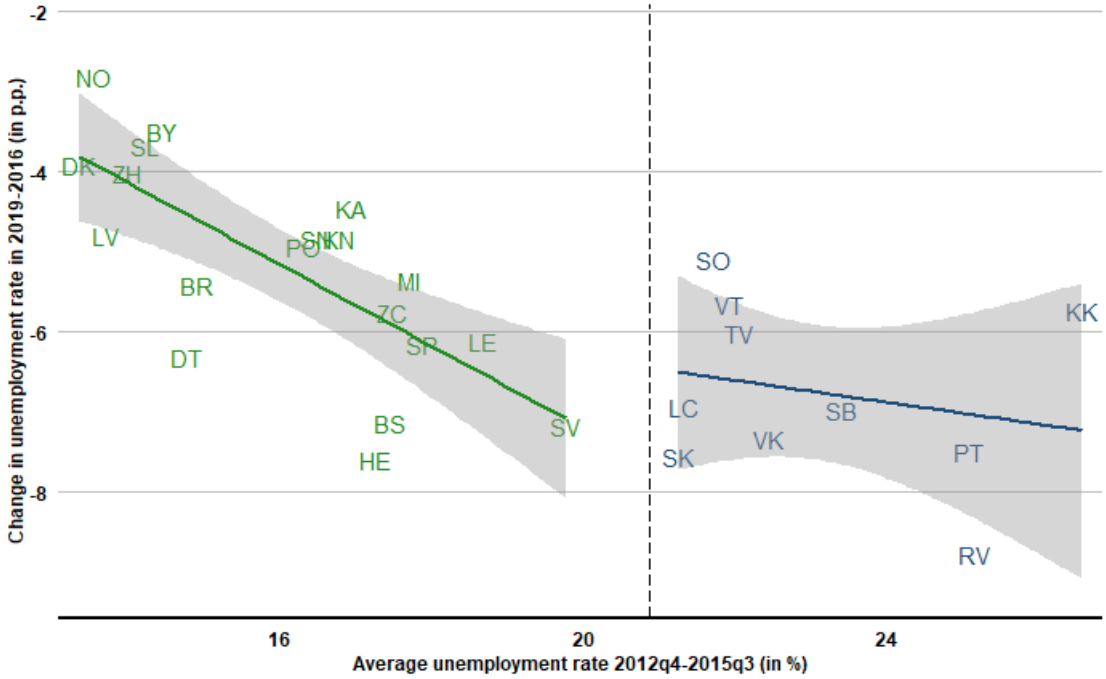
Slovak regional polices are mainly aimed at reducing regional disparities. A flagship policy is the least developed districts (LDD) policy. It was designed to provide subsidies to the districts with the highest registered unemployment. At the beginning of the policy in 2016, 12 districts were fulfilling this criterion.[21] These were later joined by 8 more districts in the subsequent years (see Box 3 for details). After joining the LDD, the district council, supervised by the authority in charge of the regional policy on national level, had to develop an action plan that would list the priorities to be financed from the policy in the given district.[22] After the approval of the action plans, subjects of regional cooperation (self-governing regions, municipalities, NGOs and regional agencies) as well as firms could apply for the funds.

The LDD policy did not significantly reduce unemployment. Figure 4.15 and Figure 4.16 depict the impact of the LDD on the unemployment rate and share of long-term unemployed in its first beneficiaries. Observe that although both indicators declined faster in the light of economic expansion

[21] The total number of districts in Slovakia is 79, from which 9 are the boroughs of Bratislava and Košice.
[22] The supervising national entity changed from the Ministry of Transport and Construction to the Government Office in 2016. Two years later the supervision authority switched to the Vice-Prime Minister's office, which became the Ministry of investments, regional development and informatization following the 2020 elections.

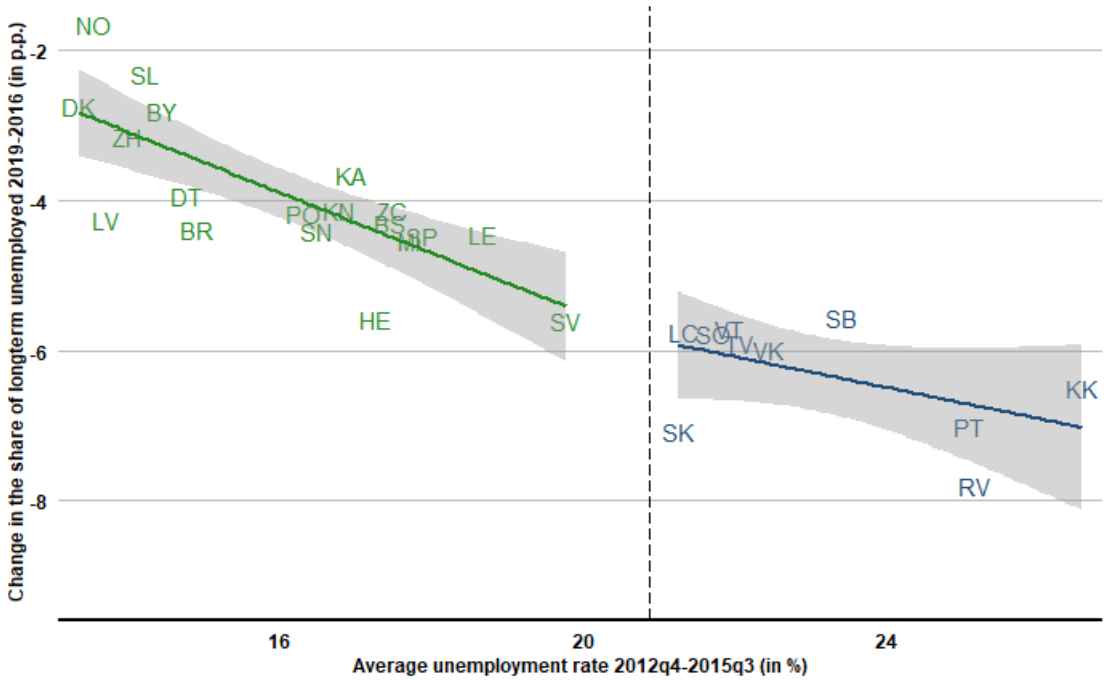
in the LDD, there is no significant shift at the threshold. Thus, the policy did not help much to solve the unemployment problems of the LDD.

Figure 4.15:Impact of the LDD policy on changes in registered unemployment within 7.5 p.p. of the threshold.



Source: UPSVaR. Note: More detailed results for this as well as other bandwiths are reported in the appendix (Table 2).

Figure 4.16: Impact of the LDD policy on change in share of longterm unemployed on total registered unemployed within 7.5 p.p. of the threshold



Source: UPSVaR. Note: More detailed results for this as well as other bandwiths are reported in the appendix (Table 3).

Box 4.3: Methodology applied to evaluate the LDD

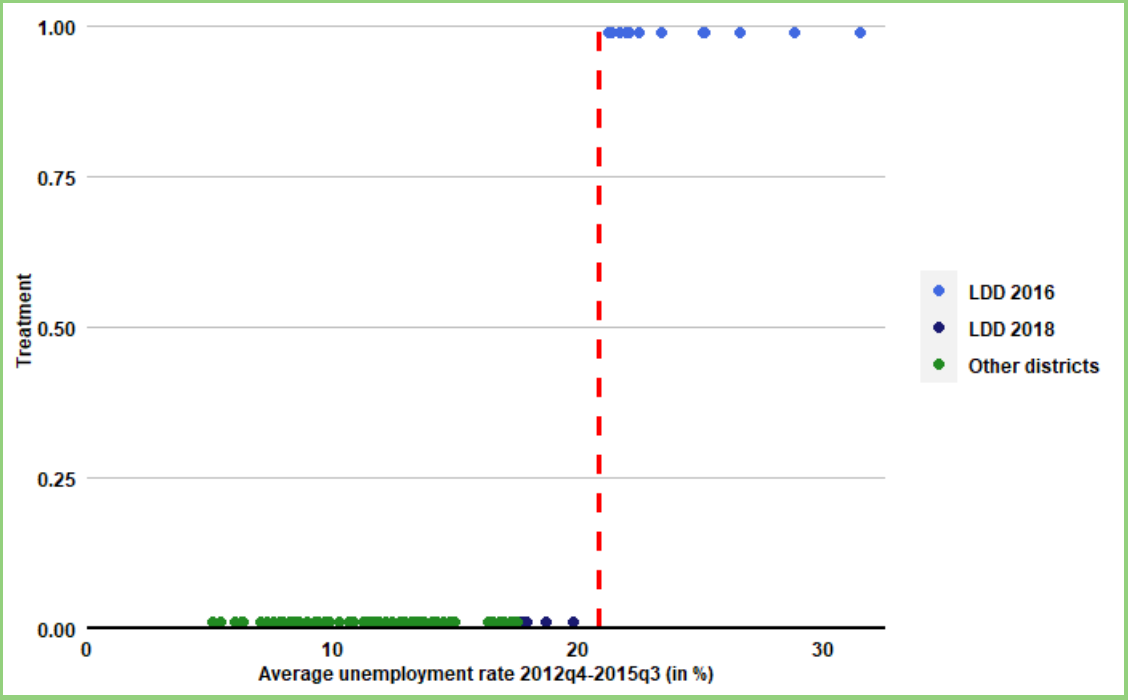
The districts joined the LDD club in three waves:

- 2016: LC, PT, VK, RS, RA, KK, SB, SK, VT, RA, SO, TV
- 2017: GL, BJ, ML
- 2018: KS, LE, SV, SP, MI

In the analysis of the LDD, we evaluate the first wave as sufficient time has passed to see an effect. We took advantage of the fact that there is a criterion of having an unemployment rate that exceeds the national rate by a multiple of 1.6 in 9 out of 12 consecutive months. This allowed us to implement a sharp non-parametric regression discontinuity design (RDD) with the threshold calculated as the 1.6 multiple of the average national unemployment from fourth quarter in 2012 until third quarter in 2015. Although our augmented criterion is slightly different than the official one, the probability of inclusion in the LDD is not affected (Figure 4.17).

The other two groups create a sort of a conundrum whether or not they should be included in the sample for the control group. Here, we use the fact that there was a delay between the admission of a district to the LDD club and the approval of the action plan that included planned projects (around 233 days on average). Even though this delay was still not enough to include the second wave in the control group, it was sufficient to keep the districts that became LDD in the third wave. Furthermore, the exclusion of these regions would result in a less observations in the control group in the neighborhood of the threshold (Figure 4.17).

Figure 4.17: Probability of inclusion in the LDD



Source: UPSVaR.

The RDD looks as follows:

$$\Delta u_i = \beta_0 + \delta_1 u_i + \delta_2 d_i + \sum_{j=1}^{J} \beta_{ij} x_{ij} + \varepsilon_i \quad (2)$$

where the dependent variable is the change in the unemployment rate between 2016 and 2019. Alternatively, we also use the change in the share of long-term unemployed (more than 12 months) on total unemployed persons in the same time period as the dependent variable. As independent variables, we have the criterion that determined the allocation of regions to the LDD (average unemployment rate from fourth quarter in 2012 until third quarter in 2015, denoted as u_i) and the treatment dummy (d_i), equal to 1 if a district is an LDD and 0 otherwise. Lastly, our model includes socioeconomic control variables (log of the average wage, migration balance, proportion of persons with tertiary education among the registered unemployed and driving time from the largest city in the district to Bratislava) with the values from 2015 and the error term. We compute the model for several bandwidths: 5 p.p., 7.5 p.p., 10 p.p. as well as the whole sample.

The LDD policy was ineffective. Mitrík (2021) names several aspects of the policy that were quite weak. Most importantly, the policy lacked mechanisms that would guarantee the use of funds for the purpose of creating sustainable jobs. He notes that the primary use of the funds by the municipalities, the main beneficiaries of the policy, was improving infrastructure and other needs that do not necessarily bolster employment. Although the projects were required to include the number of jobs that were planned to be created, there was no monitoring of the actually created jobs. Furthermore, the beneficiaries faced an overcomplicated administrative procedure before having a project approved, leading to a sluggish absorption rate of the funds. Consequently, Mitrík (2021) mentions that the municipalities were pressured to spend the funds quickly rather efficiently.

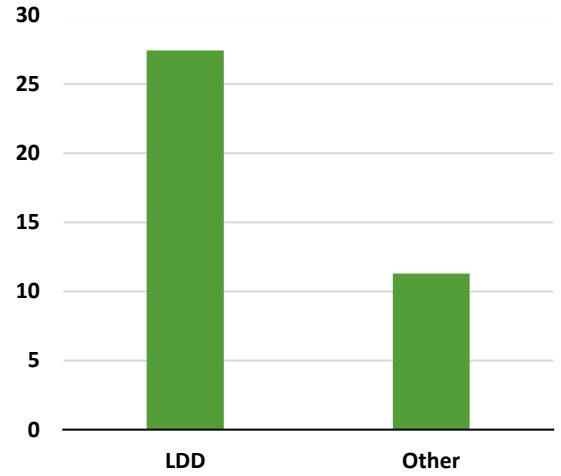
ESIF constitute another major source of funds to support the catching up of regions. With the exception of the Bratislava Region, the Regions receive a sizable amount by belonging to the less developed region of the EU.[23] Yet, due to the strong concentration of economic activity in Bratislava, around 66% of ESIF end up drawn by beneficiaries from the Bratislava Region (Bobovník and Harňák, 2020). An explanation might be that contracted companies from Bratislava could use their employees rather than the local labour force at the realisation site of the project, thus dampening the impact of ESIF outside of Bratislava and therefore also the convergence process.

Another instrument of the regional policy is the regional investment aid. The aim of this policy is to support the foreign and domestic investors as well as SMEs with subsidies for job creation or procurement of a new property or in the form of a tax relief in order to help disadvantaged regions. In their analysis of the regional investment aid, Ivan et al. (2018) point out that it was not successful in reducing the regional disparities as only around 22% of the funds distributed in 2016 and 2017 were drawn by investments in the LDD. Since then, the situation has improved to around 40%, and in fact in per capita terms more regional aid is invested in the LDD (Figure 4.18). The authors further point out that most of the funds were spent to support subjects from the manufacturing sector, prominently the automotive industry, while only a small portion was spent in the science and technology sector. They

[23] The criterion for being a less developed region is having GDP per capita in PPP below the 75% of the EU average.

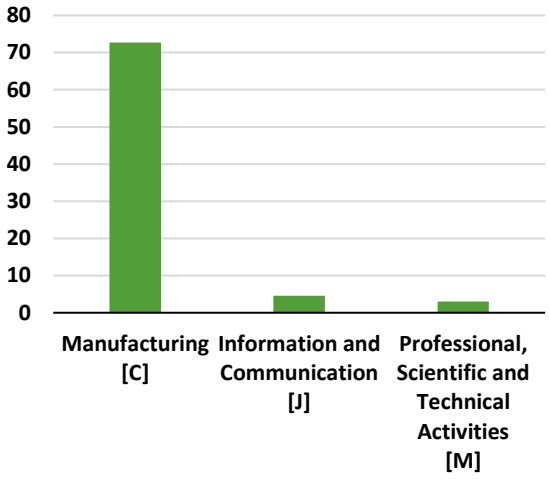
note that according to the economic policy plan of the Ministry of Economy, the goal is to support more innovative applicants. However, Figure 4.19 shows that a shift towards more innovative industries has not yet taken place.

Figure 4.18: Investment aid invested in LDD in 2018-2020 (eur per capita)



Source: Ministry of Economy.

Figure 4.19: Share of investment aid by sectors in 2018-2020 (in %)



Source: Ministry of Economy.

Box 4.4: Examples of best practices

An inspiration for regional policy could lie in the Swiss New Regional Policy (NRP). NRP was launched in 2008 in order to promote competitiveness in rural, mountainous and border areas. Like the multiannual financial framework of the EU, the NRP is structured in multi-year periods with a focus on a more specific aspect, such as the innovation in SMEs in 2016-2023, defined by the federal government. Furthermore, there is a synergy between the NRP and sectoral policies. The cantons, in cooperation with regions, then design projects that are to be implemented. Importantly, the funding of the projects is split between the federal level and the cantons. So far, the NRP has generated sustainable jobs (Regiosuisse, 2017; OECD, 2016).

The Finnish Proactive Structural Change programme promotes evidence-based policy. With the use of an analytical framework that quantifies the sensitivity of a region to structural shocks based on characteristics of a given region. The goal of the policy is to find weakness and opportunities of a region and with the help of various stakeholders devise measures for orientation of regional economies (Hautamäki and Vesasto, 2013; OECD, 2016).

The regional policy in Slovakia needs to be redesigned. Although there is a concept of the regional policy, the implementation of it is poor. OECD (2016) note that countries should concentrate more on boosting the productivity of all regions rather than only the disadvantaged ones. In the context of Slovakia, this could denote that LDD would not be a separate policy, but rather a part of the regional investment aid. Regional investment aid could be altered to consider the challenges of all regions. This includes, for instance, changes needed in the sectoral composition in the districts in the northwest and southeast of Slovakia to reduce the risk of job loss from automation and a shift from less productive sectors to sectors with a higher value added, respectively. The east of the country could further benefit

from policies aimed at improving the quality of the human capital. The LDD itself could be improved by including the largest cities in the east in the policy. Supporting the ICT sector along with scientific activities in Košice could have spillover effects on the surrounding regions. In fact, a regional ICT cluster, Košice IT Valley, has been established in 2007. It enables cooperation between educational institutions, ICT companies and regional governments. However, according to OECD (2014) it lacks support from the national government. Incorporating the support of Košice IT Valley into the regional policy could thus help to reduce regional disparities. It should be noted that it is important to engage stakeholders, such as local companies, in the redesign of the regional policy.

Conclusion

The Report on productivity and competitiveness of the Slovak Republic 2019 pointed out the main strengths and weaknesses of our economy since the country's transition to a market economy. The successes thus far were compared to low-hanging fruit, as Slovakia reaped the benefits of an attractive geographic location and cheap labour force to become the assembly plant for more developed countries. We proposed that in order to now reach for fruit on higher branches, ambitious reforms are needed.

The need for these reforms was amplified by the COVID-19 pandemic and the associated recession which exacerbated many long-term processes. As a result of the non-pharmaceutical interventions designed to curb the spread of the virus, the economy headed for a downturn, with a contraction of GDP by 4.8%. Consequently, measures taken to support the economy and the loss of revenues due to the recession amounted to 5.4% of GDP, resulting in a deficit of 6.2% of GDP (MF SR, 2021) (see more in Section 1.1).

The COVID-19 recession highlighted the dependence of the Slovak economy on the automotive sector. This heavy reliance resulted in a decline of industrial production to historically low levels, which presented the greatest drop among EU countries. The risk of automation of labour in this industry constitutes a major risk factor for the future development of the Slovak economy, as it leaves almost 30% of jobs at stake (see more in Sections 2.1 and 3.1).

On a positive note, the labour market was resilient to the economic slowdown due to government-financed furlough or "kurzarbeit" schemes. The total employment figures in Slovakia decreased by 1.9% from 2019 to 2020 (although regional disparities widened), while the decline in hours worked was more than fourfold, at 8.8% (see more in Section 1.3).

The lag of the productivity and competitiveness of the Slovak economy is growing. One of the identified warning signals in the 2019 Report was the slowed-down labour productivity growth without growth of labour costs following suit, which could lead to a loss of competitiveness (as elaborated on in Section 1.3). Indeed, Harmonized Competitiveness Indicators show a loss of Slovak competitiveness in 2020, as well as a greater increase in Slovak price levels compared to our trading partners (Section 1.2). Most alarmingly, there are presently only 6 countries out of the evaluated 63 that are considered less competitive than Slovakia in the IMD World Competitiveness Ranking. Likewise, Slovakia's readiness for transformation into a modern and resilient economy is a matter of concern, as it is classified as the worst performer in the region according to the World Economic Forum (2020).

Even before the COVID-19 pandemic, children from socially disadvantaged and Roma families achieved significantly worse results than other children. The pandemic exacerbated these socio-economic disparities, when school attendance was replaced by independent computer work and online home-schooling. Compared to 95% of children from ordinary households, only 52% of children from poor, and 40% of children from Roma households have access to online teaching and study materials. In addition to affecting children's education and social skills, school closures also have a significant impact on their future economic situation and earnings (see more in Section 2.3.). Evidently, investments and reforms in education are vital for the upgrading of the Slovak economy. The Slovak Recovery and Resilience Plan offers a chance to fulfil these needs.

While children were out of school, many parents found themselves incapable of working due to lack of space, technological devices or having to dedicate more time to their children´s education. On the one hand, rapid implementation of home office arrangements due to the pandemic has undeniably accelerated the digital transformation of the work life. On the other hand, according to EU Digital Economy and Society Index, Slovakia has the lowest share of jobs that can be performed from home compared to neighbouring countries, revealing the unpreparedness of our economy for the digitalization megatrend (see more in Section 2.3.2).

Even though there have been calls to transform Slovakia from an "assembly line" to an innovative economy, there has not been a significant improvement in the innovation environment since 2012. The main underlying problems are insufficient funding and exaggerated bureaucracy connected to funding of R&D (see more in Section 3). These problems further result in extensive brain drain (Section 3.2.1), inability of Slovak research centres to attract talent from abroad, low-quality higher education institutions and lack of innovative companies, products and processes. On a positive note, the Slovak labour market shows signs of upskilling, where the number of working persons with tertiary education over the last 12 years almost doubled (Section 3.2.2), although many such graduates are not able to secure jobs corresponding to their level of education upon completion of their studies.

Regional disparities in Slovakia are relatively high. The existing regional policy is ineffective in dealing with the reduction of disparities, even though the catching-up of the less developed regions belongs to its main goals. Hence, a redesign of the policy that can be inspired from best practices elsewhere is needed. The new policy should reflect the different needs of Slovak regions: risk of automation in western Slovakia and a move to more productive industries in the east. Districts in the southeast of Slovakia suffer also from low level of accessibility and human capital (Section 4). Thus, these regions would benefit from educational reforms and a cost-efficient completion of highways that would connect these regions to the TEN-T network. Finally, a housing policy that would make rents of dwellings more affordable is called for to facilitate labour mobility.

The 2020 Report identified the main trends in the economy resulting for the COVID-19 pandemic, as well as barriers that could hinder future economic growth. A common element between most crises is that they tend to bring about significant changes in the economy and create a "new normal". This can be an opportunity to bring Slovakia back on track in terms of productivity growth and convergence. In this Report, we suggest to redesign policies in specific aspects of the economy, so as to minimize the negative impacts of the crisis and maximise the transformative potential. Some of the presented suggestions for improvements include funding of more innovative R&D projects, re-skilling the workforce in order to satisfy future market demands and avoid increase in unemployment, supporting the digitalization of the country, and improving the technological infrastructure of education institutions. All of these measures would increase the resilience of the economy to external shocks, such as the COVID-19 pandemic. Furthermore, we continue to emphasise the importance of evidence-based policy making, which increases the reliability of newly implemented policies. Many of the changes suggested in this Report are in close alignment with the Recovery and Resilience Plan of the Slovak Republic. While the effectiveness of its execution remains to be seen, the Recovery and Resilience Plan, along with the European Structural and Investment Funds in the next programming period, offer a promising starting point for building a more resilient and competitive Slovak economy in the post-covid era.

List of figures

List of tables

References

Adalet McGowan, M., Andrews, D. and Millot, V. (2017). The walking dead? Zombie firms and productivity performance in oecd countries. OECD ECONOMICS DEPARTMENT WORKING PAPERS, [online] No. 1372. Available at: https://www.oecd.org/economy/growth/The-Walking-Dead-Zombie-Firms-and-Productivity-Performance-in-OECD-Countries.pdf (Accessed on 10.5.2021).

Alon T., Doepke M., Olmstead-Rumsey J., Tertilt M. (2020). The Impact of COVID-19 on Gender Equality. Working paper 26947. National Bureau of Economic Research. Available at: https://www.nber.org/system/files/working_papers/w26947/w26947.pdf (Accessed on 21.05.2021).

Andrews, D., Sánchez, A. C., and Johansson, Å. (2011). Housing and the economy: Policies for renovation. *Economic policy reforms 2011: Going for growth*, 181-204. [online] Available at: https://www.oecd-ilibrary.org/economics/economic-policy-reforms-2011/housing-and-the-economy-policies-for-renovation_growth-2011-46-en (Accessed on 10.5.2021).

Andrews, D., Adalet McGowan, M. and Millot, V. (2017). Confronting the zombies: Policies for productivity revival. OECD Economic Policy Papers. Available at: https://www.oecd-ilibrary.org/economics/confronting-the-zombies_f14fd801-en (Accessed on 5.5.2021).

ASFEU (2015). "Výročná správa Agentúry Ministerstva školstva, vedy, výskumu a športu Slovenskej republiky pre štrukturálne fondy EÚ za rok 2014". Available at: https://www.minedu.sk/data/att/8322.pdf (Accessed on 26.2.2021).

Baláž, V., Dokupilová, D., and Nežinský, E. (2018). Do Motorways Induce Wider Economic Benefits? Evidence from the Slovak Republic. *Ekonomický časopis (Journal of Economics)*, *66*(5).

Baliak, M., Domonkos, Š., Fašungová, L., Hábel, B., Chujac, T., Komadel, J., Veselková, M. and Vojtechová,B. (2021).
'Prvá pomoc Slovensku: priebežná správa o sociálnej pomoci pracujúcim a rodinám (Aktualizácia 8).' *Analytický komentár Inštitútu sociálnej politiky Ministerstva práce, sociálnych vecí a rodiny SR*.Available at: https://institutsocialnejpolitiky.gov.sk/wp-content/uploads/2021/01/ISP_2020_Prva_pomoc_update8_FINAL.pdf (Accesed on 21.5.2021).

Baliak, M., Domonkos, Š., Fašungová, L., Hábel, B., Chujac, T., Komadel, J. and Veselková, M. (2021). Prvá pomoc Slovensku: priebežná správa o sociálnej pomoci pracujúcim a rodinám (Aktualizácia 9). *ISP*. Available at: https://www.employment.gov.sk/files/slovensky/ministerstvo/analyticke-centrum/analyticke-komentare/isp_2021_prva_pomoc_update9_final.pdf (Accessed on 21.5.2021).

Bande, R., Fernández, M., and Montuenga, V. (2008). Regional unemployment in Spain: Disparities, business cycle and wage setting. *Labour Economics*, *15*(5), 885-914.

Bell, B., Bloom, N., Blundell, J. and Pistaferri, L. (2020). Prepare for large wage cuts if you are younger and work in a small firm. [online] VOX EU, CEPR Policy Portal. Available at: https://voxeu.org/article/prepare-large-wage-cuts-if-you-are-younger-and-work-small-firm (Accessed on 16.4.2021).

Bednarik, M., Hidas, S., and Machlica, G. (2019). Enhancing the social integration of Roma in Slovak Republic. OECD Economics Department Working Papers, No. 1551, OECD Publishing, Paris. Available at: https://doi.org/10.1787/197eb309-en (Accessed on 10.5.2021).

Berger, M. and Baláž, V. (2007). Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments The "POLICY MIX" Project. Available: https://ec.europa.eu/invest-in-research/pdf/download_en/slovakia.pdf Accessed: 19th of February 2021.

Berlingieri, G., Calligaris, S., Criscuolo, C., and Verlhac, R. (2020). Laggard firms, technology diffusion and its structural and policy determinants. *OECD Science, Technology and Industry Policy Papers, 86*. Available at: https://doi.org/10.1787/281bd7a9-en (Accessed on 21.5.2021).

Blasko, Z. (2020). Working from Home when Teachers Do the Same – Teleworking and Work-Family Conflicts during COVID-19 Lockdowns. Joint Research Centre EC. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3729301 (Accessed on 21.5.2021).

Bloom, N., Bunn, P., Mizen, P., Smietanka, P. and Thwaites, G. (2021). The impact of Covid-19 on productivity. VOX EU, CEPR Policy Portal. Available at: https://voxeu.org/article/impact-covid-19-productivity (Accessed 13 March 2021).

Bobovník, D. and Harňák, K. (2020). Kam smerujú EUROFONDY? Available at: https://www.vlada.gov.sk/data/files/7916_kam-smeruju-eurofondy-komentar_po-zapracovani-pripomienok-recenzentov_final.pdf (Accessed on 10.5.2021).

Boskin, M. (2020). How does the COVID recession compare? World Economic Forum, Available at: <https://www.weforum.org/agenda/2020/08/how-does-the-covid-recession-compare> [Accessed 17 February 2021].

Bughin, J., Dimson, J., Hunt, V., Allas, T., Krishnan, M., Mischke, J., Chambers, L., Canal, M. (2018). Solving the United Kingdom's productivity puzzle in a digital age. *McKinsey Global Institute*. Available at: https://www.mckinsey.com/~/media/mckinsey/featured%20insights/meeting%20societys%20expectations/solving%20the%20united%20kingdoms%20productivity%20puzzle%20in%20a%20digital%20age/mgi-productivity-in-the-uk-discussion-paper-september-2018.pdf

Bughin, J., Seong, J., Manyika, J., Chui, M. and Joshi, R., (2018). Notes from the AI frontier: Modeling the impact of AI on the world economy. McKinsey Global Institute.

Burgess, S and Sievertsen, H. (2020), Schools, skills, and learning: The impact of COVID-19 on education, VOX EU, CEPR Policy Potral. Available at: https://voxeu.org/article/impact-covid-19-education

Buti, M. and Messori, M. (2020). NEXT GENERATION EU: An interpretative guide. Policy Brief 29/2020. [online] Luiss School of European Political Economy. Available at: <https://sep.luiss.it/sites/sep.luiss.it/files/Next%20Generation%20EU%20-%20English.pdf> [Accessed 12 March 2021].

Buti, M. (2021). Lessons from the financial crisis to prevent the Great Fragmentation. [online] VOX EU, CEPR Policy Portal. Available at: <https://voxeu.org/article/lessons-financial-crisis-prevent-great-fragmentation> [Accessed 12 March 2021].

Caballero, R., Hoshi, T., and Kashyap, A. (2008). Zombie Lending and Depressed Restructuring in Japan. The American Economic Review, 98(5), pp. 1943-1977.

Cedzová, N. and Rybanská, V. (2020). Spolupráca medzi akademickým a privátnym sektorom: Efektívna cesta k inováciám? Available: https://www.vlada.gov.sk/data/files/8009_spolupraca-medzi-akademickym-a-privatnym-sektorom.pdf Accessed: 6th of March 2021.

Cluver, L., Lachman, J., Sherr, L., Wessels, I., Krug, E. and Rakotomalala, S. (2020). Parenting in time of COVID-19. The Lancet. Volume 395, issue 10231, e64, april 11, 2020.

CVTI (2016) Research and development in Slovakia. Available at: https://indd.adobe.com/view/26a29a42-9009-4d47-95ea-0ef4f927ef5f (Accessed on 6.3.2021)

De Grauwe, P. and Ji, Y. (2020). A tale of three depressions. VOX EU, CEPR Policy Portal. Available at: https://voxeu.org/article/tale-three-depressions (Accessed on 12.3.2021).

Deloitte (2021). „How digital is changing car sales: Disruption in the automotive industry". Available at: https://www2.deloitte.com/xe/en/insights/industry/automotive/how-digital-is-changing-car-sales.html (Accessed on 8.2.2021).

Demmou, L., Calligaris, S., Franco, G., Dlugosch, D., McGowan, M. A., and Sakha, S. (2021). *Insolvency and debt overhang following the COVID-19 outbreak: Assessment of risks and policy responses.* Paris: OECD Publishing. Available online at: https://doi.org/10.1787/747a8226-en (Accessed on 21.5.2021).

di Mauro, F. and Syverson, C. (2021). The COVID crisis and productivity growth. VOX EU, CEPR Policy Portal. Available at: https://voxeu.org/article/covid-crisis-and-productivity-growth (Accessed on 13.3.2021).

Dijkstra, L., Poelman, H., and Ackermans, L. (2019). *Road Transport Performance in Europe. Introducing a New Accessibility Framework*. Working Papers—A Series of Short Papers on Regional Research and Indicators Produced by the Directorate-General for Regional and Urban Policy. 2018. Available at: https://ec.europa.eu/regional_policy/sources/docgener/work/2019_02_road_transport.pdf (Accessed on 10.5.2021).

Domonkos, Š., Fašungová, L., Hábel, B., Komadel, J. and Veselková, M. (2020). Prvá pomoc Slovensku: priebežná správa o sociálnej pomoci pracujúcim a rodinám. *ISP*. Available at: https://www.employment.gov.sk/files/slovensky/ministerstvo/analyticke-centrum/analyticke-komentare/isp_2020_prva_pomoc_slovensku_final5.pdf (Accessed on 21.5.2021).

Dujava, D., Peciar, V. (2020). Trh práce v karanténe. Institute for Financial Policy. Available online at: https://www.mfsr.sk/sk/financie/institut-financnej-politiky/publikacie-ifp/komentare/komentare-z-roku-2020/10-trh-prace-karantene.html (Accessed on 21.5.2021).

Dujava, D., Peciar, V., Plutzer, V. (2021). Silný finiš v 2020. IFP Monitor. Available at: https://www.mfsr.sk/sk/financie/institut-financnej-politiky/publikacie-ifp/tyzdenny-monitor/nova-web-stranka.html#w07 (Accessed on 3.4.2021).

Ebrahimy E., Igan D., and Peria, M.S. (2020) The Impact of COVID-19 on Inflation: Potential Drivers and Dynamics. *International Monetary Fund Research's Special Notes Series on Covid-19*. Available at: www.imf.org%2F~%2Fmedia%2FFiles%2FPublications%2Fcovid19-special-notes%2Fen-special-series-on-covid-19-the-impact-of-covid-19-on-inflation-potential-drivers-and-dynamics (Accessed on 21.5.2021).

EIGE (2020). Gender Equality Index 2020. European Institute for Gender Equality. Available at: https://eige.europa.eu/gender-equality-index/2020 (Accessed on 10.4.2021).

ERA Portál Slovensko. (2020). Slovenské firmy a Seal of Excellence. Available at: https://eraportal.sk/aktuality/slovenske-firmy-a-seal-of-excellence/ (Accessed: on 3.2.2021).

European Commission (2020a). ECFIN Forecast Autumn 2020: Slovakia. European Commission.

European Commission. (2020b). "European Innovation Scoreboard 2020". Available at: https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1150 (Accessed on 12.2.2021).

European Commission (2020c). The Digital Economy and Society Index, https://ec.europa.eu/digital-single-market/en/desi (accessed on 20 February 2021).

European Commission (2021a). 2021 report on gender equality in the EU. Available at: https://ec.europa.eu/info/sites/info/files/aid_development_cooperation_fundamental_rights/annual_report_ge_2021_en.pdf (Accessed on 21.5.2021).

European Commission (2021b). International Women's Day 2021: COVID-19 pandemic is a major challenge for gender equality. *Press release (5 March 2021). Brussels*. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_1011 (Accessed on 21.5.2021).

European Union and Government Office of the Slovak Republic (2013). „Partnership Agreement 2014 – 2020". Available: https://www.partnerskadohoda.gov.sk/uvodna-stranka-en/ Accessed: 17th of February 2021.

Eurostat. (2020). "R&D expenditure in the EU at 2.19% of GDP in 2019". Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20201127-1 (Accessed on 19.2.2021).

Fidrmuc, J., Gardoňová, K., Hulényi, M. and Zavarská, Z. (forthcoming). Dialnice nie sú všeliekom.

Gylánik, M., (2020). Trh práce: Nie je kríza ako kríza. Národná banka Slovenska.

Habrman, M., and Žúdel, B. (2017). Od Tatier k Dunaju, diaľnice stavajú. Available at: https://www.mfsr.sk/sk/media/komentare-ifp-uhp/od-tatier-k-dunaju-dialnice-stavaju-jul-2017.html (Accessed on 10.5.2021).

Hanushek and Woessmann (2020). The Economic Impacts of Learning Losses. Available at: http://www.oecd.org/education/The-economic-impacts-of-coronavirus-covid-19-learning-losses.pdf (Accessed 20.5.2021)

Hellebrandt, T. (2020). Koľko stratia deti na budúcich príjmoch kvôli zatvoreným školám? 24.6.2020. Blog ÚHP. Available at: https://www.mfsr.sk/sk/financie/hodnota-za-peniaze/blogy-uhp/2020/vplyv-zatvorenych-skol-buduce-prijmy-ziakov/ (Accessed on 21.5.2021).

Hellebrandt, T. (2021). Updated version of calculations for: Koľko stratia deti na budúcich príjmoch kvôli zatvoreným školám? 24.6.2020. Blog ÚHP. Available at: https://www.mfsr.sk/sk/financie/hodnota-za-peniaze/blogy-uhp/2020/vplyv-zatvorenych-skol-buduce-prijmy-ziakov/ (Accessed on 10.5.2021).

Hojdan, D., Pažický, M. and Žúdel, B. (2021). Ekonomika v zimnom spánku. IFP Monitor. Available at: https://www.mfsr.sk/sk/financie/institut-financnej-politiky/publikacie-ifp/tyzdenny-monitor/nova-web-stranka.html#w03] (Accessed on 83.2021).

Huebener M., Waights S., Spiess K., Siegel N. and Wagner G. (2021). Parental well-being in times of Covid-19 in Germany. Review of Economics of the Household volume 19, pages91–122(2021).

Ilzetzki, E. (2020). The economic cost of UK school closures, VOX EU, CEPR Policy Portal. Available at: https://voxeu.org/article/economic-cost-uk-school-closures (Accessed on 10.5.2021).

IFP (2021). Monitor: Máj, práce čas (24. týždeň). Available at: https://infogram.com/ifp-monitor-242021-1hxr4zxmx759q6y?live&fbclid=IwAR0cf22t9LGm-V3bDHdsvIfzTE8UW3jOfamGOUmI8pMPGbJyuEI5xZd2fnA (Accessed on 14.07.2021).

IMD, (2020). Country Profile: Slovak Republic. IMD World Competitiveness Yearbook, Talent and Digital 2020: summaries. IMD.

Ivan, Š., Krotáková, K. and Neumann, S. (2018). Investičná pomoc v SR– Analytická správa. Available at: https://www.nku.gov.sk/documents/10157/6e9a8d86-f560-4428-bd86-4e811c995695 (Accessed on 10.5.2021).

Kovalčík, J. (2017). Diaľničné sľuby politikov a realita – úplne odlišné svety. Available at: https://www.ineko.sk/file_download/1074/Dialnicne+sluby+politikov+a+realita.pdf (Accessed on 10.5.2021)

Kubala, J. and Peciar, V. (2019). V nájme ďalej zájdeš. Podpora bývania na Slovensku. Available at: https://www.mfsr.sk/sk/financie/institut-financnej-politiky/publikacie-ifp/ekonomicke-analyzy/53-najme-dalej-zajdes-podpora-byvania-slovensku.html (Accessed on 10.5.2021).

McKinsey & Company. (2020a). Automotive revolution – perspective towards 2030. Available at: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/disruptive-trends-that-will-transform-the-auto-industry/de-de# (Accessed on 12.2.2021).

McKinsey & Company. (2020b). Reimagining the auto industry´s future: It´s now or never. Available at: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/reimagining-the-auto-industrys-future-its-now-or-never# (Accessed on 8.2.2021).

MF SR (2021). Program stability Slovenskej republiky na roky 2021 až 2024. Ministry of Finance of the Slovak Republic.

Mičúch, M. and Solčanská, H. (2018), Dobré časy zmenšujú ekonomické rozdiely medzi slovenskými krajmi. Available at: https://www.nbs.sk/_img/Documents/_komentare/AnalytickeKomentare/2018/AK52_%20Regionalne_rozdiely.pdf (Accessed on 10.5.2021).

Mičúch, M. and Tvrz, S. (2015). Aby nezamestnanosť v okrese klesla, iba otvoriť diaľnicu nestačí. *Biatec*, 4-10.

Mikloš, M. (2016). Rýchlostná cesta R1 regiónu ekonomicky veľmi nepomohla. Available at: https://iness.sk/sk/stranka/11882-Rychlostna-cesta-R1-regionu-ekonomicky-velmi-nepomohla (Accessed on 10.5.2021).

Ministry of Finance of the Slovak Republic (2020). Návrh rozpočtového plánu Slovenskej republiky na rok 2021. Available at: https://ec.europa.eu/info/sites/info/files/economy-finance/2021_dbp_sk_sk_0_1.pdf (Accessed on 21.5.2021).

Ministry of Finance of the Slovak Republic (2021). Plán obnovy. Cestovná mapa k lepšiemu Slovensku. *Ministry of Finance of the Slovak Republic.* Available at: https://www.planobnovy.sk/files/dokumenty/cely_plan_obnovy.pdf

Ministry of Education (2020). https://www.minedu.sk/usmernenie-ministerky-skolstva-vedy-vyskumu-a-sportu-sr-vo-veci-prerusenia-vyucovania-v-skolach-a-skolskych-zariadeniach-z-12-marca-2020/

Mitrík, K. (2021). Správa o kontrole výsledku: Podpora najmenej rozvinutých okresov prostredníctvom poskytovania regionálneho príspevku. Available at: https://www.nku.gov.sk/documents/10157/1407476/Spr%C3%A1va_Najmenej+rozvinut%C3%A9+okresy.pdf/15fcc1be-dcec-41d6-ac9f-ad493795d5c2 (Accessed on 10.5.2021).

Múčka Z., and Novysedlák, V. (2018). Bezpečná úroveň dlhu pre Slovensko. *Analytický komentár Kancelárie Rady pre rozpočtovú zodpovednosť* 1/2018. Available at: https://www.rozpoctovarada.sk/download/2019_01_krrz_komentar_bezpecny_dlh.pdf (Accessed on 21.5.2021).

National Bank of Slovakia (2020a). Mesačný bulletin NBS December 2020. Národná banka Slovenska.

National Bank of Slovakia (2020b). Mesačný bulletin NBS Február 2020. Národná banka Slovenska.

National Bank of Slovakia (2020c). Strednodobá predikcia 4. štvrťrok 2020. Národná banka Slovenska.

National Bank of Slovakia (2021). Štrukturálne výzvy. ISSN: 2729-8825. Available at: https://www.nbs.sk/_img/Documents/_Publikacie/sktrukturalne_vyzvy/2021/Strukturalne_vyzvy_2021.pdf (Accessed on 21.5.2021).

OECD (2014). OECD Economic Surveys: Slovak Republic 2014. OECD Publishing, Paris. Available at: https://doi.org/10.1787/eco_surveys-svk-2014-en (Accessed on 10.5.2021).

OECD (2016). Small regions, TL3: Demographic statistics (Edition 2015). OECD Regional Statistics (database). Available at: https://doi.org/10.1787/a4db5a39-en (Accessed on 17 April 2021).

OECD (2017). "OECD Economic Surveys: Slovak Republic 2017". Available at: https://www.oecd-ilibrary.org/economics/oecd-economic-surveys-slovak-republic-2017/the-impact-of-brain-drain-on-the-competitiveness-is-substantial_eco_surveys-svk-2017-graph61-en (Accessed on: 4.2.2021).

OECD (2019). PISA 2018 Results (Volume I): What Students Know and Can Do, PISA, OECD Publishing, Paris. Available at: https://doi.org/10.1787/5f07c754-en (Accessed on 21.5.2021).

OECD (2020a). „Slovak Republic: The potential impacts of COVID-19 on local labour markets". Available at: http://www.oecd.org/cfe/leed/Slovak%20Republic.pdf (Accessed on 12.2.2021).

OECD, (2020c). Coronavirus (COVID-19): SME policy responses. [online] oecd.org. Available at: <https://www.oecd.org/coronavirus/policy-responses/coronavirus-covid-19-sme-policy-responses-04440101/> (Accessed on 12.4.2021).

OECD (2020d). OECD Regions and Cities at a Glance 2020, OECD Publishing, Paris. Available at: https://doi.org/10.1787/959d5ba0-en (Accessed on 10.5.2021).

OECD (2020e). Housing and Inclusive Growth, OECD Publishing, Paris. Available at: https://doi.org/10.1787/6ef36f4b-en (Accessed on 19.07.2021).

OECD (2021). The state of school education. One year into the COVID pandemic. Preliminary results March 2021. Available at: https://www.oecd-ilibrary.org/docserver/201dde84-en.pdf?expires=1619420001&id=id&accname=guest&checksum=728A90D5F35835DBFFB305EABC89C610 (Accessed on 21.5.2021).

Ostertágová A., Čokyna J. (2020). Hlavné zistenia z dotazníkového prieskumu v základných a stredných školách o priebehu dištančnej výučby v školskom roku 2019/2020. Available at: https://digitalnakoalicia.sk/wp-content/uploads/2020/09/Prieskum-IVP-o-priebehu-distancnej-vyucby-2020.pdf (Accessed on 21.5.2021).

Plutzer, V. (2021). Priemysel v čase korony: Vplyv prvej vlny koronakrízy na priemyselnú aktivitu na Slovensku. Komentár 2021/3: Inštitút finančnej politiky.

Policy Advice. 2021. „20 In-Depth Global and US Auto Sales Statistics for 2021". Available at: https://policyadvice.net/insurance/insights/us-auto-sales-statistics/ (Accessed on 9.2.2021).

Regiosuisse (2017). The New Regional Policy of the Federal Government. Available at: https://regiosuisse.ch/sites/default/files/2017-09/seco-nrp-en.pdf (Accessed on 10.5.2021).

Roland Berger (2020). This crisis is different- Comparing the coronavirus crisis with the financial clash. [Blog] Available at: https://www.rolandberger.com/en/Insights/Publications/This-crisis-is-different-Comparing-the-coronavirus-crisis-with-the-financial.html (Accessed on 17.2.2021).

SARIO. (2021). „Automotive Sector in Slovakia". Available: https://sario.sk/sites/default/files/sario-automotive-sector-in-slovakia-2021-02-05.pdf (Accessed on 9.2.2021).

Savic D. (2020). COVID-19 and Work from Home: Digital Transformation of the Workforce. TGJ Volume 16, Number 2, Summer 2020. Available at: https://www.researchgate.net/profile/DobricaSavic/publication/341493908_COVID-19_and_Work_from_Home_Digital_Transformation_of_the_Workforce/links/5ec41359299bf1c09acbc46f/COVID-19-and-Work-from-Home-Digital-Transformation-of-the-Workforce.pdf (Accessed on 21.5.2021).

Schmidhuber, J. and Qiao, B. (2020). Comparing crises: Great Lockdown versus Great Recession. Rome: Food and Agriculture Organization of the United Nations.

SOVVA. (2020). Ako zlepšiť výskum a inovácie na Slovensku? Analýza hodnotení výskumných a inovačných politík medzinárodnými inštitúciami. Available: http://www.sovva.eu/files/attachments/Hodnotenie%20EK.pdf (Accessed on 12.2.2021).

Sow, M., and Razafimahefa, M. I. F. (2015). *Fiscal decentralization and the efficiency of public service delivery* (No. 15-59). International Monetary Fund.

TALIS (2018).Country note. Available at: https://www.oecd.org/education/talis/TALIS2018_CN_SVK.pdf (Accessed on 21.5.2021).

ÚHP (2019). Revízie výdavkov na skupiny ohrozené chudobou alebo sociálnym vylúčením: Záverečná správa. Available at: https://www.mfsr.sk/files/archiv/5/ReviziavydavkovnaohrozeneskupinyFINAL.pdf (Accessed on 10.5.2021).

ÚHP (2020a). Priority vo výstavbe cestnej infraštruktúry. Available at: https://www.mindop.sk/uploads/PRIORITY_MATERIAL_FINAL.pdf (Accessed on 10.5.2021).

ÚHP (2020b) Revízia výdavkov zamestnanosti a odmeňovania vo verejnej správe. Available at: https://ec.europa.eu/info/sites/default/files/2020-european-semester-stability-programme-annex-3-slovakia_sk.pdf (Accessed on 3.5.2021)

UN Women (2019). SLOVAK REPUBLIC. Twenty-fifth anniversary of the Fourth World Conference on Women and adoption of the Beijing Declaration and Platform for Action (1995). Available at: https://unece.org/fileadmin/DAM/Gender/Beijing_20/Slovakia.pdf (Accessed on 8.4.2021).

UNESCO (2019). Education: Outbound internationally mobile students by host region. Available at: http://data.uis.unesco.org/Index.aspx?queryid=172&fbclid=IwAR0SqHL9x4zEBN4dTzZ9PKY7fq9w8VMW7U0xLTAsWRtU2M7BVAE5DPK x12I# (Accessed on 8.2.2021).

Vlachos, J., Hertegard E., Svaleryd H. (2020). School closures and SARS-CoV-2. Evidence from Sweden's partial school closure. Available at: https://www.medrxiv.org/content/10.1101/2020.10.13.20211359v3.full-text (Accessed on 21.5.2021).

Výskumná agentúra (2018a). Available at: http://www.vyskumnaagentura.sk/sk/ (Accessed on 24.2.2021).

Výskumná agentúra. (2018b). RIS3 Available: https://www.opvai.sk/ris3/ (Accessed on 24.2.2021).

Výskumná agentúra. (2020). Výročné správy Operačného programu Výskum a Inovácie. Available at: https://www.opvai.sk/dokumenty/v%C3%BDro%C4%8Dn%C3%A9-spr%C3%A1vy-op-vai/ (Accessed on 22.2.2021).

World Bank (2008). The Automotive Industry in the Slovak Republic: Recent Developments and Impact on Growth. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/28010/577280NWP0Box353766B01PUBLIC10gcwp029web.pdf?sequence=1 (Accessed on 8.2.2021).

World Intellectual Property Organization (2009). World Intellectual Property Indicators. Available at: https://www.wipo.int/edocs/pubdocs/en/intproperty/941/wipo_pub_941.pdf (Accessed on 31.3.2021).

World University Ranking 2020 (2020). The Times Higher Education. Available at: https://www.timeshighereducation.com/world-university-rankings/2020/world-ranking#!/page/0/length/25/locations/SK/sort_by/scores_teaching/sort_order/desc/cols/scores (Accessed on 19.3.2021).

World Economic Forum (2020). Special Edition 2020: How Countries are Performing on the Road to Recovery. The Global Competitiveness Report. World Economic Forum.

Yildirim M. (2020). The differential impact of COVID-19 on the work conditions of women and men academics during the lockdown. Gender, Work & Organization. Supplement: Feminist Frontiers. Volume 28, Issue S1.

Zavarska, Z. (2021). Updated version of calculations for: Úmrtia v čase pandémie- monitorovanie nadmerných úmrtí použitím Surveillance v R (2020). Government Office of the Slovak Republic. Available at: https://www.vlada.gov.sk/data/files/7968_umrtia-v-case-pandemie-final-reviewed.pdf (Accessed on 21.5.2021).

ZBHS (2016). Dostupné nájomné byty by mali patriť k prioritám novej vlády. Available at: http://www.zbhs.sk/?p=3088 (Accessed on 10.5.2021).

A. Appendix

Abbreviations

EC	European Commission
ESIF	European Structural and Investment Funds
EU	European Union
EZ	Eurozone
FDI	foreign direct investment
GDP	gross domestic product
GVA	gross value added
ICT	information and communications technology
IFP	Institute of Financial Policy
IT	information technologies
LDD	least developed districts
MRC	marginalized Roma community
NBS	National Bank of Slovakia
NGO	non-governmental organisations
NRP	New regional policy
OECD	Organization for Economic Cooperation and Development
p.p.	percentage point
PPP	purchasing power parity
PR1BINA	Nitra-Banská Bystrica section of R1
Q	quarter
R1	Trnava-Nitra section of R1
RCA	Revealed comparative advantage
SME	small and medium enterprise
SOSR	Statistical Office of the Slovak Republic
TEN-T	Trans-European Transport Network
TL	territorial level
ÚHP	Útvar hodnoty za peniaze
UPSVaR	Ústredie práce, sociálnych vecí a rodiny
ZBHS	Združenie bytového hospodárstva na Slovensku
NACE Rev. 2 sectors	
A	Agriculture, Forestry and Fishing
B	Mining and Quarrying
C	Manufacturing
D	Electricity, Gas, Steam and Air Conditioning Supply
E	Water Supply; Sewerage, Waste Management and Remediation Activities
F	Construction
G	Wholesale and Retail Trade; Repair of Motor Vehicles
H	Transportation and Storage
I	Accommodation and Food Service Activities
J	Information and Communication
K	Financial and Insurance Activities

L	Real Estate Activities
M	Professional, Scientific and Technical Activities
N	Administrative and Support Service Activities
O	Public Administration and Defense; Compulsory Social Security
P	Education
Q	Human Health and Social Work Activities
R	Arts, Entertainment and Recreation
S	Other Service Activities
T	Activities of Households as Employers; Undifferentiated Goods and Services Producing Activities of Households for Own Use
U	Activities of Extraterritorial Organisations and Bodies
Countries	
AT	Austria
CZ	Czechia
HU	Hungary
PL	Poland
SK	Slovakia
Regions	
BA	Bratislava Region
TT	Trnava Region
NR	Nitra Region
TN	Trenčín Region
ZA	Žilina Region
BB	Banská Bystrica Region
KE	Košice Region
PO	Prešov Region

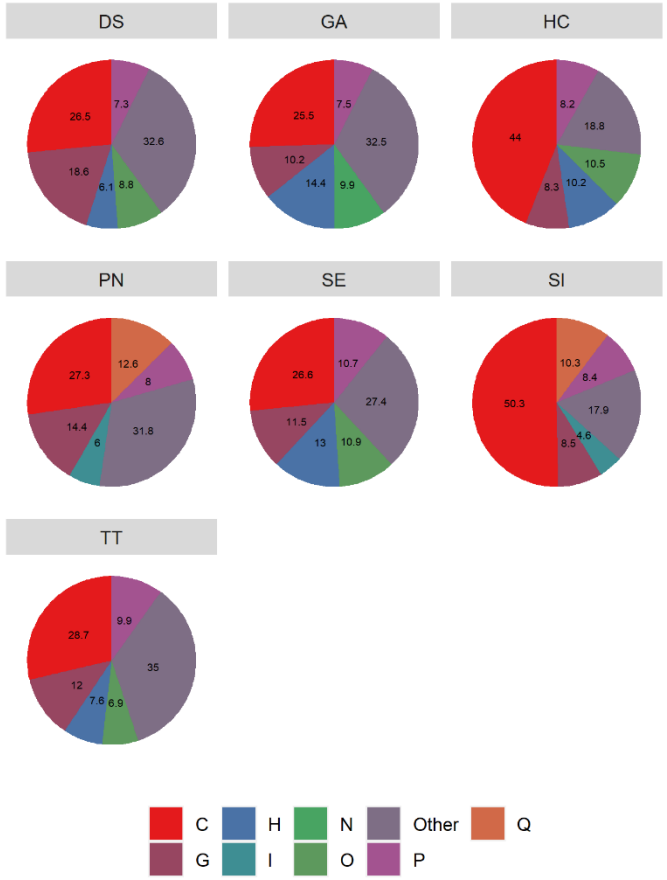
Districts

BN	Bánovce nad Bebravou
BB	Banská Bystrica
BS	Banská Štiavnica
BJ	Bardejov
BAI	Bratislava I
BAII	Bratislava II
BAIII	Bratislava III
BAIV	Bratislava IV
BAV	Bratislava V
BR	Brezno
BY	Bytča
CA	Čadca
DT	Detva
DK	Dolný Kubín
DS	Dunajská Streda
GA	Galanta
GL	Gelnica
HC	Hlohovec
HE	Humenné
IL	Ilava
KK	Kežmarok
KN	Komárno
KS	Košice - okolie
KEI	Košice I
KEII	Košice II
KEIII	Košice III
KEIV	Košice IV
KA	Krupina
KM	Kysucké Nové Mesto
LV	Levice
LE	Levoča
LM	Liptovský Mikuláš
LC	Lučenec
MA	Malacky
MT	Martin
ML	Medzilaborce
MI	Michalovce
MY	Myjava
NO	Námestovo
NR	Nitra
NM	Nové Mesto nad Váhom
NZ	Nové Zámky
PE	Partizánske
PK	Pezinok
PN	Piešťany
PT	Poltár
PP	Poprad
PB	Považská Bystrica
PO	Prešov
PD	Prievidza
PU	Púchov
RA	Revúca
RS	Rimavská Sobota
RV	Rožňava
RK	Ružomberok
SB	Sabinov
SC	Senec
SE	Senica
SI	Skalica
SV	Snina
SO	Sobrance
SN	Spišská Nová Ves
SL	Stará Ľubovňa
SP	Stropkov
SK	Svidník
SA	Šaľa
TO	Topoľčany
TV	Trebišov
TN	Trenčín
TT	Trnava
TR	Turčianske Teplice
TS	Tvrdošín
VK	Veľký Krtíš
VT	Vranov nad Topľou
ZM	Zlaté Moravce
ZV	Zvolen
ZC	Žarnovica
ZH	Žiar nad Hronom
ZA	Žilina

Figure A.1: Sectoral shares of persons employed of total persons employed in a district in Bratislava Region in 2019 (in %)

Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[24]

Figure A.2: Sectoral shares of persons employed of total persons employed in a district in Trnava Region in 2019 (in %)



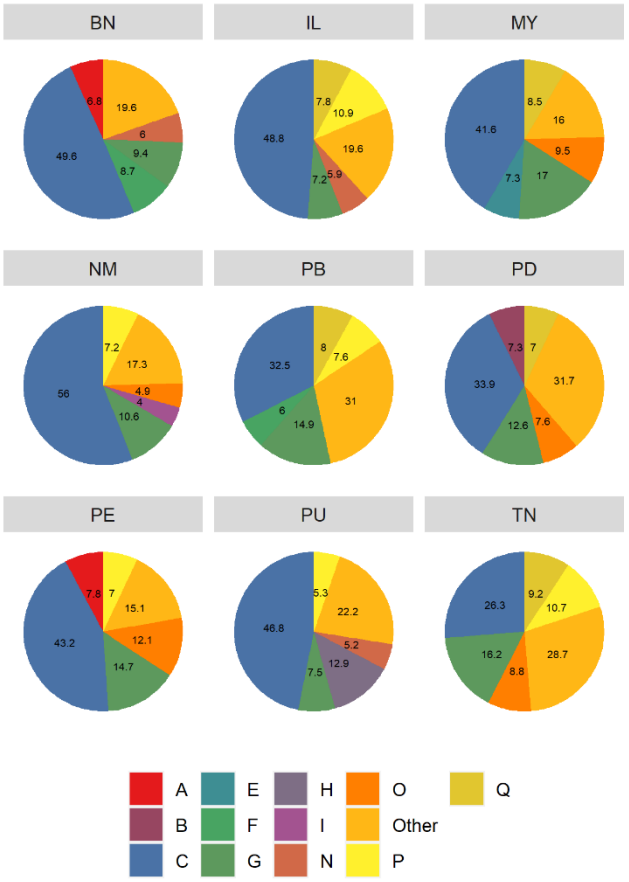
Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[25]

[24] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.
[25] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.

Figure A.3: Sectoral shares of persons employed of total persons employed in a district in Nitra Region in 2019 (in %)

Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[26]

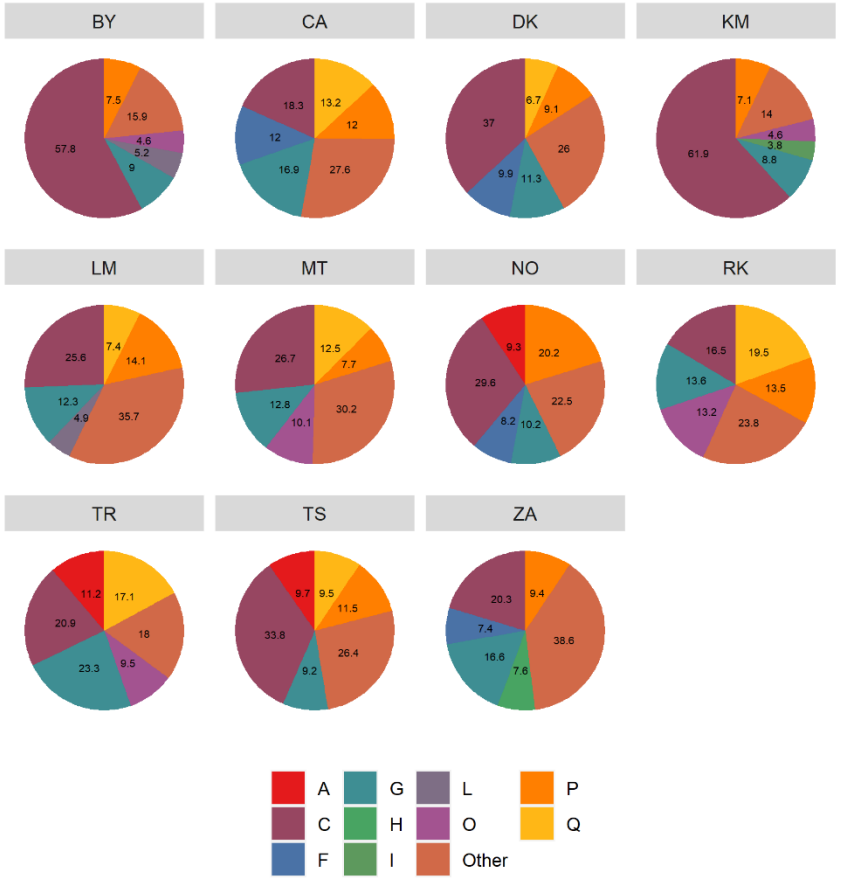
Figure A.4: Sectoral shares of persons employed of total persons employed in a district in Trenčín Region in 2019 (in %)



Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[27]

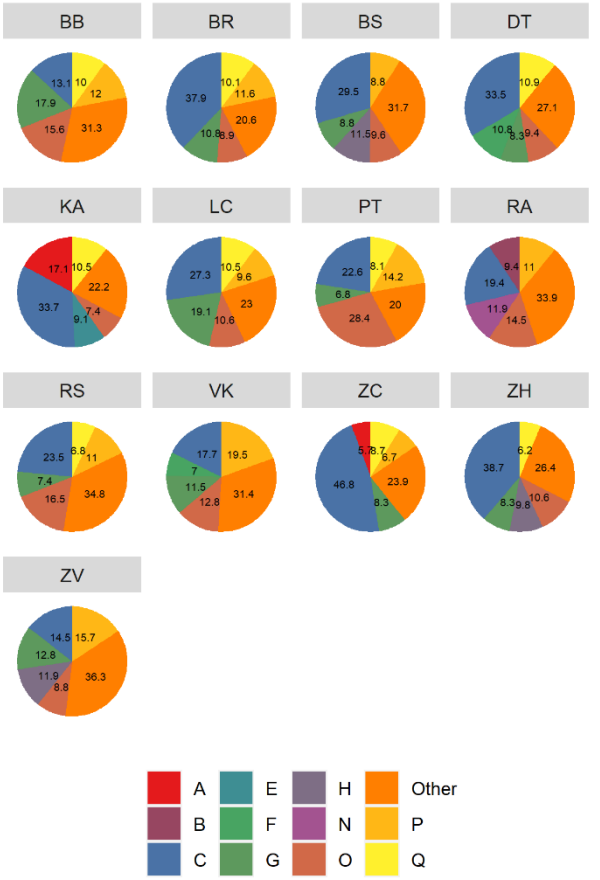
[26] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.
[27] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.

Figure A.5: Sectoral shares of persons employed of total persons employed in a district in Žilina Region in 2019 (in %)



Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[28]

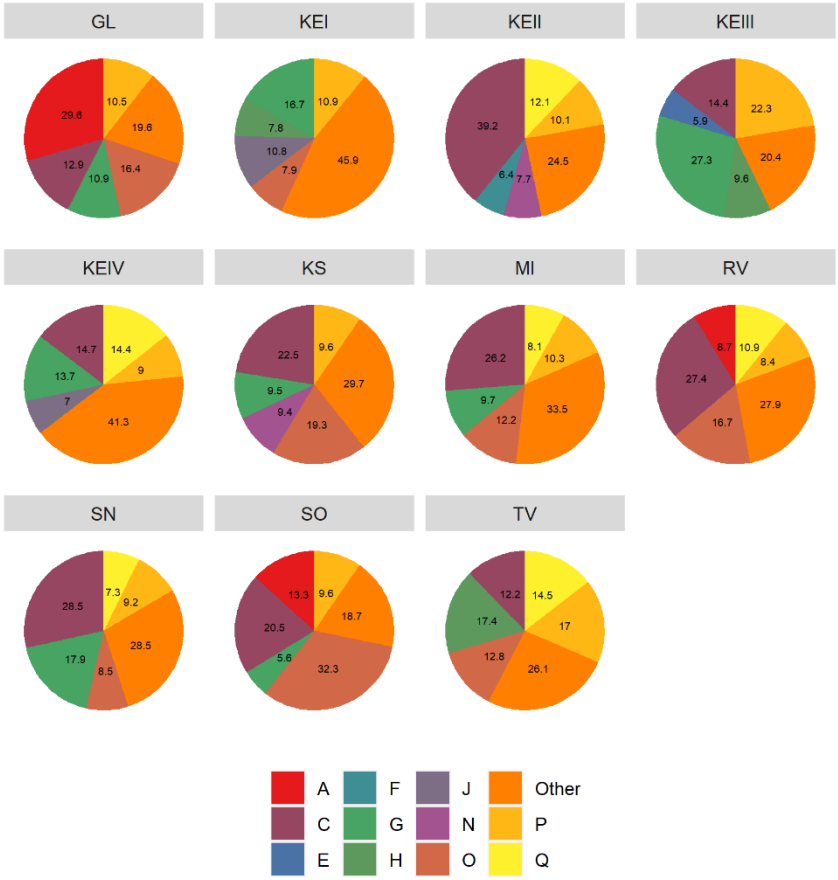
Figure A.6: Sectoral shares of persons employed of total persons employed in a district in Banská Bystrica Region in 2019 (in %)



Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[29]

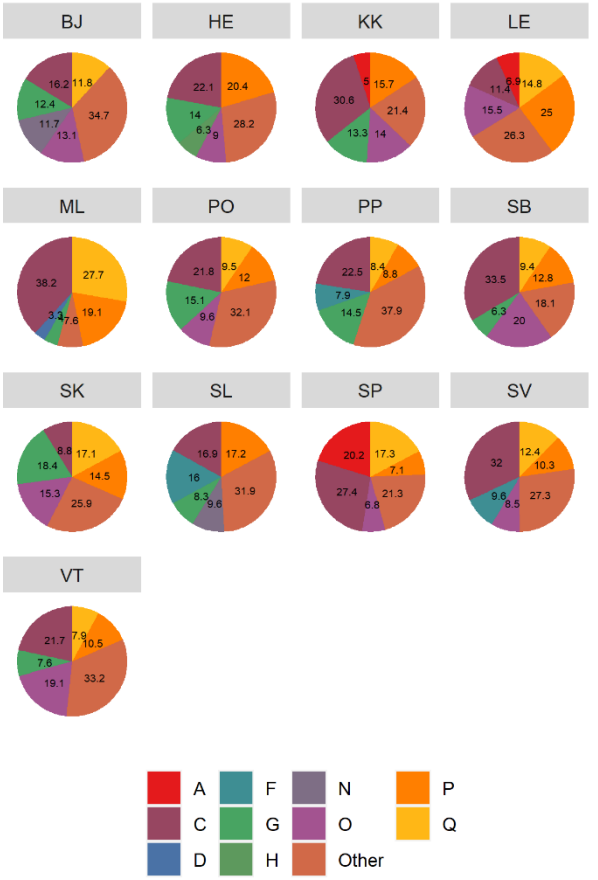
[28] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.
[29] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.

Figure A.7. Sectoral shares of persons employed of total persons employed in a district in Košice Region in 2019 (in %)



Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[30]

Figure A.8: Sectoral shares of persons employed of total persons employed in a district in Prešov Region in 2019 (in %)



Source: Trexima. Note: The NACE Rev. 2 level 1 codes are in the legend.[31]

[30] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.
[31] Sectors corresponding to the NACE Rev. 2 codes used in this Figure are listed in the Appendix.

Table A.1: Impact of the R1 highway on unemployment in central Slovakia

	(1)	(2)	(3)
	Full sample	**Urban**	**Rural**
constant	8.7780***	29.9769***	8.7453***
	(2.3809)	(10.0287)	(2.4769)
p^1	2.3241***	2.0194	2.5072***
	(0.2723)	(1.6688)	(0.2805)
p^2	-8.2145***	-3.8508	-8.1961***
	(0.3566)	(2.7513)	(0.3597)
d^1p^1	-1.9378***	-1.0367**	-1.9967***
	(0.2118)	(0.4391)	(0.2207)
d^2p^2	1.7070***	0.8670	1.7583***
	(0.2970)	(0.7796)	(0.3097)
Total observations	19,283	936	18,347
Number of municipalities	805	39	766
Socioeconomic controls	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Adjusted R-squared	0.5782	0.7763	0.5759
R squared	0.5787	0.7830	0.5765
F-statistic	237.37***	102.09***	226.66***

Source: Fidrmuc et al. (forthcoming). Note: Dependent variable is the municipal unemployment rate. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: Impact of LDD on change in the regional unemployment rate

	(1) bandwith 5 pp	(2) bandwith 7.5 pp	(3) bandwith 10 pp	(4) full sample
constant	-6.12	16.029	9.812	-2.017
	(24.191)	(18.655)	(10.780)	(6.523)
u	-0.483*	-0.399**	-0.465***	-0.415***
	(0.225)	(0.154)	(0.072)	(0.0378)
d	1.316	0.915	1.268*	1.184**
	(1.084)	(1.076)	(0.671)	(0.472)
Observations	20	29	45	75
Treated	9	10	11	12
Socioeconomic controls	Yes	Yes	Yes	Yes
R-squared	0.5775	0.6037	0.798	0.8837
Adjusted R-squared	0.3825	0.4956	0.7661	0.8735
F-statistics	2.658**	5.44***	21.45***	63.29***

Source: Central offfice of Labor, Social Affairs and Family. Note: Dependent variable is the districtual unemployment rate. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Impact of LDD on the change in the share of longterm unemployed on total registered unemployed

	(1) bandwith 5 pp	(2) bandwith 7.5 pp	(3) bandwith 10 pp	(4) full sample
constant	2.749	23.426	14.208	5.008
	(17.620)	(13.014)	(7.80)	(-0.327)
u	-0.305*	-0.37***	-0.312**	-0.327***
	(0.140)	(0.102)	(0.057)	(0.027)
d	-0.271	-0.005	-0.345	-0.049
	(0.775)	(0.747)	(0.483)	(0.311)
Observations	20	29	45	75
Treated	9	10	11	12
Socioeconomic controls	Yes	Yes	Yes	Yes
R-squared	0.8309	0.8444	0.8858	0.9328
Adjusted R-squared	0.7529	0.8019	0.8678	0.9269
F-statistics	26.76***	26.99***	48.03***	144.6***

Source: Central offfice of Labor, Social Affairs and Family. Note: Dependent variable is the districtual unemployment rate. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.