Structural Challenges

2023

NÁRODNÁ BANKA SLOVENSKA
EUROSYSTÉM

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Contact

Národná banka Slovenska
Imricha Karvaša 1
813 25 Bratislava
info@nbs.sk

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Abbreviations

A8	The 'Accession Eight' countries, comprising the eight central and eastern European countries that joined the EU in 2004
AI	artificial intelligence
AMECO	The annual macroeconomic database of the European Commission's Directorate General for Economic and Financial Affairs
AMI	acute myocardial infarction
APVV	Slovak Research and Development Agency / Agentúra na podporu výskumu a vývoja
BMI	body mass index
BPM6	The sixth edition of the IMF's Balance of Payments and International Investment Position Manual
CBR	Council for Budget Responsibility
CO2	carbon dioxide
CT	computer tomography
CVTI SR	Slovak Centre of Scientific and Technical Information / Centrum vedecko-technologickych informacii Slovenskej republiky
DESI	Digital Economy and Society Index
DG ECFIN	The European Commission's Directorate-General for Economic and Financial Affairs
DSTI	debt service-to-income (ratio), with the income component reduced by the borrower's necessary living expenses
EC	European Commission
ECB	European Central Bank
EIB	European Investment Bank
EMD	Economic and Monetary Developments (report), published by NBS on a quarterly basis
ERC	European Research Council
EU	European Union
EU27	The 27 Member States of the European Union
FDI	foreign direct investment
GDP	gross domestic product
GII	Global Innovation Index
GVCs	global value chains
HFCS	Household Finance and Consumption Survey
HICP	Harmonised Index of Consumer Prices
HRST	human resources in science and technology
ICT	information and communications technology

IFP	Institute for Financial Policy (under the Slovak Finance Ministry)
IFR	International Federation of Robotics
IMD	International Institute for Management Development
IMF	International Monetary Fund
IP	intellectual property
KEGA	Cultural and Educational Grant Agency / Kulturna a edukačna grantova agentura
MFP	multifactor productivity
MRI	magnetic resonance imaging
NBS	Národná banka Slovenska
NO2	nitrogen dioxide
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty (the international patent system)
PISA	Programme for International Student Assessment
pp	percentage point(s)
PPP	purchasing power parity
PM2.5	particulate matter with diameters of 2.5 microns or less
PPI	producer price index
R&D	research and development
RDI	research, development and innovation
RIS 3	Research and Innovation Strategy for Smart Specialisation of the Slovak Republic
ROE	return on equity
RRF	Recovery and Resilience Facility (of the European Union)
RRP	recovery and resilience plan
S2	A long-term indicator of fiscal sustainability, measuring the structural primary balance adjustment that would be required to stabilise public debt over the long term
SARIO	Slovak Investment and Trade Development Agency / Slovenska agentura pre rozvoj investicii a obchodu
SAV	Slovak Academy of Sciences / Slovenska akademia vied
SBA	Slovak Business Agency
SD	super-deduction
SIEA	Slovenska Innovation and Energy Agency
SIH	Slovak Investment Holding
SMEs	small and medium-sized enterprises
STEM	science, technology, engineering and mathematics
SO SR	Statistical Office of the Slovak Republic
SZRB	Slovak Guarantee and Development Bank / Slovenska zaručna a rozvojova banka
TFP	total factor productivity
UNDP	United Nations Development Programme

V4	Visegrad Four (a cultural and political alliance of four countries: Czechia, Hungary, Poland and Slovakia)
VA	Research Agency / Vyskumna agentura
VAIA	Research and Innovation Authority / Vyskumna a inovačna autorita
VEGA	Research and Educational Grant Agency / Vyskumna a edukačna grantova agentura
VAT	value-added tax
WIPO	World Intellectual Property Organization

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1 Structural challenges summary

Slovakia's convergence with western EU countries is stalling, with the gap having increased slightly during the pandemic crisis and the subsequent war in Ukraine and related energy crisis. The slowdown in convergence is a long-term trend and its reversal will require substantial structural reforms. Low labour productivity, leading to relatively low income and consumption, remains a major challenge for the Slovak economy.

To revive economic convergence with EU countries will require transitioning to a new economic model based on innovation. This transition necessitates improving the business environment by cutting red tape, digitalising public services, and enhancing law enforcement. It is essential to continue reforms in the education system and in research funding and organisation, as well as to further increase expenditure on research and development. Long-term efforts must be aimed at improving students' results and their preparation for the labour market of the future, as well as at increasing the number of science, technology, engineering and mathematics (STEM) graduates. Policies to retain domestic talent and attract foreign talent could immediately help further that goal.

Slovakia is also facing major challenges in other areas. The pandemic exacerbated Slovakia's already significant underperformance in health outcomes and the problems in its healthcare system. Much work is needed to align the country's economic convergence with the green transition. The war in Ukraine and energy crisis have accelerated the need to reduce dependence on fossil fuels and to diversify fossil fuel imports. On the social inclusion front, Slovakia's score remains positive, although sharply rising prices of food and energy have had a disproportionate impact on low-income groups. Compared with the EU average, the risk of poverty and social exclusion has increased notably, as has the risk of material deprivation.

The Slovak economy is challenged by debt sustainability risks and persisting problems in absorbing EU funds. Sound public finances are a prerequisite for the Slovak economy's further development; however, the pandemic, war in Ukraine and energy crisis, together with broadly applied government measures, have had an adverse impact on the country's coffers. A rapidly ageing population will in future place an additional burden on public budgets. In terms of their sustainability, public finances are therefore a significant vulnerability for Slovakia's economy, and the new government will have its work cut out to repair them. Steps that may be

useful in this regard include improving tax collection, targeting social policy to a greater extent, strengthening value-for-money principles, and implementing spending caps in the budget process. It is also important to be more efficient in absorbing EU funds – including funds from the Recovery and Resilience Facility (RRF), through the implementation of Slovakia's recovery and resilience plan (RRP) – as this could add a significant growth impetus to the domestic economy. These funds, however, cannot replace public investment from domestic funding sources, but rather should contribute to additional investment focused on improving the country's outcomes in the areas of greatest underperformance.

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2 Economic convergence and structural challenges

Looking at the key challenges facing Slovakia, they remain unchanged since last year. Reviving Slovakia's convergence with Western countries and reducing the underperformance of its economic productivity require significant reforms in the areas of education, business environment and public institution quality, and innovation capacity. Another notable vulnerability facing the Slovak economy is the sustainability of public finances. The pandemic exacerbated Slovakia's already significant underperformance in health outcomes and the problems in its healthcare system. Although the country scores relatively well in the areas of social inclusion and environment, even here it is confronted with the challenge of integrating marginalised communities and aligning climate goals with economic convergence. From a longer-term perspective, the only notable shift has been an increase in vulnerabilities related to public finances.[1]

Overall, compared with last year's report, there has been only a slight change in the scoreboard. The underperformance of labour productivity has become moderately worse, as the temporary increase in productivity during the pandemic was followed by a negative correction. Social inclusion outcome indicators remain favourable, although the relatively high level of inflation has had an upward impact on the risk of poverty and social exclusion, as well as on material deprivation, in comparison with the EU average. By contrast, the labour market situation has improved moderately.

[1] Compared with 2015 there has been moderate improvement in the metrics of social inclusion, labour market, and environment. On the other hand, health outcomes have deteriorated owing to the pandemic. The slight deterioration in the productivity score should be interpreted with caution given the below-discussed methodological issues with purchasing power parity indicators.

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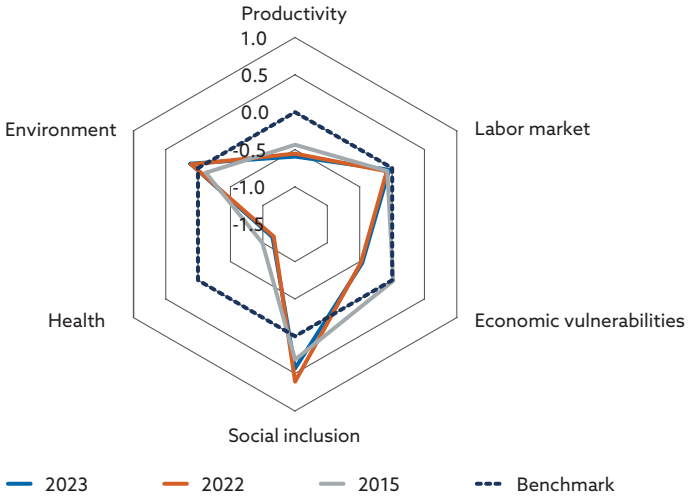
Chart 1
Outcome indicator scores vis-à-vis the benchmark



Sources: Eurostat, OECD, ECB, and NBS calculations.
Note: The scores denote the difference between the indicator value for Slovakia and the average of the reference countries normalised by the standard deviation. Positive values denote above-average outcomes. For productivity, the outcome indicator is GDP per hour worked at purchasing power parity; for the labour market, the employment rate. On other dimensions, composites of outcome indicators were used. The scores for 2022 and 2023 represent the most recent values available when producing the Structural Challenges report for the given year; the score for 2015 refers to the indicator values for that year. A more detailed description of the methodology can be found in NBS's 2021 Structural Challenges report.

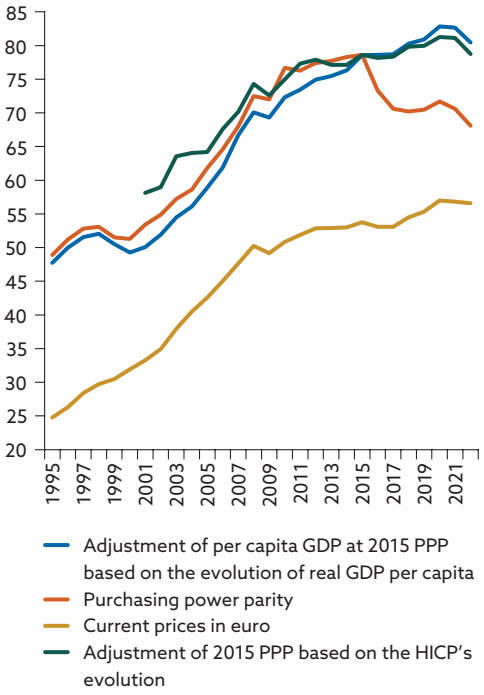
Convergence with EU countries continues to stall. While methodological problems surround the estimation of the evolution of per capita GDP at purchasing power parity (PPP),[2] it is apparent also from analytical adjustments to the indicator based on the evolution of per capita GDP at constant prices, or from adjustments to the evolution of 2015 PPP based on the evolution of the HICP as well as per capita GDP in euro[3] (Chart 2), that convergence was al-

[2] This problem has been highlighted by, for example, the Slovak Finance Ministry's Institute for Financial Policy (IFP) in Dujava, D. and Žúdel, B., "O parite: Komentár ku konvergencii slovenskej ekonomiky k EÚ" (Regarding parity: Commentary on the Slovak economy's convergence with the EU), *Commentaries*, No 2023/6, Institute for Financial Policy, March 2023 (in Slovak only). It stems primarily from price collection heterogeneity across countries, with housing prices in Slovakia being overvalued. Moreover, there is a break in the time series with post-2015 data being inconsistent with older data. The IFP authors further argue that views of per capita GDP at constant prices and at PPP may also differ owing to the impact of export and import price movements, with per capita GDP at constant prices measuring the volume of economic output and per capita GDP at PPP measuring the purchasing power of incomes. By a similar token, they recommend looking at convergence in terms of per capita (nominal) GDP in euro.

[3] Národná banka Slovenska's analytical adjustment of the per capita GDP at PPP indicator according to the evolution of per capita real GDP assumes that per capita GDP at 2015 PPP was correct; it then indexes the indicator over time based on the evolution of per capita GDP at constant prices. Similarly, the adjustment according to the HICP assumes the correctness of purchasing power parities in 2015, which are then adjusted over time according to the HICP's evolution; the parities so adjusted are then used to used to recalculate the level of per capita nominal GDP. The assumption of the correctness of per capita GDP at purchasing power parity in 2015 may not necessarily be valid; hence the level of both indicators may not correspond to reality, and the indicators should only be used to assess convergence over time and

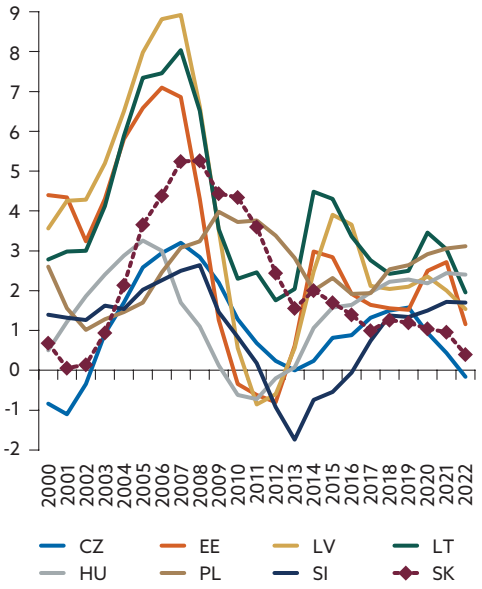
ready slowing significantly even in the pre-pandemic period. Moreover, the impacts of the pandemic crisis and the war in Ukraine during the 2020–22 period were slightly worse for Slovakia than for the EU27 on average, as the increase in per capita GDP at constant prices was 0.4 pp slower in Slovakia.

Chart 2
Per capita GDP in Slovakia (percentage of EU27 average)



Sources: Eurostat, and NBS calculations.

Chart 3
Gap with the EU27 in terms of average per capita GDP growth at constant prices (five-year moving average differential in percentage points)



Sources: Eurostat, and NBS calculations.

The Slovak growth model's loss of momentum has not been sudden, but rather a longer-lasting trend. The speed of convergence can also be assessed by comparing the gaps between A8 countries[4] and the EU27 countries in terms of the five-year moving average of per capita GDP at constant prices (Chart 3). Slovakia's economic convergence peaked before the global financial crisis, when its pace was surpassed among the A8 economies only by the Baltic States. All A8 countries saw a slowdown in convergence in the

not to assess Slovakia's underperformance relative to the EU27. A comparison of both indicators shows that the faster growth of export prices than import prices after 2015 had a negative impact on the purchasing power of incomes, though this impact was relatively small. For the sake of completeness, we also present the evolution of per capita GDP in euro, which does not alter the picture of the Slovak economy's stalling convergence. A downside of this indicator is its failure to distinguish between real and nominal convergence – in other words, it indicates there is some convergence with the EU average purely due to the impact of price convergence.

[4] A group comprising the eight central and eastern European countries that joined the EU in 2004.

wake of that crisis, but in the case of Slovakia the slowdown became a gradual long-term trend. Slovakia's economic convergence has come to a virtual halt in recent years, with Slovakia and Czechia experiencing the lowest growth among the A8 countries during this period. This implies that the stalling of convergence with the EU average has probably less to do with temporary factors than with a long-term structural deficiency of the Slovak economy. Reviving convergence with western economies will therefore require far-reaching structural reforms that address the key problems of the Slovak economy and set it on a path to sustainable growth.

While low productivity keeps incomes and consumption relatively low, price convergence is advancing. Low labour productivity remains a major challenge for the Slovak economy. It has a direct impact on compensation per employee and on household incomes, which are well below the EU27 average. Low incomes are then reflected in a lower level of consumption. Prices, by contrast, are catching up more quickly with the EU average. This trend is partly related to a problematic methodology for calculating purchasing power parities, but it is the case that the consumer price inflation in Slovakia has been outpacing EU27 inflation in recent years.

Table 1 Economic convergence indicators (percentage of EU27 average)

Indicator		2016	2017	2018	2019	2020	2021	2022
Gross domestic product per capita	PPP	73	71	70	71	72	71	68
	euro	53	53	55	55	57	57	57
Labour productivity per hour worked	PPP	73	71	70	71	74	76	73
	euro	53	53	54	55	58	61	60
Gross adjusted disposable income per capita	PPP	68	66	67	68	68	67	
	euro	49	50	53	54	54	55	57
Actual individual compensation per capita	PPP	70	69	69	70	73	73	74
	euro	51	52	53	55	58	58	62
Compensation per employee	PPP	64	63	63	65	67	68	67
	euro	46	48	49	51	53	55	55
Compensation per hour worked	PPP	60	60	61	63	66	68	66
	euro	44	45	47	49	52	55	55
Comparative price level of GDP		72	75	78	78	79	81	83
Comparative price level of actual individual consumption		72	76	79	79	81	82	
Comparative price level of household final consumption		78	82	85	86	89	90	

Sources: Eurostat, and NBS calculations.
Note: Eurostat data at (nominal) purchasing power parity may in recent years have been affected by issues with the estimation of PPP for Slovakia. PPP represents an artificially constructed common currency that eliminates price level differences across countries and therefore allows volume indicators of different countries to be compared.

Slovakia also lags behind advanced economies in competitiveness rankings. In the competitiveness ranking produced by the Institute for Ma-

nagement Development (IMD), Slovakia dropped four places and replaced Poland as the lowest-ranked of the Visegrad Four (V4) countries. The overall ranking is based on a number of indicators under four different competitiveness factors, with Slovakia continuing to underperform mainly in the economic performance factor. Its ranking on this metric has dropped 14 places in the last four years.

Slovakia appears in a somewhat better light in Harvard Growth Lab's Atlas of Economic Complexity ranking. In terms of export complexity and sophistication, Slovakia was placed 13th in 2020. In this regard, all the V4 countries ranked highly, with Slovakia ranking second behind Poland. At the same time, however, this indicator does not take into account a structural problem of the Slovak economy: the production of sophisticated final exports implies high reliance on imports of sophisticated subcomponents and therefore results in low value added. This problem is also highlighted in the European Commission's 2023 In-Depth Review of Slovakia,[5] published in May of this year.

Table 2 Competitiveness rankings of V4 countries

IMD – World Competitiveness Ranking									
	2015	2016	2017	2018	2019	2020	2021	2022	2023
Slovakia	-	-	-	55	53	57	50	49	53
Czechia	-	-	-	29	33	33	34	26	18
Hungary	-	-	-	47	47	47	42	39	46
Poland	-	-	-	34	38	39	47	50	43
Harvard Atlas of Economic Complexity – 133 countries									
	2015	2016	2017	2018	2019	2020	2021	2022	2023
Slovakia	14	16	14	15	13	13	-	-	-
Czechia	7	6	6	6	6	6	-	-	-
Hungary	10	10	9	9	10	9	-	-	-
Poland	24	24	51	24	27	26	-	-	-

Sources: IMD, and Harvard Growth Lab.

Moreover, according to the European Commission, Slovakia's reliance on low value-added activities is impairing its ability to absorb price shocks. The Slovak economy's structural problems have been further accentuated by price developments over the past year, which has seen real appreciation of the exchange rate and a higher increase in unit labour costs than in labour productivity. Slovakia is also one of the countries where jobs are most at risk from automation.[6] On the other hand, with its automotive industry seeing heavy investment in electric vehicle production, Slovakia

[5] European Commission: In-Depth Review 2023

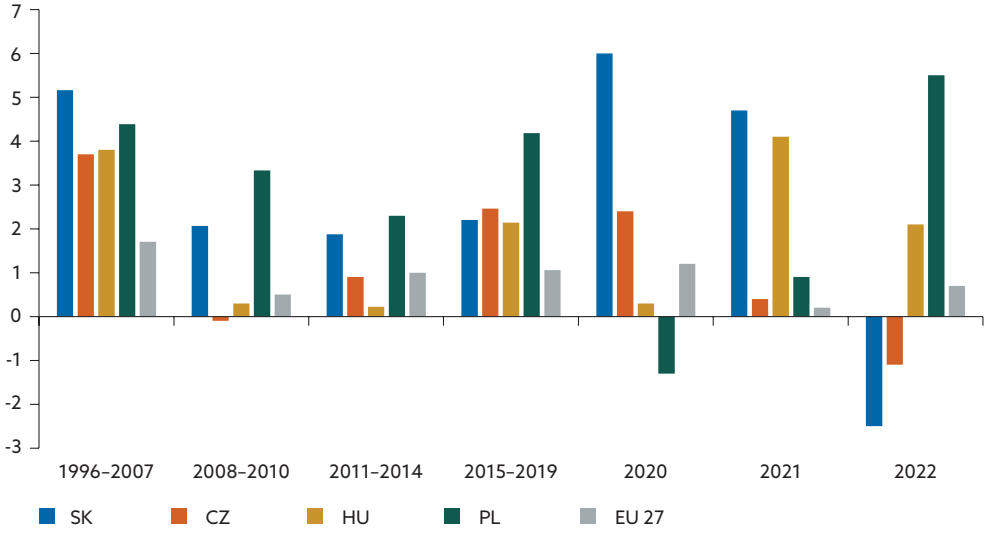
[6] Giorno, C., "Increasing the benefits of Slovakia's integration in global value chains", *OECD Economics Department Working Papers*, No 1552, May 2019.

has a unique opportunity to promote the industry's technological capabilities, according to the EC. With the right policies, this development could lead to further foreign investment, for example in testing autonomous vehicles or the development of alternative fuel vehicles.

2.1 Economic performance

The acceleration in labour productivity growth during the pandemic years was likely temporary, and slow productivity growth will continue to be a key challenge for the Slovak economy. The increase in hourly labour productivity during the pandemic was accompanied by a sharp decline in hours worked, especially in the first year of the crisis. This increase was partly due to the reallocation of hours worked in favour of more productive firms.[7] The year 2022 saw a recovery in hours worked and a decline in labour productivity. The acceleration in labour productivity growth during the pandemic years thus appears to have been only temporary, and the Slovak economy continues to face the challenge of reversing the gradual downtrend in labour productivity growth, which by 2019 was more pronounced than in the other V4 countries and also compared with EU27 average productivity growth

Chart 4
Hourly labour productivity (percentages)



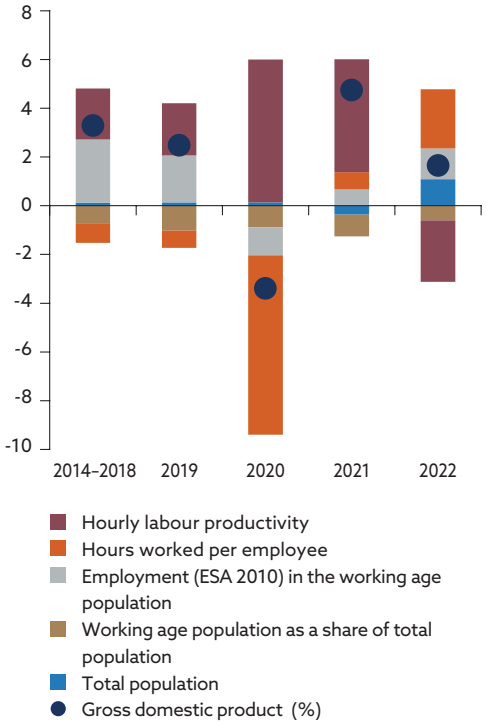
Sources: Eurostat, and NBS calculations.

Overall, Slovakia's economic growth in the years 2020 to 2022 – a period of crises in form of the COVID-19 pandemic and then the war in Ukraine – was roughly on a par with the EU27's economic growth. The main driver of Slovak GDP growth in this period was hourly labour productivity growth.

[7] The pandemic's impact on the Slovak economy was addressed in more detail in last year's Structural Challenges report.

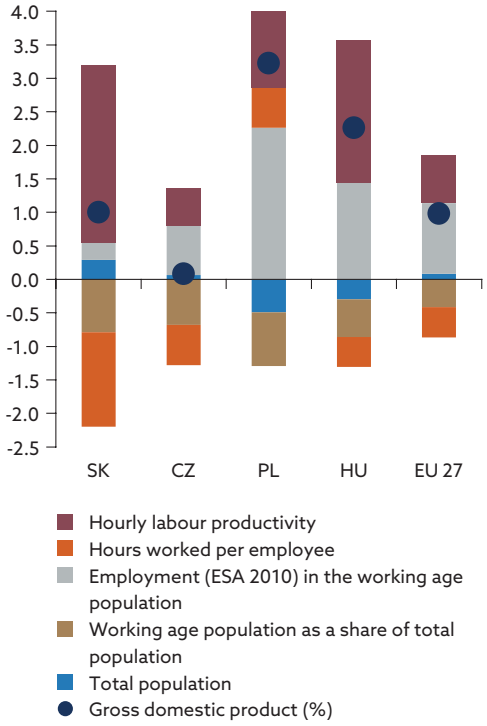
Conversely, the decline in hours worked per employee had a significant negative impact. In Slovakia, the pandemic period saw a jump in hourly labour productivity, as well as in hours worked, which was at odds with the overall trend in the EU27 and in the other V4 countries. The increase in the number of people in employment relative to the working age population was another factor that contributed positively to Slovakia's economic growth, though its impact was not as great as in the other V4 countries or in the EU 27 as a whole. As in other countries, population ageing is having a negative impact on economic growth.

Chart 5
Contributions to real GDP growth in Slovakia (percentage point contributions)



Sources: Eurostat, and NBS calculations.

Chart 6
Contributions to real GDP growth in V4 countries and the EU27 (average growth for 2020–22)



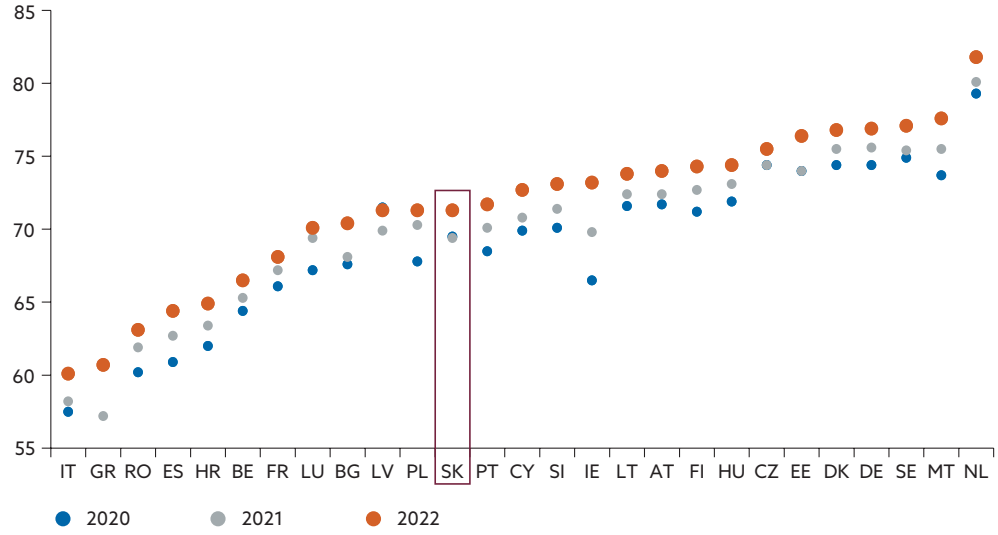
Sources: Eurostat, and NBS calculations.

Slovakia's employment rate increased in 2022. In the previous year, Slovakia and Latvia were the only EU27 countries that failed to improve their employment rate. For the 20-64 age group, Slovakia last year reported the fifth-highest employment growth in the EU27, bettered only by Greece, Ireland, Estonia and Bulgaria. Slovakia thus slightly surpassed the EU27 average employment rate.[8] A more detailed breakdown of em-

[8] Slovakia remains, however, slightly below the (unweighted) EU country average, which is used in estimating underperformance in particular areas (so-called policy gaps). A more detailed explanation of the methodology can be found in the 2021 Structural Challenges report.

ployment rates by age group and gender shows that Slovakia outdid the EU27 average in every group apart from men and women aged 15–24 and men aged 55–64.

Chart 7
Employment rates in EU27 countries



Source: Eurostat.

Employment in all groups contributed positively to Slovakia's employment growth in 2022, but it was the raising of the retirement age that had the largest impact. The largest increase in employment was observed in the 55–64 age group, for both men and women. In this age group, employment growth among women was almost double that among men.

In 2022 employment growth was higher among low-skilled workers than among high-skilled workers. Low-skilled employment was back almost to pre-pandemic levels, after falling significantly faster than employment of workers with higher education in 2020 and 2021.

The share of young people aged 15–29 who are not in employment, education or training reached a historical low in Slovakia in 2022. Almost all EU27 countries saw a drop in this proportion, and the EU27 average decrease was almost the same as Slovakia's result. The only countries where the share increased were Czechia, the Netherlands, Slovenia and Finland

Table 3 Selected employment rate indicators

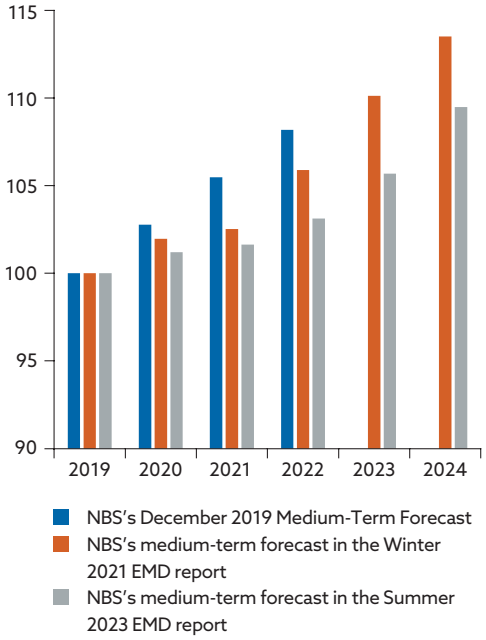
Indicator		2015	2017	2018	2019	2020	2021	2022
Employment rate	SK	64.5	68.1	69.5	70.4	69.5	69.4	71.3
(percentage)	EU27	64.1	66.4	67.3	68.1	67.0	68.3	69.8
Employment rate of age group 15–24	SK	23.4	27.0	27.6	25.0	22.8	20.8	21.3
(percentage)	EU27	30.4	32.2	33.0	33.5	31.5	32.7	34.7
Employment rate of age group 55–64	SK	48.3	54.6	55.9	58.8	60.2	60.6	64.1
(percentage)	EU27	51.4	55.5	57.2	58.6	59.0	60.5	62.3
Part-time employment rate	SK	4.1	4.2	3.5	3.2	3.2	3.1	3.1
(percentage)	EU27	13.6	13.8	13.7	13.2	11.9	12.1	12.1
Temporary employment rate	SK	6.1	5.4	4.7	4.5	3.7	3.5	3.6
(percentage)	EU27	19.6	19.5	19.3	19.3	17.8	17.7	17.6
Employment rate of persons with less than upper-secondary educational attainment	SK	13.9	16.5	16.2	15.9	13.9	13.7	15.4
(percentage)	EU27	41.9	43.6	44.4	44.9	43.6	44.0	45.8
Employment rate of persons with tertiary educational attainment	SK	82.0	83.8	84.7	85.9	85.5	85.4	86.9
(percentage)	EU27	82.2	83.8	84.3	84.8	83.8	85.0	86.0
Young people aged 15–29 not in employment, education or training	SK	16.4	15.1	13.8	13.7	14.4	14.2	12.3
(percentage)	EU27	15.5	14.0	13.3	12.8	13.9	13.1	11.7

Source: Eurostat.

2.2 Economic vulnerabilities

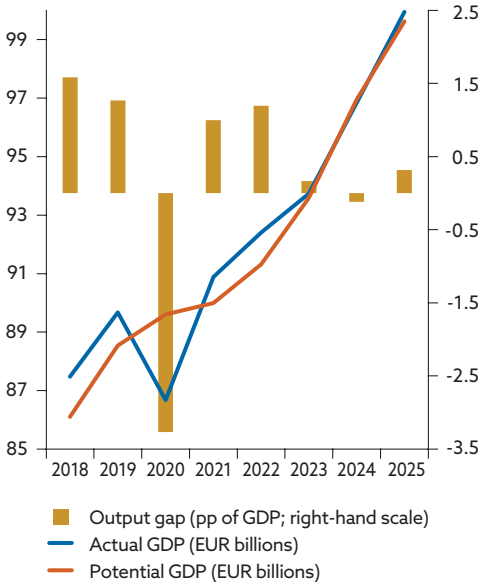
The Slovak economy has been relatively resilient to negative shocks in the form of the pandemic crisis, the war in Ukraine and the war-related energy crisis. As the pandemic's negative impact has faded, cyclical developments are expected to be relatively favourable, with the domestic economy operating at close to potential. Moreover, this development is expected to be coupled with a gradual decline in inflation, which peaked in February of this year. In the recent crisis years, however, with the pandemic being followed by the Ukraine war and high energy prices, there have been supply chain disruptions, trend shifts in consumer behaviour and the labour market, and a weakening of the part of the corporate sector more exposed to these negative shocks. These factors have weighed on the Slovak economy's potential output, which has undershot projections made before the pandemic and before the outbreak of the Ukraine war (Chart 8). The low growth potential of the Slovak economy points to a need to implement structural reforms and increase innovation capacity.

Chart 8
Potential output projection (index: 2019 = 100)



Source: NBS.

Chart 9
Cyclical developments



Source: Národná banka Slovenska's Summer 2023 Economic and Monetary Developments report.

A stable financial sector has also contributed to the Slovak economy's resilience. Slovak banks are sufficiently well capitalised[9] to cope with a potential increase in credit losses. Banks' capital strength is reinforced by their capital headroom, i.e. surplus of capital resources above minimum regulatory requirements.[10] At the same time, banks' profit-making capacity is currently at a healthy level that allows them to maintain solvency. Banks are now benefiting from rising interest rates, as a result of which their net interest margins have returned to growth after a decade of decline. In order to further boost banks' resilience, the countercyclical capital buffer (CCyB) has been raised by 50 basis points, to 1.5% of risk-weighted assets, with effect from 1 August 2023. In terms of their liquidity position, banks in Slovakia remains stable, although they are facing gradually rising funding costs, as reflected, for example, in their issuance of securities. In the insurance sector, capital adequacy also remains elevated.

Financial sector developments have moderated since the autumn of last year. The credit and housing markets, which until recently were experiencing strong expansionary trends, have cooled significantly. A combination

[9] The total capital ratio of the Slovak banking sector was 19.7% of risk-weighted assets at the end of the first quarter of 2023.

[10] The aggregate capital headroom amounted to 3.9% of risk-weighted assets at the end of the first quarter of 2023.

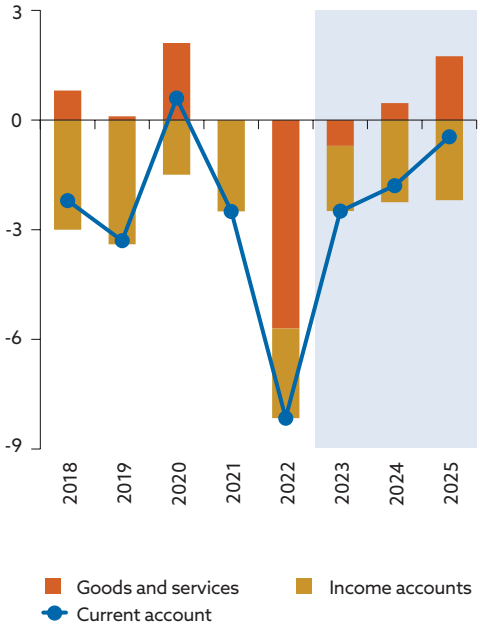
of rising interest rates, increases in living costs and manufacturing input costs, housing price expectations, and persisting uncertainty have made households and firms less included to borrow. In Slovakia, the tightening of financial conditions has been reflected mainly in a softening of demand for new mortgages and a housing market downturn. The slowdowns in the mortgage and housing markets can be viewed as positive from a financial stability, given these markets' previously strong upswings. It is the case, however, that the share of new mortgages with riskier attributes (a high DSTI ratio[11] for a 30-year maturity) has increased. Non-performing loan ratios remain low for the time being. Nor is the volume of provisioning out of line with normal levels. In the context, however, of rising costs and interest rates, some borrowers may find it increasingly difficult to service their debts. Higher sensitivity is particularly evident in the commercial real estate sector.[12]

A risk lies in the Slovak economy's declining price competitiveness, resulting from surging inflation and unfavourable developments in Slovakia's current account balance. Real effective exchange rate appreciation, caused mainly by consumer and producer price inflation being higher in Slovakia than in its trading partners, is affecting the cost-efficiency of production in Slovakia. Even so, manufacturing producer price developments remain relatively favourable for the time being. Tightening of the labour market due to skilled labour shortages, as well as to the impact of higher inflation on wage bargaining, has resulted in unit labour cost growth exceeding the EU27 average. Owing to high energy prices and a deterioration in price competitiveness, last year saw significant declines in the trade and current account balances. According to NBS projections, normalisation of energy prices as well as strongly rising exports will bring about a gradual improvement in the trade balance.

[11] An indicator of debt servicing capacity – the ratio of a borrower's total monthly loan repayments to the borrower's net monthly income less necessary living expenses.

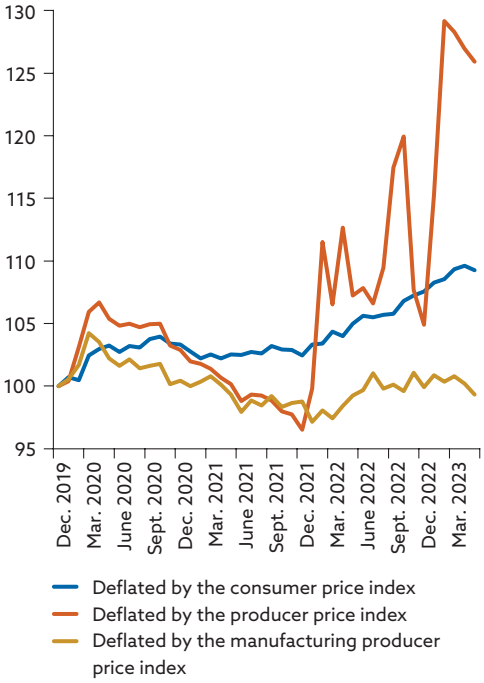
[12] This topic is analysed in more detail in NBS's May 2023 Financial Stability Report.

Chart 10
Balance of payments current account (percentages of GDP)



Source: Eurostat, and NBS's Summer 2023 Economic and Monetary Developments report.

Chart 11
Real effective exchange rate (index: December 2019 =100)



Source: NBS calculations.[13]
Note: Real effective exchange rate growth expresses the real appreciation of the exchange rate.

Public finance sustainability remains a major vulnerability of the Slovak economy According to the European Commission's S2 sustainability gap indicator,[14] Slovakia has the highest debt sustainability risk in the EU and this risk is increasing.[15] The risks in this regard relate mainly to a rapidly ageing population and an unsustainable configuration of the pension system, but also to the current loose fiscal policy. Public finances are being burdened by measures taken in response to high energy prices and to the broader increase in consumer prices. While some of the measures are only temporary in nature, the problem lies in untargeted measures that entrench a high burden on public finances. The recovery of public finances thus represents a key challenge for the Slovak economy.

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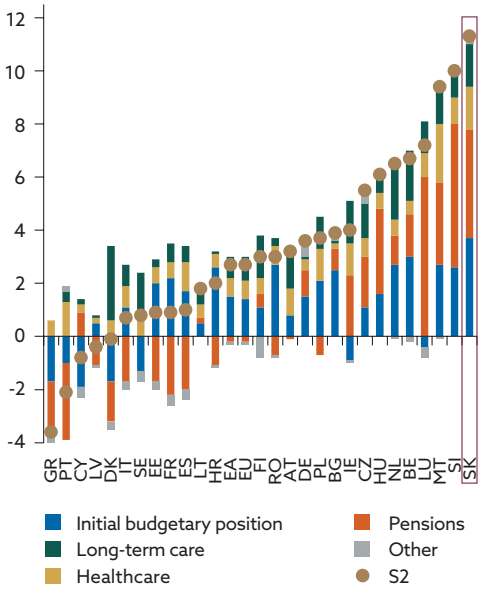
[13] A detailed description of the methodology can be found on the NBS website.

[14] The S2 indicator shows the adjustment to the current structural primary balance required to stabilise public debt.

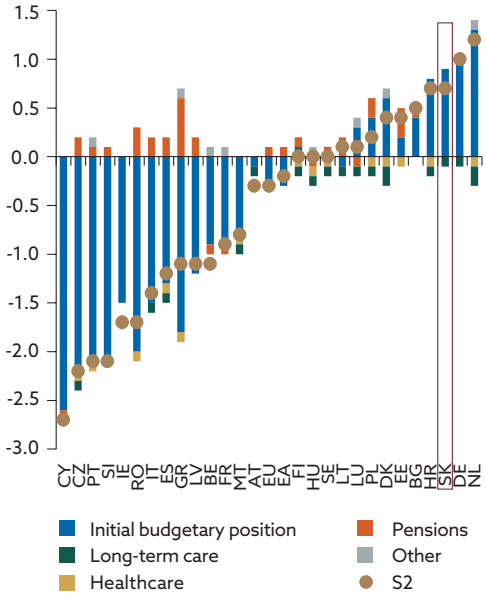
[15] Slovakia's Council for Budget Responsibility (CBR) estimates the S2 indicator to be at 5.9 pp of GDP. The CBR argues, that, unlike the EC, it takes into account long-term projections of all revenue and expenditure items of public finances as well as recent adjustments to the pension system. However, the CBR's approach may not be internationally comparable. Furthermore, even according to the CBR's estimate, Slovak public finances face a high sustainability risk.

Chart 12
Decomposition of the S2 fiscal sustainability gap indicator (2022)



Source: European Commission.

Chart 13
Change in the S2 indicator between 2021 and 2022



Source: European Commission.

2.3 Social inclusion

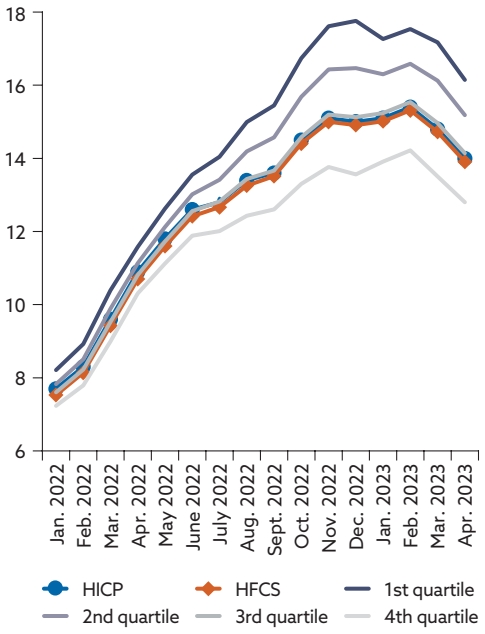
Slovakia's social inclusion scoreboard has worsened, as surging inflation has adversely affected the living standards of vulnerable groups. Last year, the share of the Slovak population at risk of poverty or social exclusion (AROPE) was higher than the EU average, as was the country's material deprivation rate. Despite the easing of headline inflationary pressures in early 2023, price increases continue to affect some households more than others, mainly households with the lowest level of consumption. The increase in price of these households' consumption basket has remained around 3 pp higher compared with higher-income households (Chart 14).[16]

Moreover, low-income groups are unable to tap into savings – and therefore absorb a negative price shock – to the same extent that high-income households can. The households that have managed to accumulate savings at a greater rate than they did before the pandemic are primarily higher-income. Conversely, lower-income households were spending their savings even before the pandemic crisis had passed (according to 2021 observations) (Chart 15). Median-income households showed similar behaviour during both observation periods, while the households able to increase their savin-

[16] The analysis works with data from the third wave of the Household Finance and Consumption Survey conducted in Slovakia in 2017, not from the fourth wave conducted in 2021. This is because any consumption basket changes during the pandemic were likely to be temporary and forced.

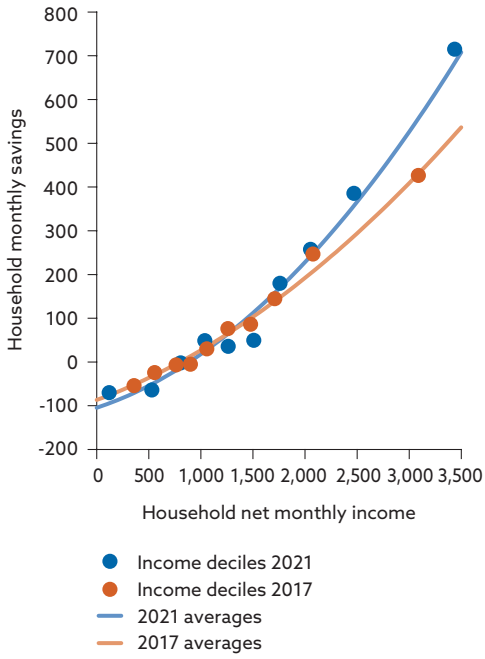
gs by around €100 per month were mostly in the top 30% income bracket. Based on this partial analysis, it can be argued that the 'pandemic' increase in total savings had only a limited impact on the ability of low-income groups to cope with the increase in their living costs during 2022. For low-income individuals in employment, this negative development was, however, partly offset by their nominal incomes rising faster than those of higher earners.[17]

Chart 14
Inflation in Slovakia by quartiles



Sources: SO SR, HFCS 2017, and NBS calculations.
Note: Inflation based on household consumption baskets, by volume of household consumption according to the 2017 HFCS. Other aspects of the analysis are presented in Box 1 of NBS's Winter 2022 EMD report.

Chart 15
Savings during the pandemic period



Source: HFCS 2017, HFCS 2021, and NBS calculations.
Note: Comparison of monthly savings levels by deciles of net household income between 2017 and 2021 (two HFCS waves). The x-axis shows net monthly income; the y-axis, net savings (in euro). The differences are statistically significant.

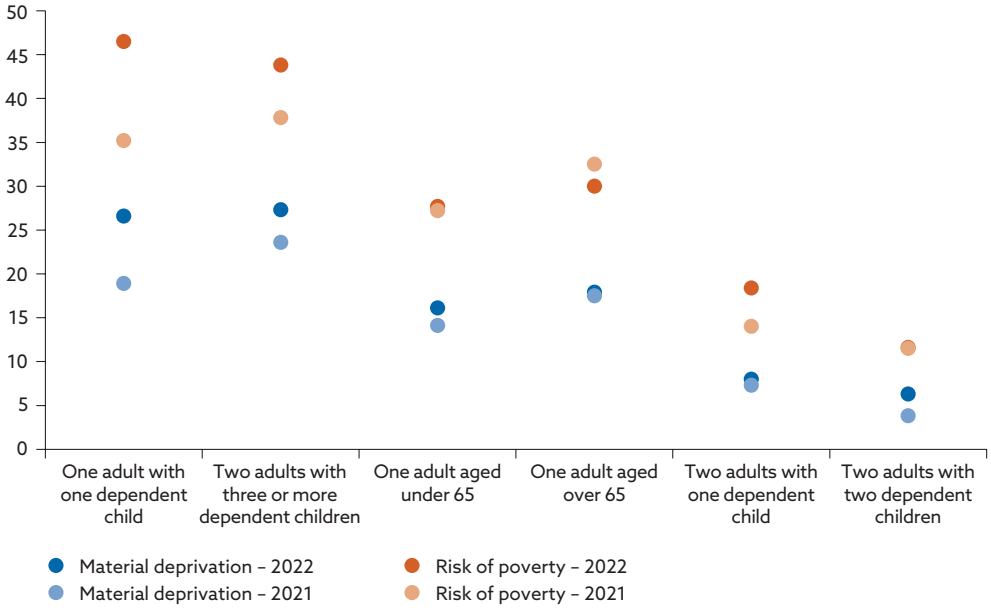
In 2022 the risk of poverty or social exclusion increased in particular for the most vulnerable household groups. For single-parent families, this risk was as much as one-third higher in 2022 than in the previous year. As a result, this household type became the most at risk of poverty or social exclusion, ahead of households with two adults and three or more dependent children. Households comprising one person aged over 65 were the only household type whose AROPE rate fell slightly in 2022, after it had more than doubled between 2018 and 2021. This was a modest drop that stemmed

[17] A more detailed analysis can be found in Section 4.2 of NBS's May 2023 Financial Stability Report. In 2022 the decline in real incomes, defined as the difference between the increase in nominal net incomes and the average increase in prices, was less pronounced for lower-income employees.

from relatively large one-off measures, including a 14th pension payment and a vaccination bonus – part of which was not paid in December 2021 but was carried over to 2022. Across EU27 countries, an opposite trend was observed for these types of households. For single pensioners, the risk of poverty or social exclusion is higher, while for single-parent households and two-parent households with three or more children, it is lower.

The material deprivation rate developed very similarly to the AROPE rate in 2022. It increased the most for single-parent households and two-parent households with three or more children, but these increases were less than those in the AROPE rate. Conversely, for households comprising one person aged over 65 and households with two adults and two children, the material deprivation rate increased more than the AROPE rate.

Chart 16
Comparison of material deprivation and AROPE rates in 2021 and 2022



Source: Eurostat.

Across EU countries, the gender income gap narrowed moderately in 2022, as it did also in 2021. In Slovakia, by contrast, the gap increased. On this metric, the country's position within the EU27 returned to its 2019 level, though that still represented an improvement in absolute terms.

Government measures should focus more on targeted support for population groups that have been disproportionately affected by increases in food and energy prices. The rises in food and energy prices have differentially affected different population groups, compounding disparities in market and social income developments. Although government measures have been extensive, they have not been sufficiently targeted at the most vulnerable groups. In addition to the key challenge of putting Slovakia's

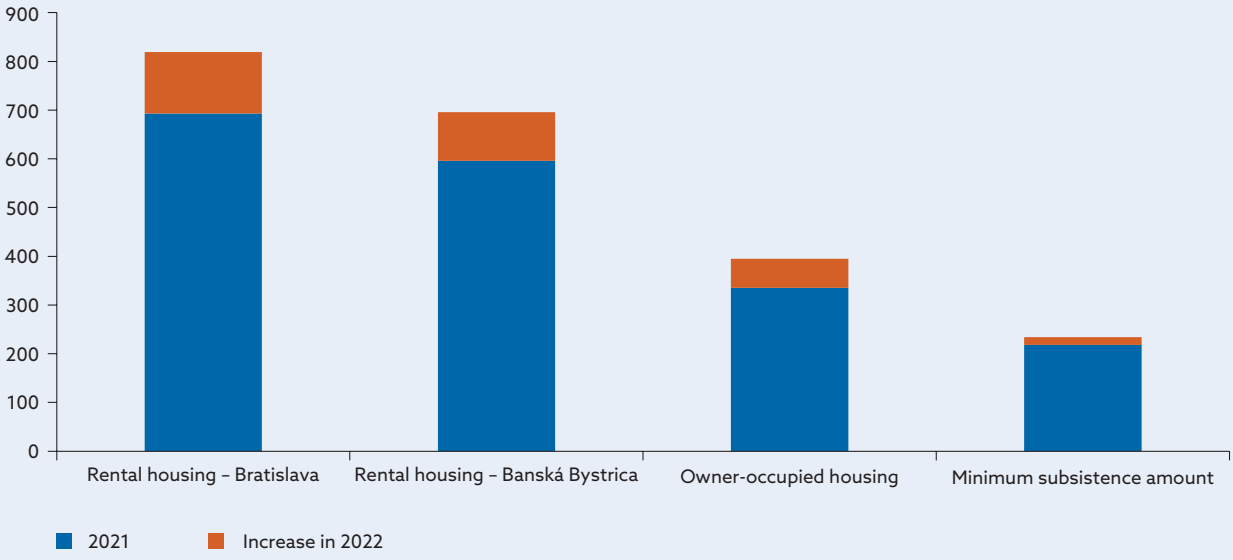
public finances back on a sustainable track, there remains the challenge of how to better design social policies, which would also benefit from a review of how the subsistence minimum is calculated (Box 1).

Box 1
Living income

Social security in Slovakia is largely based on the concept of a minimum subsistence amount, i.e. how much money households need to meet their basic needs. This amount, however, is not well measured, since fundamental aspects of the current system were set back in 1998; they reflect the economic situation as it was then and are now outdated (Novysedlák et al., 2022[18]).

In an NBS Discussion Note, Fabo and Gertler (2023)[19] introduced the concept of a 'living income' that reflects households' living costs based on real prices. The authors draw on a methodology laid down in the literature (Fabo et al., 2022[20]). The main finding is that the state-set minimum subsistence amount is significantly lower than the estimation of the living income, and that this gap widened further in 2022 (Chart A).

Chart A
The living income for a single-person household compared with the current minimum subsistence amount (euro)



Source: Fabo and Gertler (2023).

[18] Blog post by Viktor Novysedlák, Zuzana Sierbertová and Norbert Švarda, "Dvojaká chudoba ...alebo keď nevieme, kto je chudobný" (Double poverty... or when we don't know who is poor), *Analytické postrehy*, Council for Budget Responsibility, May 2022 (in Slovak only).

[19] Fabo, B. and Gertler, P., "Ekonomické životné minimum – nová metrika životných nákladov domácností" (The living income – a new metric of households' living costs). *NBS Discussion Notes*, No 127, Národná banka Slovenska, April 2023 (in Slovak only).

[20] Fabo, B., Guzi, M. and Šofranková, B., "The living income for Slovak households", *NBS Occasional Papers*, No 1/2022.

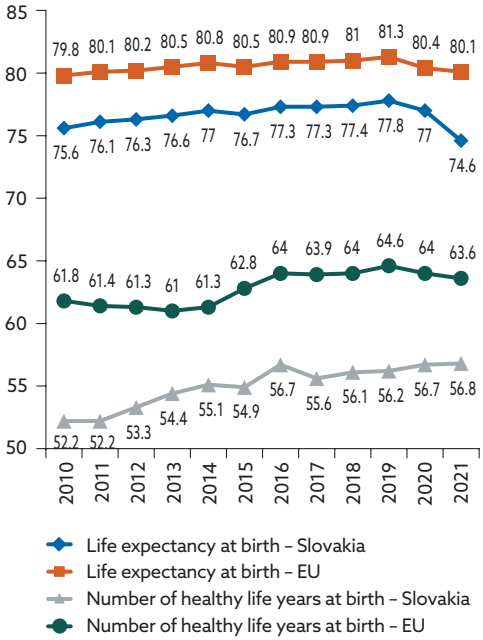
In February 2023 the Slovak Parliament approved an amendment to the Material Need Act, effective from 1 April 2023, which adjusted the indexation method for the minimum subsistence amount. The indexation will now reflect the impact of inflation on low-income households and will no longer take income developments into account. As a result, the minimum subsistence amount will rise by 14.7% from July 2023, which for single-person households means an increase from €234 to €269 per month. According to an analysis by Fabo and Gertler (2023), not even this increase will bring the minimum subsistence amount close to the real cost of living in Slovakia.

The existence of significant disparities between real living costs and the state-set minimum subsistence amount leads to a need to use arbitrary multipliers of the minimum subsistence amount when setting the level of social benefits. Such a situation entails potential undesirable effects in the form of the introduction of arbitrariness into the social assistance system and the complication of social policy targeting. Therefore, it would in future be advisable to initiate a professional debate on how to set the minimum subsistence amount so that it is line with real living costs. Any adjustment of the minimum subsistence amount will also require a reassessment of the many government transfers currently linked to that amount, taking into account the possibilities of the state budget and the incentivisation dimension of the social assistance system.

2.4 Health

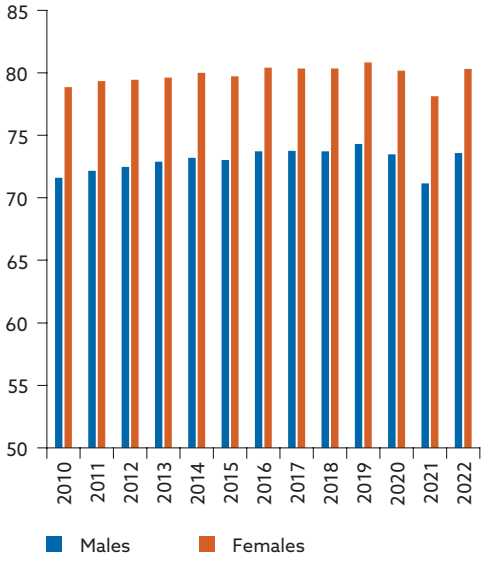
As in previous years, Slovakia shows significant underperformance in key health outcome indicators. The COVID-19 pandemic was a major cause of the deterioration, but the adverse trend points also to deeper problems. Life expectancy at birth in Slovakia has long been one of the lowest in the EU, and it fell markedly further in 2021 (Chart 17). Indeed, life expectancy was almost 2.5 years lower in 2021 than in 2020, compared to an average decline of only half a year for the EU as a whole. By comparison, the decline in life expectancy between 2019 and 2020 was at a similar level of almost ten months in both Slovakia and the EU on average. The latest data suggest that life expectancy at birth for both males and females in 2022 had recovered to 2020 levels (Chart 18), but the above-mentioned underperformance relative to the EU persists. In terms of the number of healthy life years at birth, the gap between Slovakia and the EU is even wider (Chart 17). For life expectancy at birth, the average difference between Slovakia and the EU between 2010 and 2021 was three years and almost 11 months, while for the number of healthy life years at birth, it was seven years and nine and a half months.

Chart 17
Life expectancy at birth (years) and number of healthy life years at birth



Source: Eurostat.

Chart 18
Life expectancy at birth for males and females in Slovakia (years)



Source: SO SR.

The infant mortality gap between Slovakia and the EU average has widened further in recent years, while maintaining significant regional disparities. The deterioration relative to the EU is mainly because infant mortality rates have improved in the EU while remaining unchanged in Slovakia. This situation will need to be monitored in coming years in order to assess whether it concerns an EU trend that we have failed to capture or whether it is an effect of the postponement of pregnancies during the pandemic. Regional disparities in this regard have also remained largely the same, with Bratislava Region at a similar level as Czechia and with western Slovakia on a par with the EU average or with the lowest-ranked, north-western region of Czechia. Eastern Slovakia trails far behind these regions, with an infant mortality rate four times higher than that in Bratislava Region.

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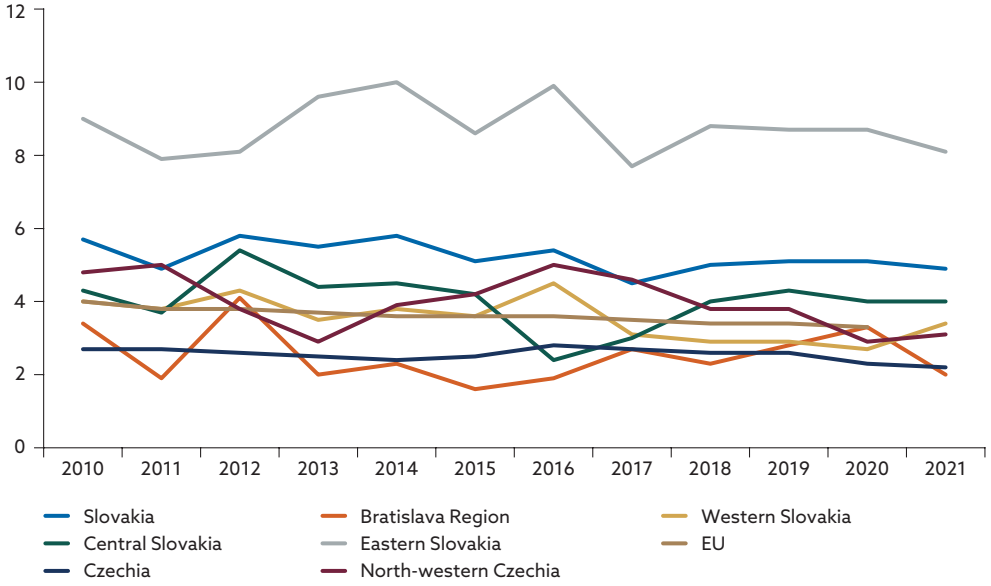
Chart 19
Infant mortality (deaths per 1,000 live births)



Source: Eurostat.

Slovakia currently has a shortage of doctors and, even more so, nurses compared with the EU average. This shortage may be one of the factors contributing to the suboptimal health outcomes mentioned above. It is highly likely that population ageing will make this problem even more acute in coming years. According to a projection by Múčka and Múčka (2023),[21] there will be 12,000 fewer nurses by 2050 than there are now unless the healthcare system undergoes changes of a more fundamental nature. The shortage of healthcare staff and the negative outlook in this regard represent a significant barrier to reversing the unfavourable trend in prevention and preventable mortality. It also raises serious questions about the health system's preparedness for possible future health crises.

Slovakia's outcomes in cancer prevention and treatment have been poor for a long time. The estimated incidence of cancer is higher than the EU average, especially for prostate, breast, colorectal and lung cancers.[22] A significant role in this regard is played by risk factors such as smoking, obesity, alcohol consumption and by the number of premature deaths due to air pollution, which are failing to improve or are worsening compared with the EU average. Barriers to accessing cancer care in Slovakia include financial barriers for those on low incomes and geographical barriers for people living in regions with a limited supply of healthcare services.

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[21] Múčka and Múčka, "Budúcnosť lekárov a sestier v zdravotníctve" (The future of doctors and nurses in the health system), blog of the Council for Budget Responsibility, 2023.

[22] OECD, "Country Cancer Profile: Slovak Republic 2023", EU Country Cancer Profiles, OECD Publishing, Paris.

Another problem appears to be insufficient basic public awareness of screening programmes, as shown by a study on colorectal cancer prevention.[23] Prevention could be improved by raising public awareness, increasing access to cancer prevention services (including making appointment systems as simple as possible) and making cancer testing kits available from pharmacies. The announced introduction of lung cancer screening through an improved digital ticket system (eExchange) can be seen as a step in the right direction, though how beneficial it is will greatly depend on how effectively it is implemented.

Additional causes for concern are a declining influenza vaccination rate among people aged over 65 and a slide in the measles vaccination rate to below the herd immunity threshold.[24] A sustained decline in vaccination rates may pose a further significant risk to the sustainability of the health system. It is therefore necessary to closely monitor and assess whether the current decline stems from people temporarily postponing vaccinations or from a permanent shift in peoples' attitudes to vaccinations, reflecting their experience with the COVID-19 vaccination and related exposure to misinformation. Effective, scalable information interventions can help reverse this negative trend. For example, a study by Bartoš, Bauer, Cahlíková and Chytilová (2022),[25] based on surveys conducted in Czechia, identified widespread misperceptions about doctors' support for COVID-19 vaccination and subsequently showed that making known doctors' actual support for vaccination (90% of doctors trust the approved vaccines) results in a persistent increase in vaccine uptake.

2.5 Environment

One of Slovakia's main challenges is how to restart economic convergence with advanced EU economies while simultaneously reaching the target of climate neutrality by 2050. In terms of its greenhouse gas emissions (GHG) per capita, Slovakia's is currently below the EU average. At the same time, however, Slovakia is still economically lagging behind more advanced EU economies. Combining economic convergence with emissions reduction poses a significant challenge for our economy. In this regard, Slovakia should take Sweden, rather than Czechia, as an example (Chart 20).

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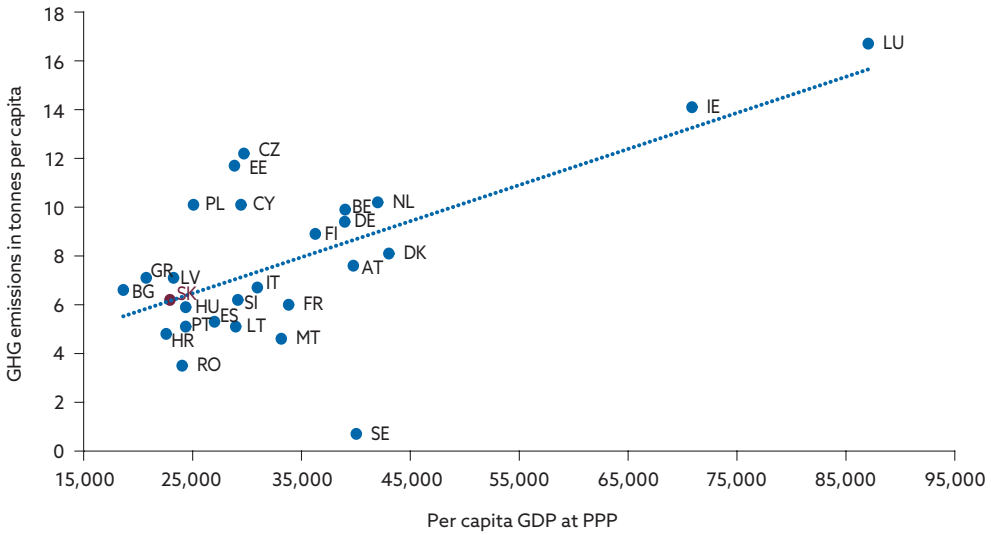
[23] Chadimová, K., Cingl, L. and Tužilová, B., "Uncovering Reasons for Colorectal Cancer Screening Avoidance", December 2022.

[24] Public Health Authority of the Slovak Republic, Press Release, April 2023.

[25] Bartoš, V., Bauer, M., Cahlíková, J. and Chytilová, J., "Communicating doctors' consensus persistently increases COVID-19 vaccinations", *Nature,* No 606(7914), June 2022, pp. 542–549.

Chart 20

Greenhouse emissions relative to GDP per capita for EU27 countries

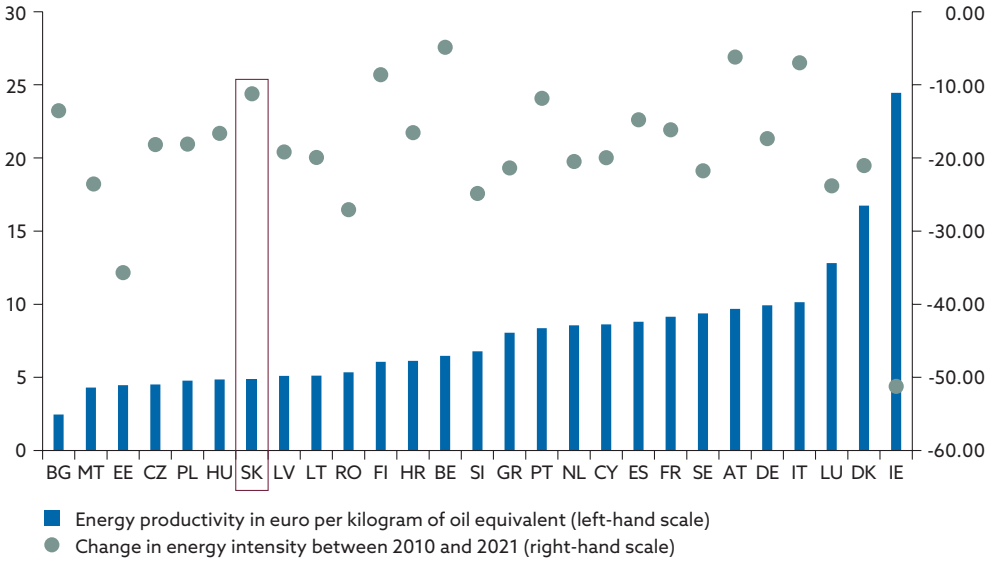


Source: Eurostat.

The energy crisis has highlighted the relatively high energy intensity of the Slovak economy. Chart 21 shows energy productivity – the amount of economic output produced per unit of gross available energy, expressed in euro per kilogram of oil equivalent. In 2021 Slovakia was in the bottom third of EU27 countries for energy productivity. Between 2011 and 2021, Slovakia's energy intensity dropped 11.2%, exceeding the decline observed in most other EU countries.

Chart 21

Energy productivity (2021)



Source: Eurostat.
Note: Energy intensity is expressed as units of energy per unit of GDP at 2010 constant prices.

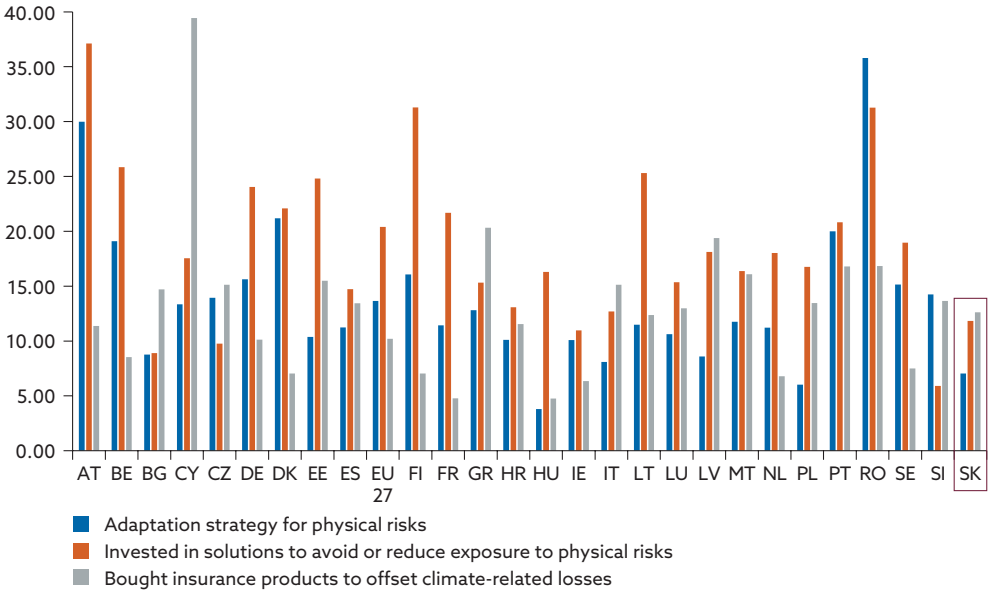
Another challenge is to cut CO2 emissions in the passenger transport sector, as Slovakia is falling further behind the EU average for average emissions from new passenger cars. There is a paramount need for greater promotion of electromobility, but it is evidently also important to continue encouraging people to buy lower-emission cars. Such measures include, of course, supporting alternative propulsions in transport, as well as investment in infrastructure. There is also concern Slovakia will become a dumping ground for older, higher-emission cars western Europe.

The share of solid fossil fuels in final energy consumption remains high, and this situation is likely to worsen because of the war in Ukraine. The share's downtrend reversed in 2021 for the first time since 2010, after falling by three percentage points between that year and 2020. How the share continues to evolve will depend heavily on energy price developments as well as on the possible introduction of green taxes.

Awareness among firms about the adverse weather effects associated with the climate crisis is increasing, but it still remains lower than in many other European countries. In Slovakia, investment in measures to build resilience to physical climate risks is mostly directed towards the purchase of insurance products, less towards specific solutions and still less towards adaptation strategies. In advanced economies such as Austria, Belgium, Denmark, Germany, Finland and the Netherlands, investment in this area is heavily allocated to specific solutions, while investment in insurance products is relatively lower.

Chart 22

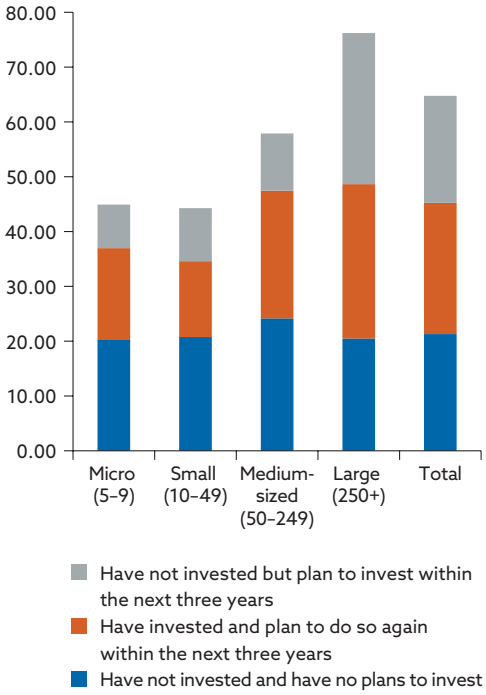
Investment in measures for building resilience to physical risks (percentages in 2022)



Source: EIB Investment Survey 2022.

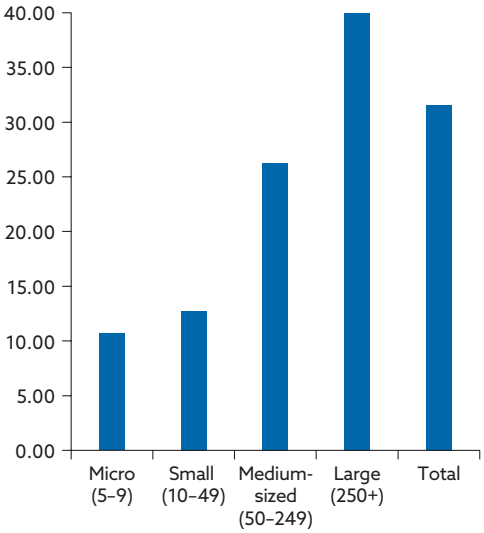
Investments in addressing weather event impacts, in reducing emissions and in monitoring targets for relevant GHG emissions are being led mainly by large and medium-sized firms. Among large firms, 76.19% have either made such investment or they are at least planning to do so within the next three years. For micro and small firms, the figure is less than half. However, only around one-third of large and medium-sized firms have made such investment and plan to make further such investment within the next three years. For micro and small firms, the figure is less than one-fifth. Even lower shares of firms, across all sizes, are setting and monitoring GHG targets. Investments tied to Slovakia's recovery and resilience plan (RRP) may increase these numbers significantly, but it is yet to be seen whether there will be further widening of the disparities between firm size classes in terms of climate resilience investments.

Chart 23
Firms' investment and plans for investment in addressing weather event impacts and in reducing emissions (percentages; 2022)



Source: EIB Investment Survey 2022.

Chart 24
Share of firms that set and monitor targets for relevant GHG emissions (percentages; 2022)



Source: EIB Investment Survey 2022

2.6 Regional challenges

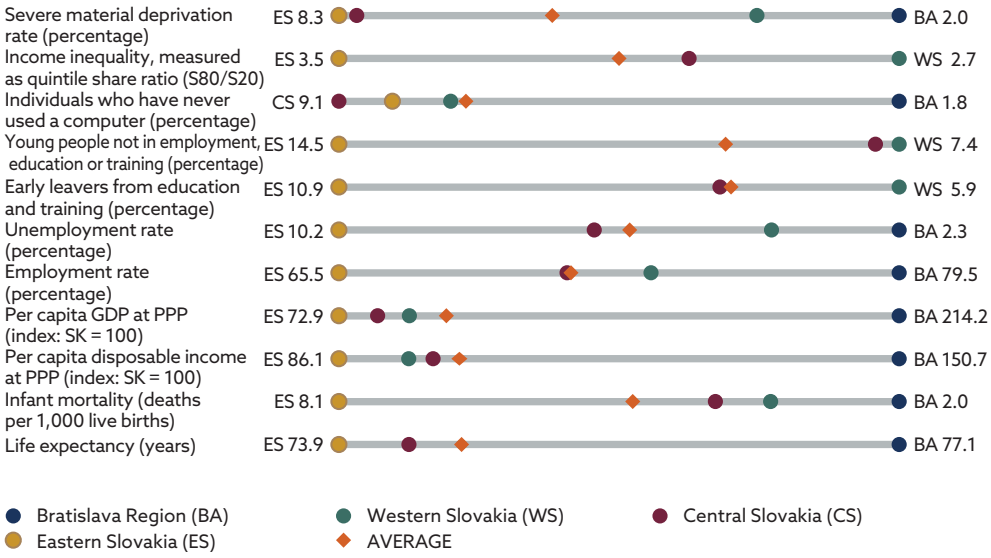
Regional disparities in Slovakia remain significant, but they are narrowing in some areas. This narrowing is most evident in economic indicators. Bratislava Region's disposable income per capita relative to the national average fell in 2022 by more than 14 pp compared with the previous

year. In all of the country's other regions, the disposable income index moved closer to the national average.

Labour market developments have contributed to the reduction in regional disparities. Although the employment rate increased in all regions, it grew faster in central and eastern Slovakia than in western Slovakia and Bratislava Region.

As for infant mortality, western Slovakia was the only region in which it increased in 2022. In Bratislava Region, the infant mortality rate fell to such an extent that it is now more than four times lower than the rate in eastern Slovakia. Western Slovakia also saw a deterioration in the share of young people not in employment, education or training. In terms of this indicator, western Slovakia fell almost to the level of central Slovakia, while eastern Slovakia is almost two times higher.

Chart 25
Selected indicators for Slovak regions



Source: Eurostat.
Note: BA – Bratislava Region, WS – western Slovakia, CS – central Slovakia, ES – eastern Slovakia.

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3 Innovation

The task of reducing Slovakia's productivity gap with Western countries while preparing its economy for dynamic technological changes and the green transition challenges requires migration to a new innovation-based economic model. After proceeding rapidly before the global financial crisis, the convergence of living standards towards the levels of Western countries has almost come to a standstill, and Slovakia now finds itself facing the so-called middle-income trap.[26] This situation indicates a need to reassess the country's current growth model, one based on foreign investment inflows directed primarily to industrial assembly lines. Although this model has brought significant development to the Slovak economy, its potential has in recent years become increasingly exhausted. The transition to an innovation policy implies investing in research and development (R&D), improving the business environment, education and infrastructure, and increasing the competitiveness and innovation potential of domestic firms. Innovation should be at the heart of growth and development across economic sectors, in industry and services alike; not to mention the opportunities in green and social innovation. If successful in managing this transition, Slovakia can avoid the middle-income trap and ensure the sustainable growth and development of its economy.

Our aim in this section is to try to explain what innovation is, how it can be measured, and why the state should support innovation at all. We then map the innovation environment in Slovakia and highlight its weaknesses and strengths in an international context using indicators measuring its performance. Finally, based on examples of good practice from abroad as well as recommendations from international organisations, we attempt to provide recommendations for improving the innovation environment in Slovakia.

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[26] The middle-income trap refers to a situation where a middle-income country can no longer compete internationally in standardised labour-intensive commodities because wages are relatively too high, but it can also not compete in higher value added activities on a broad enough scale because productivity is too low (Paus, E., "Latin America and the Middle Income Trap", *Financing for Development Series*, No 250, ECLAC, United Nations, July 2014, p. 9). The result is slow growth, stagnant or falling wages, and a growing informal economy (Paus, E., "Escaping the Middle-Income Trap: Innovate or Perish", *ADBI Working Paper Series*, No 685, Asian Development Bank Institute, Tokyo, March 2017). A survey of the literature is provided in Glawe, L. and Wagner, H., "The Middle-Income Trap: Definitions, Theories and Countries Concerned – A Literature Survey", *Comparative Economic Studies,* Vol. 58, No 4, 2016, pp. 507–538).

3.1 What is innovation, how do we measure it, and why is it important?

Definitions of innovation vary over time, as well as between different researchers and institutions. Innovation was in the past often viewed narrowly in terms of R&D expenditure or R&D outputs such as patents and other intellectual assets. Over time, however, the understanding of innovation has evolved. Today it encompasses a complex and continuous process that involves the generation of new ideas, activities and results, including their social impact.[27]

For the purposes of describing the innovation environment in Slovakia, we lean towards the definition of innovation laid down in the Oslo Manual[28] – a joint publication of the OECD and Eurostat which sets out an international methodology for collecting and using statistics on innovation and is thus an important starting point for statisticians, researchers and policymakers seeking to understand the importance of innovation and to describe national innovation systems. It defines an innovation as follows: An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).

Innovations are the result of result of innovation activities. Innovation activities include all development, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm. In this context, R&D is just one of the possible innovation activities. Hence data on the registration of intellectual property (IP) rights and on R&D expenditure may not be sufficiently indicative of actual innovation.

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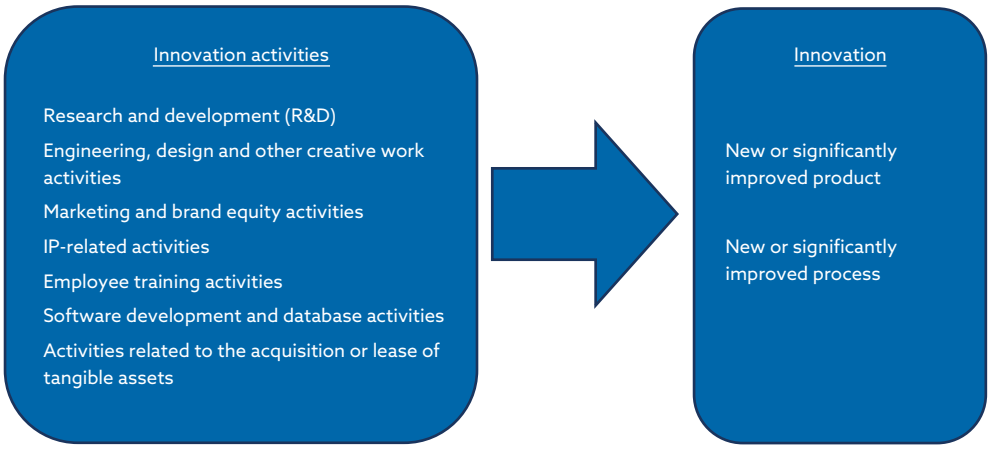
[27] In this edition of the Structural Challenges report, the chapters on innovation focus primarily on innovation in the business environment and its direct economic impact. Social innovation is an important component of the overall innovation environment with direct and indirect impacts extending beyond the economic sphere.

[28] OECD/Eurostat, "Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation", 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, 2018.

Figure 1
Innovation activities and innovations



Source: NBS on the basis of the Oslo Manual (2018).

For this reason, statistical surveys on innovation are needed to provide a broader view of innovation activities and their outcomes. An example in the European context is the Community Innovation Survey.[29] Such surveys bring a more comprehensive view of innovation, allowing a better understanding of what activities contribute to innovation and what impact these innovations have on the economy and society. Ultimately, they provide policymakers and entrepreneurs with better information with which to promote innovation effectively and thus contribute to sustainable growth and economic development.

Innovation is generally considered to be an important driver of economic growth, especially in the long term. However, the relationship between innovation and growth is complex and difficult to quantify. On the one hand, there is no direct relationship between innovation activity and the outcomes of that activity. On the other hand, as the previous section explained, a precise definition of innovations is also problematic. These problems thus complicate the search for an empirical relationship between innovation and economic growth. As pointed out by the OECD (2015),[30] however, if innovation's contribution to economic growth is looked at through a production function framework, it is found to be in three key places:

- **A contribution resulting from technological progress embodied in physical capital; for example, investment in more advanced machine-**

[29] Eurostat: Community Innovation Survey. The Community Innovation Survey (CIS) is the benchmark survey on innovation in firms in EU countries, Norway and Turkey. Data are collected every other year and are also used to compile some of the indicators in the European Innovation Scoreboard.

[30] *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*, OECD Publishing, OECD, Paris, 2015.

ry or in new computers. According to the OECD,[31] between 0.2 and 0.4 pp of OECD countries' GDP growth between 1985 and 2000 was linked to such embodied technological progress. Similarly, about 0.35 pp of GDP growth between 1995 and 2013 can be attributed to investment in ICT capital alone.

- **Investment in intangible capital, such as R&D, software, design and data.** According to one study,[32] this type of investment accounted for around 0.5 pp of GDP growth in EU countries from 1995 to 2007, and 0.9 pp in the United States. Similarly, a 0.1% of GDP increase in business expenditure on R&D can improve GDP by 0.46% in the long run. [33]
- **A contribution linked to increased multifactor productivity (MFP), reflecting increased efficiency in the use of labour and capital, a substantial part of which can be attributed to different types of innovation as well as the spillover effects of investments in technology or intangible capital.** According to OECD (2015), MFP accounted for over 0.7 pp of twenty selected OECD countries' GDP growth between 1995 and 2013 or about one-third of total OECD GDP growth.

Despite the difficulty of precisely identifying how and to what extent innovation contributes to economic growth,[34] increasing the economy's innovation capacity is crucial to reviving convergence with Western countries. According to a study by Habrman, Habodászová, and Šrámková (2022),[35] Slovakia's underperformance relative to the German economy is due mainly to allocative inefficiency and, to a lesser extent, technological backwardness. Historically, total factor productivity (TFP) growth as well as non-ICT capital made a major contribution to Slovakia's GDP growth and convergence with euro area countries (Chart 26 or Chart 27) in the period before the global financial crisis; subsequently, however, Slovakia's economic growth moderated, mainly due to a slowdown in TFP growth. Conversely, investment in ICT capital has long been a problem for the Slovak economy. Although TFP growth, as well as investment in ICT and other capital, need not be the result of innovation activity, improvements in in-

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[31] See also the following: *The Sources of Economic Growth in OECD Countries*, OECD Publishing, OECD, Paris, 2003; *Compendium of Productivity Indicators 2015*, OECD Publishing, OECD, Paris, 2015.

[32] Corrado, C., Haskel, J., Jona-Lasinio, C. and Iommi, M., "Intangible Capital and Growth in Advanced Economies: Measurement Methods and Comparative Results", *IZA Discussion Papers*, No 6733, Institute of Labor Economics (IZA), 2012.

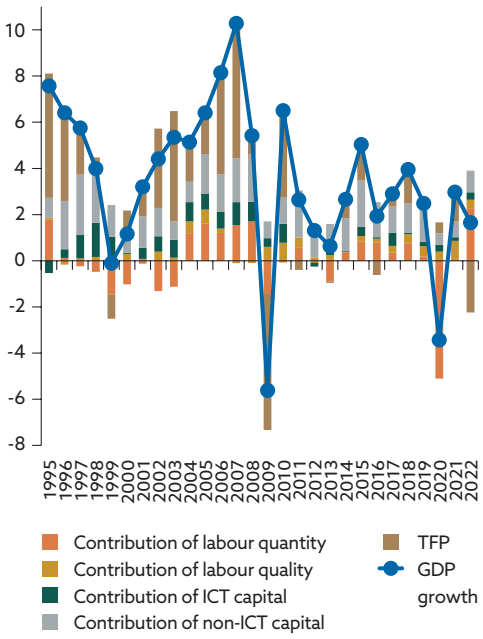
[33] Égert, B. and Gal, P., "The quantification of structural reforms in OECD countries: A new framework," *OECD Journal: Economic Studies*, OECD Publishing, 2016.

[34] Evidence shows that countries with higher R&D spending are richer (Jones, 2015)

[35] Habrman, M., Habodászová, Ľ. and Šrámková, L., "Reformný kompas slovenskej ekonomiky", Economic analysis – Policy paper, No 59, Institute for Financial Policy, 2022 (in Slovak only).

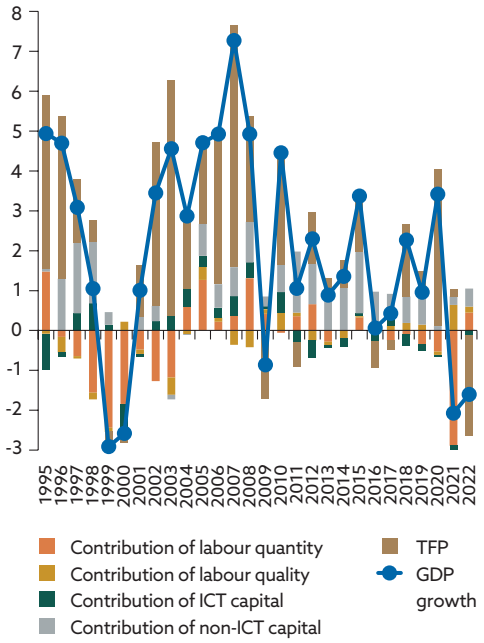
novation activity should, through these channels, translate into higher growth potential for the Slovak economy.

Chart 26
Decomposition of Slovakia's economic growth by contributions (percentage points; percentages)



Source: Total Economy Database.

Chart 27
Slovakia's economic growth and its contributions in terms of difference from the euro area average (percentage points)



Sources: Total Economy Database, and NBS calculations.

3.2 The rationale for innovation policies

The rationale for the need for innovation policies is a matter of extensive discussion among academics and policymakers. According to the OECD (2015)[36] and to Appelt et al. (2016),[37] constraints that affect innovation and can provide a rationale for existing innovation policies may be divided into the following main categories:

- **Low economic returns:** Factors that create inertia in economic systems (e.g. linked to barriers to competition, lack of cooperation within an innovation system, prevailing norms and habits, and technology lock-in) and capacity constraints These constraints are often linked to a lack of skills or infrastructure, or inadequate institutions or bureaucracy.

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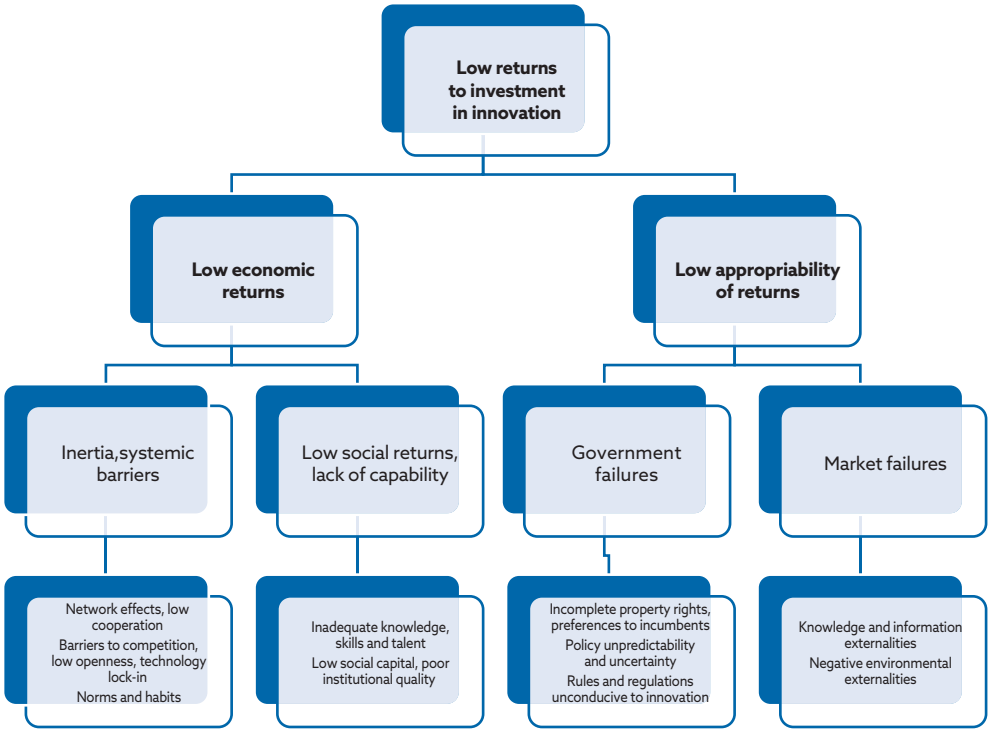
[36] *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*, OECD Publishing, OECD, Paris, 2015.

[37] Appelt, S., Bajgar, M., Criscuolo, C. and Galindo-Rueda, F., "R&D tax incentives: Evidence on design, incidence and impacts", *OECD Science, Technology and Industry Policy Papers*, No 32, OECD Publishing, Paris, 2016.

- **Low appropriability of returns:** Market or government failures prevent innovation actors from capturing the full value of their investments in innovation, thus leading to underinvestment.
- **Difficulties in finding external finance:** Innovation is an uncertain activity with information asymmetries between inventors and investors. This may imply that external capital for innovation will only be available at too high a cost or will not be available at all. This is a barrier to young and small firms in particular.

Figure 2
Rationale for innovation policies



Source: Adapted from the OECD (2015).

Low economic returns due to inertia and systemic barriers can hinder the introduction of new products and technologies Market imperfections (e.g. network effects,[38] the bias in the market towards existing technologies, insufficient cooperation between preferences for existing technologies, lack of cooperation between innovation actors) may require government intervention through specific innovation policies. However, government intervention can lead to failures (e.g. barriers to competition). **'Low social returns'** implies the absence of conditions enabling productive investment in innovation. Addressing these constraints typically requires capacity building, including a mix of public and private investment in infrastructure, education and institutions. **Government failures** that contribute to **low**

[38] Increasing returns to scale in networks result in barriers to entry.

appropriability of returns can affect different areas of the innovation system. These include in particular the preference to incumbents, the unpredictability of government policies, and regulatory barriers. **Market failures** provide the traditional rationale for innovation policies and lead to well-recognised measures, such as government support for business R&D, government investment in basic R&D, and policies that address negative environmental externalities (e.g. through carbon taxes), thus supporting green innovation. The existence of these barriers should lead to innovation-supporting policies, which we discuss in detail in Section 3.7.

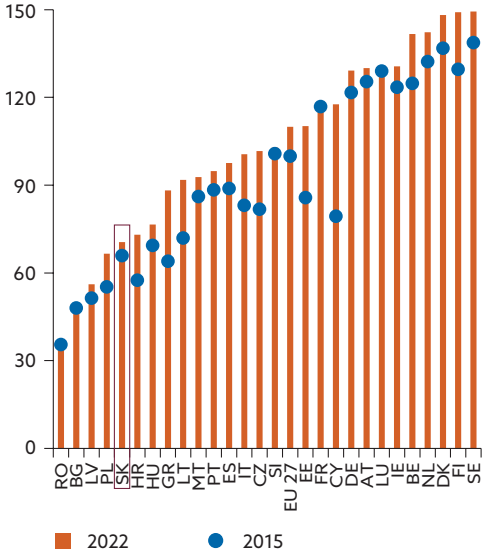
3.3 Innovation and innovation system indicators

The **European Innovation Scoreboard (EIS)** is the European Commission's annual assessment of the innovation performance of EU Member States and selected third countries. The EIS provides important information on the strengths and weaknesses of each country's innovation system and helps them to compare their performance. In the EIS, innovation performance indicators are divided into the following four main types of activities:

- **Framework conditions**: the factors that create the conditions for innovation, such as the quality of research and education, access to information and digital technologies, policy conditions, and the regulatory environment.
- **Investment:** the level of public and private investment in innovation, as well as R&D expenditure.
- **Innovation activities:** activities and processes related to innovation, such as cooperation between firms and research institutions, patent activities, intellectual property protection, and the creation of new products and services.
- **Impacts:** the results of innovation activities, such as employment in innovative sectors, income from innovations, and benefits to society

In the EIS, Member States fall into four performance groups, comprising, from highest to lowest, Innovation Leaders, Strong Innovators, Moderate Innovators, and Emerging Innovators. The countries most often categorised as Innovation Leaders are Denmark, Finland, Sweden, the Netherlands and Belgium. Slovakia, by contrast, is in the Emerging Innovators group. In all the innovation dimensions under review, its performance level is below the EU average, which indicates a need to improve its innovation ecosystem and support its innovation performance.

Chart 28
Performance of EU countries' innovation systems (European Innovation Scoreboard)



Sources: European Commission.
Note: The scores denote performance relative to the EU27 average in 2015.

Chart 29
EIS decomposition

Sources: European Commission, and NBS calculations.

It is important for Slovakia to focus on key areas where the gap between its performance and the European average is the greatest. One such area is the innovation activity of small and medium-sized enterprises (SMEs). These firms form the backbone of the Slovak economy, but their innovation potential is often underutilised Another crucial area where Slovakia is lagging behind is innovation financing and support. This concerns not only public investment in R&D and development, but also the private sector, which should be investing more in innovation. Slovakia is significantly underperforming in respect of innovation and research linkages and cooperation between different actors, such as firms, research institutions, universities, and public sector entities. Reversing this trend and improving Slovakia's EIS ranking by ten places is one of the three main objectives of Slovakia's National Strategy for Research, Development and Innovation 2030.[39]

[39] *Slovensko, ktoré si verí. Národná stratégia výskumu, vývoja a inovácií 2030*, (A Slovakia that believes in itself. National Strategy for Research, Development and Innovation 2030), Research and Innovation Authority (VAIA), 2023 (in Slovak only).

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Table 4 EIS indicator scores

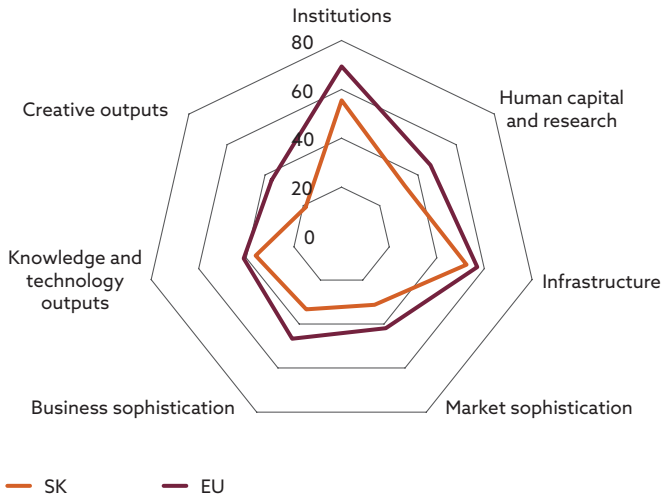
Indicator	2015	2019	2020	2021	2022
SMEs introducing product innovations	-1.10	-1.09	-1.47	-1.47	-1.45
Job-to-job mobility of HRST	-1.21	-1.25	-1.05	-1.42	-1.30
SMEs introducing business process innovations	-0.85	-1.30	-1.34	-1.34	-1.26
Venture capital expenditures	-1.67	-1.42	-1.48	-1.22	-1.15
Scientific publications among the top 10% most cited	-1.16	-1.28	-1.21	-1.29	-1.14
Employment in innovative enterprises	-1.13	-1.16	-1.21	-1.21	-1.10
Broadband penetration	-1.01	-1.01	-1.01	-1.01	-1.04
Population involved in lifelong learning	-1.01	-1.01	-1.01	-1.01	-1.01
Innovative SMEs collaborating with others	-0.39	-0.52	-0.79	-0.79	-0.96
Employment in knowledge-intensive activities	-0.93	-0.93	-0.93	-0.93	-0.93
R&D expenditure in the business sector	-0.84	-0.78	-0.86	-0.90	-0.92
PCT patent applications	-0.88	-0.90	-0.83	-0.88	-0.91
Public-private co-publications	-0.82	-0.81	-0.85	-0.87	-0.91
Knowledge-intensive services exports	-0.84	-0.80	-0.76	-0.85	-0.90
Foreign doctorate students as a % of all doctorate students	-0.55	-0.73	-0.81	-0.90	-0.90
Design applications	-0.81	-0.84	-0.98	-1.00	-0.88
Trademark applications	-0.97	-0.85	-0.86	-0.92	-0.84
R&D expenditure in the public sector	-0.77	-0.67	-0.82	-0.93	-0.83
International scientific co-publications	-0.88	-0.79	-0.85	-0.81	-0.79
Direct and indirect government support of business R&D	-0.88	-0.89	-0.90	-0.70	-0.73
Individuals with above basic overall digital skills	-0.69	-0.69	-0.69	-0.69	-0.69
Enterprises providing ICT training	-0.43	-0.51	-0.44	-0.59	-0.67
Innovation expenditures per person employed	-0.57	-0.84	-0.83	-0.83	-0.57
Population with tertiary education	-0.52	-0.52	-0.52	-0.52	-0.52
Employed ICT specialists	-0.34	-0.34	-0.34	-0.34	-0.34
Resource productivity	-0.03	-0.35	-0.42	-0.27	-0.26
New doctorate graduates	0.70	-0.06	0.01	-0.25	-0.09
Air emissions by fine particulates	0.18	0.36	0.37	0.42	0.49
Non-R&D innovation expenditures	-0.09	0.08	0.39	0.39	0.50
Sales of new-to-market and new-to-firm innovations	2.15	2.20	-0.03	-0.03	0.55
Environment-related technologies	1.08	0.99	0.98	1.08	0.66
Exports of medium and high technology products	1.32	1.54	1.59	1.65	1.58

Sources: European Commission, and NBS calculations.
Note: The scores denote the difference between the indicator value for Slovakia and the EU average normalised by the standard deviation. Positive values thus denote outcomes above the EU average in the given year. However, the absolute value of individual indicator scores may be partly affected by the use of standardised EIS results. A more detailed description of the methodology can be found in the 2021 Structural Challenges report

The Global Innovation Index (GII) captures the innovation environment and innovation performance in 132 economies and maps current global innovation trends. The GII has been produced annually by the World Intellectual Property Organization (WIPO) since 2007. It is composed of individual indicators – 81 in 2022 – divided at a basic level between input and output pillars. Input pillars capture the environment in which and from

which innovation inputs emerge. These include, for example, institutions, human capital, education, infrastructure, and market sophistication. Infrastructure encompasses a wide range of indicators, including more general ones such as gross fixed capital formation and electricity output, and more specific ones such as ICT access, ICT use and ecological sustainability. Output indicators track the quantity and quality of innovations produced in the form of knowledge, patents, and high-tech products, as well as creative activity. As the topic of innovation is itself continuing to evolve, indicators are added or removed and their collection methodology is modified.

Chart 30
Global Innovation Index 2022



Source: WIPO.

Among the V4 countries, Slovakia has the lowest GII ranking. It ranks last in both input and output indicators, with the gap being slightly greater on the input side. Slovakia's underperformance relative to the other V4 countries is most pronounced in education, specifically in expenditure and PISA scales. A second problematic area is investment, both in long-term physical capital and in the capital market. Slovakia also has unfavourable outcomes in R&D, especially in university-industry R&D collaboration in innovation, in which, for example, Czechia's result is more than one-half higher than Slovakia's. After driving Slovakia's economic growth at the start of the millennium, FDI net inflows are now largely exhausted. On this metric, too, Slovakia is the lowest-placed V4 country, while Hungary ranks highest among European countries. This result is probably linked also to the absorption of innovations from abroad, in which regard Slovakia again ranks last among the V4 countries and Hungary ranks first. On the output side, Slovakia's underperformance is most pronounced in creative outputs and in labour productivity growth. Bright spots where Slovakia leads its

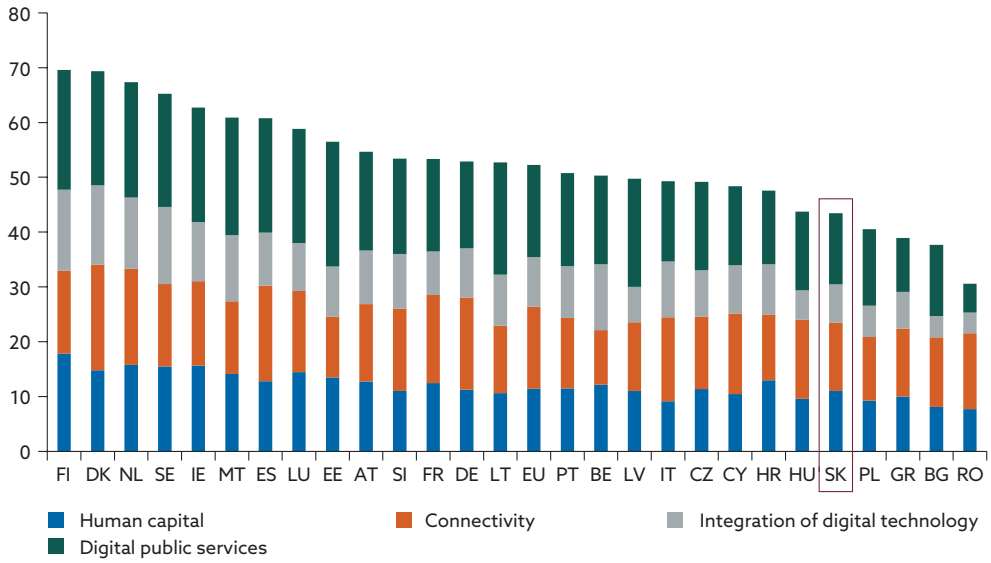
V4 neighbours can be found in the indicators of ecological sustainability and new business registrations per thousand population.

The Digital Economy and Society Index (DESI) is the main measurable indicator used to compare EU countries' fulfilment of digital policy goals. Published annually by the European Commission, the DESI provides an overview of EU countries' progress in digital development. The DESI scores countries' digital performance using indicators divided into four dimensions corresponding to the four principal policy areas of the 2030 Digital Compass:

- Human capital
- Connectivity
- Integration of digital technologies
- Digital public services

The DESI indicates a country's capacity to innovate, since innovation in digitally intensive technologies requires the availability of digital skills in the labour market as well as infrastructure readiness in the form of affordable and high-quality internet connectivity. Another important area is firms' use of AI, cloud services, big data, etc., as firms effective in using such technologies have a greater potential for innovation and for improving productivity and competitiveness. High-quality digital public services reduce the cost of communicating with the state and lead to the possibility of using open data for innovation.

Chart 31
DESI (2022)



Source: European Commission.

In the overall DESI ranking for 2022, Slovakia ranked 23rd out of 27 EU countries. Compared to the previous year, it dropped three places. Its main

area of underperformance is digital public services, where it ranks fourth from last and recorded the second-smallest improvement of any EU country between 2021 and 2022. In internet connectivity and human capital, Slovakia ranks in the bottom third of countries. Over the past five years, Slovakia's overall DESI ranking has mostly deteriorated and the country has made no clear improvement in this area.

Table 5 DESI score history

	2017	2018	2019	2020	2021	2022
SK (ranking out of 27 EU countries)	21	20	21	22	22	23

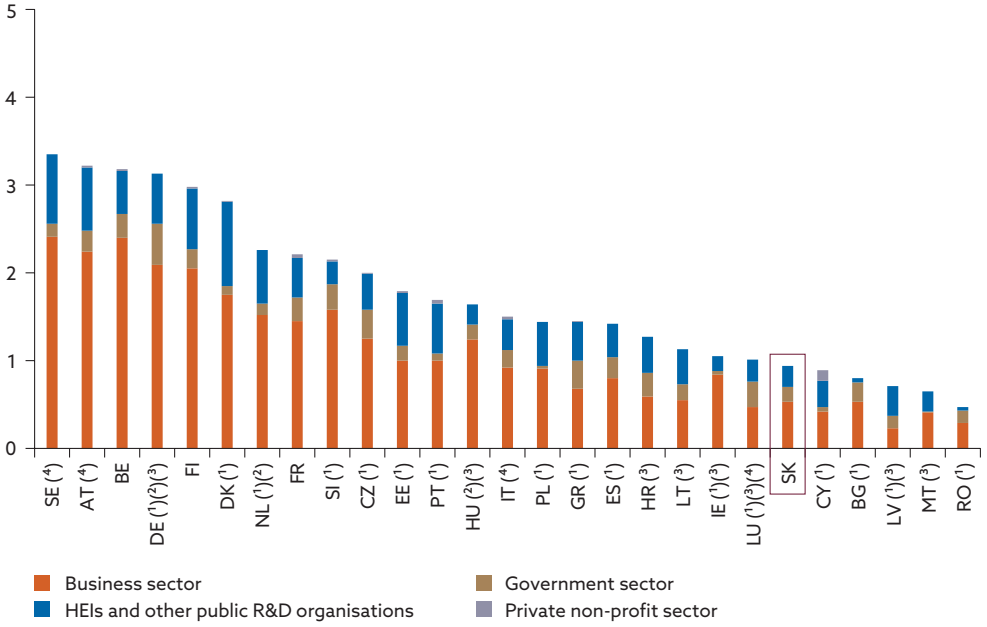
Source: European Commission.
Note: The methodology for calculating the DESI score has changed over time. For this reason, we consider mainly the overall trend rather than the exact ranking.

3.4 Organisation of R&D and innovation support in Slovakia

Slovakia's total spending on R&D as a percentage of GDP is among the lowest in the EU. Slovakia is lagging behind not only western European countries, but also the other V4 countries. The National Strategy for Research, Development and Innovation 2030[40] presented a plan to increase total R&D investment to 2% of GDP. As the OECD points out, however, even to EU innovation leaders such as Sweden,[41] it is not enough simply to increase funding; there must be simultaneous and ongoing improvement in the organisation of R&D.

[40] *Slovensko, ktoré si verí. Národná stratégia výskumu, vývoja a inovácií 2030*, VAIA, 2023.
[41] *OECD Reviews of Innovation Policy: Sweden 2016*, OECD Publishing, Paris, 2016.

Chart 32
R&D expenditure (percentages of GDP, 2021)



Sources: Eurostat and OECD.
(1) Provisional data
(2) Definitions vary (for more information see: http://ec.europa.eu/eurostat/cache/metadata/en/rd_esms.htm)
(3) Data for the private non-profit sector are not available
(4) 2021 estimation
(5) 2018
(6) 2019
(7) 2020

In Slovakia, initial steps have been taken to simplify the fragmented system of management for research, development and innovation (RDI). Support for RDI in Slovakia was for a long time provided mainly by the Ministry of Education, Science, Research and Sport of the Slovak Republic (the 'Education Ministry') and the Ministry of Economy of the Slovak Republic (the 'Economy Ministry'), in particular through Education Ministry bodies such as the Research and Educational Grant Agency (VEGA), the Cultural and Educational Grant Agency (KEGA), the Slovak Research and Development Agency (APVV), the Research Agency (VA) and the Slovak Centre of Scientific and Technical Information (CVTI SR), and through Economy Ministry bodies such as the s (SARIO), the Slovak Innovation and Energy Agency (SIEA) and the Slovak Business Agency (SBA).[42] At the same time, the Education Ministry's budget also covers expenditure on transfers to the Slovak Academy of Sciences (SAV) and on R&D at higher education institutions (HEIs). Further support for RDI is provided by the Ministry of Investments, Regional Development and Informatization of the Slovak

[42] The Economy Ministry, together with the Entrepreneurs Association of Slovakia Entrepreneurs and the Slovak Craft Industry Federation, is a founding member of the SBA.

Republic (the 'Investment Ministry') through the allocation of EU funds for research and innovation. Innovative firms may also be entitled to financial support from the Slovak Guarantee and Development Bank (SZRB) and from Slovak Investment Holding (SIH), which falls under the Ministry of Finance of the Slovak Republic (the 'Finance Ministry').

Under Slovakia's recovery and resilience plan (RRP), the Slovak Government Council for Science, Technology and Innovation (the 'Government Council') and the management and implementation of the RIS 3 agenda were transferred from the Investment Ministry to the Slovak Government Office. In addition, the Government Council, which acts as the main coordinating and advisory body for research and innovation policies, has been reformed so that it comprises, in addition to the Prime Minister and the four ministers responsible for the promotion and funding of RDI (the ministers heading the Finance, Investment, Education and Economy Ministries), ten recognised independent experts selected by an international commission. A new body, the Research and Innovation Authority (VAIA), has also been established at the Government Office of the Slovak Republic, operating as the executive body of the Government Council. In the first half of 2023, VAIA unveiled the parliamentary approved National Strategy for Research, Development and Innovation 2030 (the 'National Strategy'),[43] which, among other things, lays out the next steps for improving coordination and for consolidating the RDI management system, and presents a commitment to measuring and assessing the impacts of individual instruments

The consolidation of implementing agencies is due to be presented by the end of 2024. According to the National Strategy, the plan is eventually to have three main implementing entities, to be coordinated through a council of directors of agencies that fall under the Government Council. The first entity should administer all grant funding for research, development and innovation and provide services to researchers and firms at the national level (consolidation of APVV, VA, SEIA, SBA and SAIA and CVTI SR). The second should cover financial instruments for research and innovation (SIH), and the third should focus on attracting high value added investments and providing support to the most innovative Slovak firms in their expansion abroad and to the development of small and medium-sized enterprises (consolidation of activities falling under SARIO, the Investment Ministry, Ministry of Foreign and European Affairs of the Slovak Republic, VAIA)

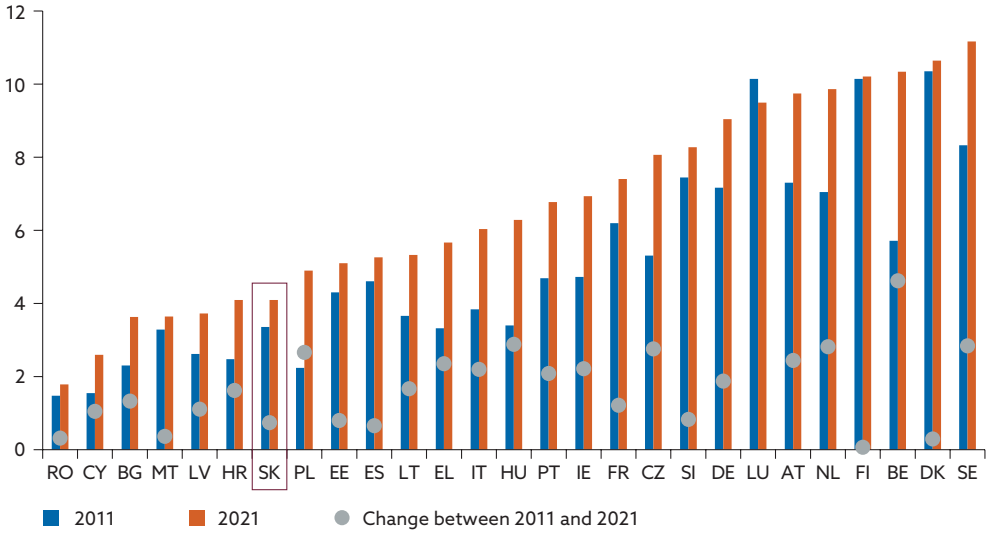
[43] The Slovak Government approved the strategy in March 2023.

The actors of the research and innovation sector in Slovakia are primarily higher education institutions (HEIs), the Slovak Academy of Sciences, sectoral institutions, and the private sector. The HEIs in Slovakia currently comprise 20 public HEIs, three state HEIs, ten private HEIs and six foreign HEIs.[44] The SAV consists of 15 institutes in the area of inorganic natural sciences, 13 institutes in the area of organic natural sciences and chemical sciences, and 17 institutes in the area of social sciences and cultural sciences. There are also a number of sectoral research institutions in Slovakia, such as the National Agricultural and Food Centre, the National Forestry Centre, the Dionýz Štúr State Geological Institute, and the Water Management Research Institute. The private sector is dealt with in more detail in the next section No 3. 5).

In terms of the number of people engaged in RDI per 1,000 population, Slovakia ranks in the bottom third of EU27 countries (Chart 33). Slovakia is also among the worst performers in regard to the number of people engaged in research and innovation (per capita increase between 2011 and 2021), while its neighbouring V4 countries are among the leading EU27 countries on this metric. To improve the quality of the innovation environment, it is vital that increases in the number of people engaged in RDI are accompanied by an improvement in their quality hand in hand with their commensurate remuneration. The importance of human capital in R&D is looked at more closely in Section 3.6.

Chart 33

Number of people engaged in research, development and innovation per 1,000 population (2011, 2021)



Sources: Eurostat, and NBS calculations.

[44] https://www.minedu.sk/vysoke-skoly-v-slovenskej-republike/

The quality of research outputs of HEIs and scientific institutions in Slovakia is below the level in western European countries.[45] It is positive to note, however, that, following the model of the UK's Research Excellence Framework and with the participation of mainly foreign experts, a Periodic Evaluation of Research, Development, Artistic and Other Creative Activities has been conducted in Slovakia in recent years and has identified several outputs of world-class quality (4% of those evaluated) and outputs of significant international quality (18%).[46] In addition, an internal assessment of SAV institutes by a panel of foreign experts was carried out by the SAV in 2016 (for the years 2012 to 2015) and 2022 (2016 to 2021). In the most recent assessment, one of the SAV's 45 institutes was rated as international/European excellence level (A rating) and six institutes were rated at European high-quality level with at least some outputs at international excellence level (A/B rating). Going forward, it will be important to continue the periodic evaluation also beyond the RRP that was the basis for the first evaluation, as well as to improve its methodology and to increase the quality and number of the foreign experts involved in it. Translating the results of these evaluations into real action will be key to the level of research, development and innovation (and their transfer). In the case of HEIs, this will include commensurate linking of funding to quality assessments, implementing performance agreements[47], and the overall management framework. At the same time, HEIs should thoroughly evaluate and proactively communicate what concrete steps they have taken and will take to improve quality, and whether it is justified to maintain their worst-rated departments and under what conditions they would do so.

3.5 Business innovation

Slovak firms are significantly underperforming in terms of their innovation activity and business R&D expenditure. The share of firms involved in innovation activity is only 36.6% in Slovakia, well below the EU average of 52.7%. It is notable that Slovakia's larger firms are also below average on

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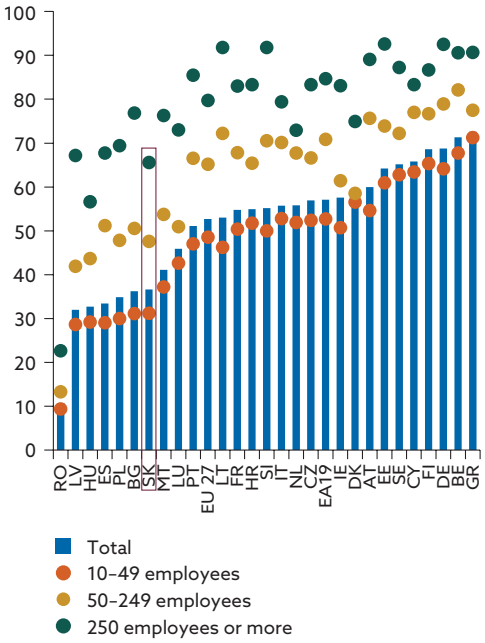
[45] A comprehensive assessment of the quality of research institutions and HEIs is beyond the scope of this publication. Conclusions on quality assessment are based on national assessments, mentioned in the text, as well as on the European Commission's assessment, results of success in international grants (ERC, Horizon 2020, etc.), international university rankings (World University Ranking, Academic Ranking of World Universities, etc.) and many others.

[46] https://www.minedu.sk/33942-sk/periodicke-hodnotenie-vyskumnej-vyvojovej-umeleckej-a-dalsej-tvorivej-cinnosti/

[47] The long-term plan for education, research, development, artistic and other creative activities in the field of higher education for 2023-2028 includes a number of the above-mentioned measures. At the time of writing this Structural Challenges report, the document was under review in inter-ministerial consultation procedure.

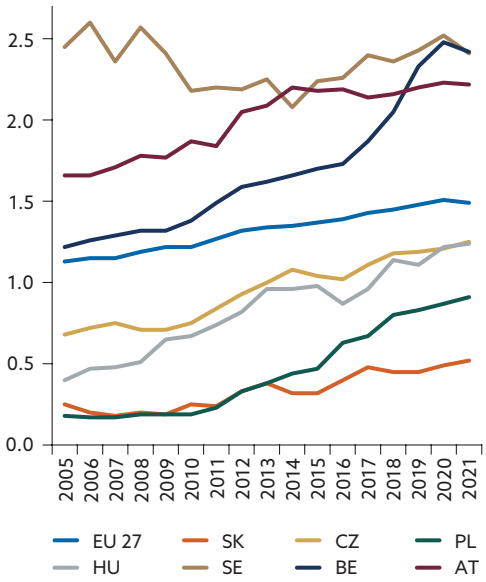
the innovation front. Of those employing more than 250 people, only 65.6% report being engaged in innovation activity, which share is the third-lowest among EU countries, after Romania and Hungary. Slovak firms are also lagging far behind in their R&D expenditure. Although it has improved slightly in recent years, business R&D expenditure in Slovakia is not only below the EU27 average but also lower than in the other V4 countries.

Chart 34
Firms with innovative activities (percentages; 2020)



Source: Eurostat.

Chart 35
Business R&D expenditure (percentages of GDP)



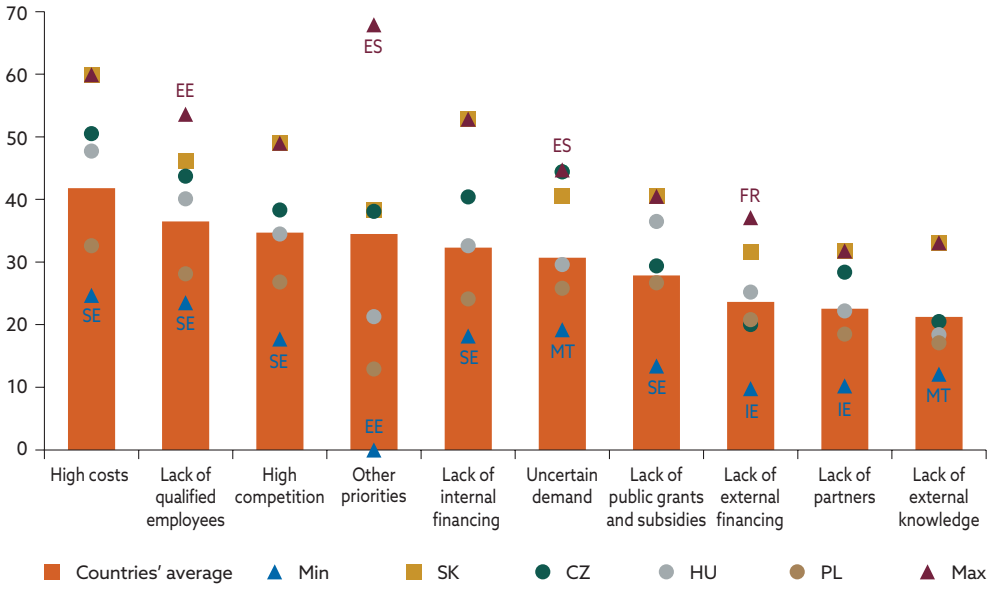
Source: Eurostat.
Note: The Chart shows business R&D expenditure in the V4 countries and the EU27, as well as in Sweden, Belgium and Austria, the EU countries that had the highest R&D expenditure in 2019-21.

Slovak firms' innovation activity is highly constrained by various barriers in several areas. In a Eurostat survey conducted in 21 EU countries, Slovak firms reported the highest barriers to innovation in six of the ten barrier categories. In Slovakia, like in other EU countries, firms say the main barriers to innovation activity are high costs, a lack of qualified employees, and high competition.[48] These factors significantly limit the ability of firms to innovate and to adapt effectively to changing market conditions. Compared with other EU countries, however, the factor of limited internal financing is also a relatively significant. A lack of partners and lack of access to external knowledge are among the less serious innovation

[48] For individual firms, strong competition can be a barrier to innovation. In general, however, as we explain below, a competitive environment is conducive to innovation.

barriers facing firms in the surveyed countries, but among Slovak firms these barriers were to a greater extent also identified as of medium or high significance, implying problems with knowledge diffusion for innovation activities.

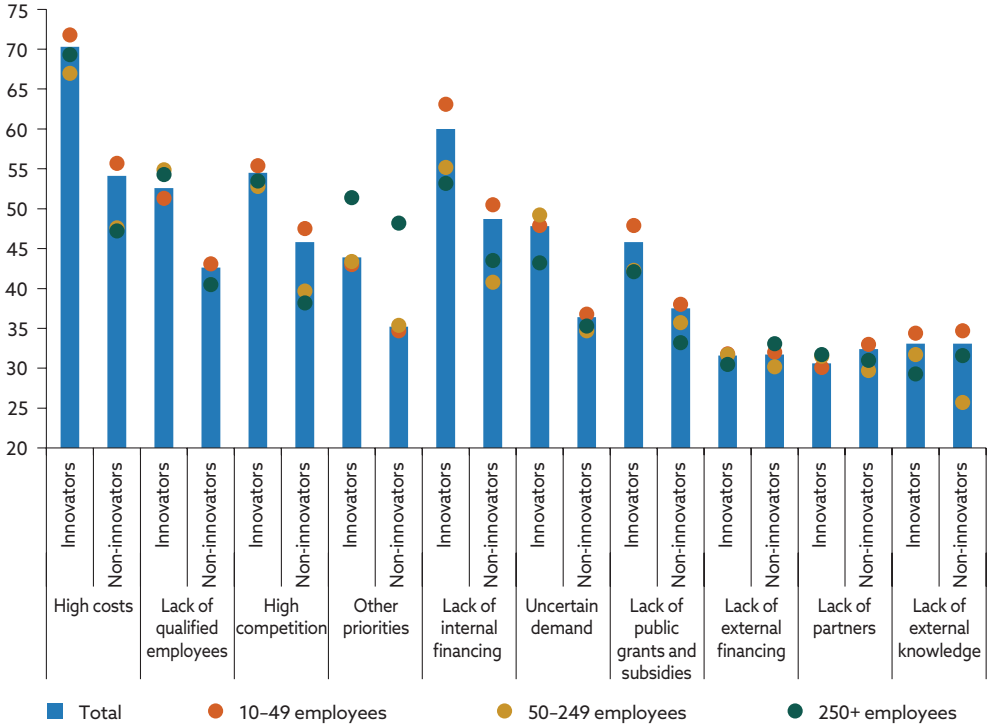
Chart 36
Barriers to business innovation (percentages; 2020)



Sources: Eurostat, and NBS calculations.
Note: The chart shows the share of firms that identified the given hampering factor as of high or medium importance. The chart covers the 21 EU countries in which firms were surveyed.

Barriers to innovation are reported more by innovative firms, and the difference in this respect between large and smaller firms is generally small. On the other hand, both innovative and non-innovative firms report to a lesser extent that innovation activity is hindered by lack of external funding, absence of partners or external knowledge. For firms with over 250 employees, different business priorities are a greater barrier to innovation than they are for smaller firms. Among small firms, by contrast, lack of internal financing is a more significant constraint on innovation. High costs and competition are more serious innovation barriers for non-innovative small firms than for non-innovative larger firms.

Chart 37
Barriers to innovation for firms in Slovakia (percentages; 2020)



Sources: Eurostat, and NBS calculations.
Note: The chart shows the share of firms that identified the given issue as a highly or moderately significant barrier to innovation.

To strengthen the innovation performance of Slovak firms it is essential to improve the business environment. According to the OECD[49] a sound business environment can contribute to innovation and productivity in several ways. First, macroeconomic stability in the form of low and stable inflation and fiscal discipline helps to reduce uncertainty and increase the efficiency of the price mechanism in allocating resources, hence providing firms with a favourable environment in which to plan and invest in innovative activities. Second, strong competition encourages firms to innovate and develop new markets, and it supports the process of creative destruction. Third, more open trade in goods and services, modernised public procurement and a sound framework for intellectual property rights similarly encourage innovation. Such factors create opportunities for firms to access new markets, to collaborate with international partners and to protect their intellectual property, thereby opening ways to innovation. Innovation-friendly government policies can also help foster business innovation, and we look at topic separately in Section 3.7.

[49] *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*, OECD Publishing, OECD, Paris, 2015, Chapter 4: The business environment for innovation.

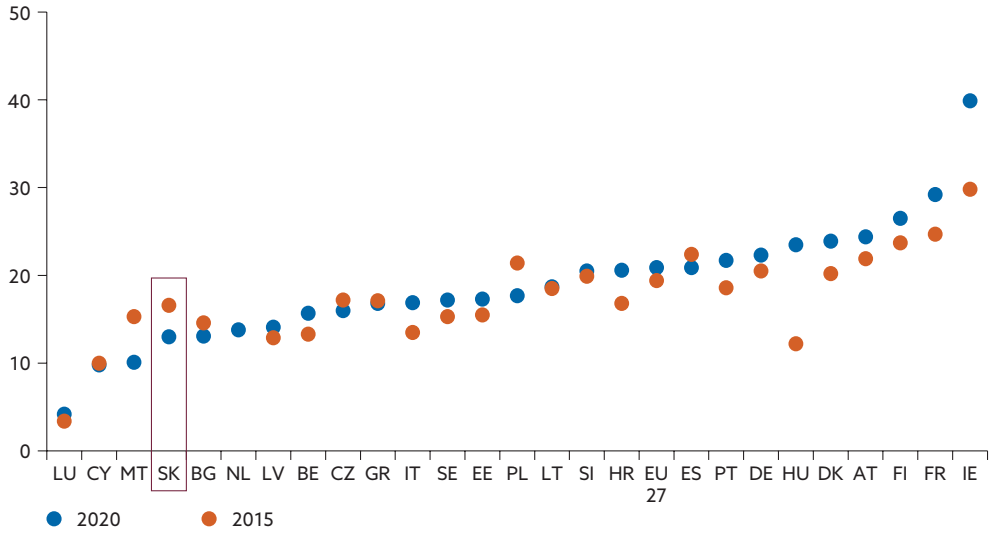
3.6 Human capital and innovation

The relationship between human capital and productivity is empirically well mapped.[50] Since the mid-1980s, economists have been using endogenous growth models based on the relationship between human capital and productivity. By human capital, we mean in particular the experience, knowledge and skills embodied in workers. High-quality workers can support productivity not only by creating innovations, but also by absorbing existing ones. High-quality human capital also helps firms survive during times of structural changes. If firms are to cope with times of crisis, when production costs or consumer preferences can change rapidly, they must have the ability to create and absorb innovations. In addition to the unexpected shocks of recent years, specifically the COVID-19 pandemic and war in Ukraine, the Slovak economy is also facing expected structural changes related to climate change, population ageing and the development of the digital economy.

Slovakia is particularly lacking in science, technology, engineering and mathematics (STEM) graduates.[51] In 2020 Slovakia had only 13 STEM graduates per 1,000 population, and over the past five years this figure has dropped by 3.6 graduates, more than in any other EU27 country apart from Malta and Poland. Further underlining Slovakia's position at the EU27 tail-end for STEM graduates is the fact that the only countries below it have economies far less focused on industry.

Chart 38

Number of STEM graduates per thousand population (graduates aged 20–29)



Source: Eurostat.

[50] *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*, OECD Publishing, OECD, Paris, 2015.

[51] STEM – science, technology, engineering and mathematics

Brain drain is a significant problem in Slovakia, as more than 20% of its undergraduate citizens are studying abroad.[52] This situation is exacerbated by the fact that the school-leavers who go abroad to study are generally the most academically successful students,[53] and that the population is ageing. Reversing the current trend will require significant improvement in the quality of Slovakia's higher education, the enhancement of opportunities in the Slovak labour market, and a general raising of the quality of life in Slovakia, including the inclusion of minorities. In the short term there is opportunity not only to increase the likelihood of Slovaks returning from abroad, but also to involve them in domestic innovation as much as possible.

The countries most successful in innovation can both cultivate high-quality human capital as well as attract it from abroad. For countries with a shortage of high-quality human capital, foreign workers are important because they increase the pace of convergence and lower its costs. Conversely, for countries at the cutting edge of innovation in any field, it is important to attract the best of the best to collaborate on further developments.

Not only does Slovakia have a very low level of immigration, but only 10% of those arriving have a university degree. Although the level of immigration reflects a number of factors, the fact remains that Slovakia, compared with neighbouring countries, has relatively strict conditions for immigration or for granting work permits to highly skilled workers. In the last five years, a number of changes have been made towards easing the conditions for granting work permits, but these mostly relate to the examination of the labour market situation based on labour office data. These changes have simplified the migration of lower-skilled workers, as high-skilled jobs are rarely registered with the labour offices. According to OECD data (Chart 40), Slovakia is one of the countries that are less attractive to foreign students. Among the V4 countries, however, Slovakia is more attractive than Poland.

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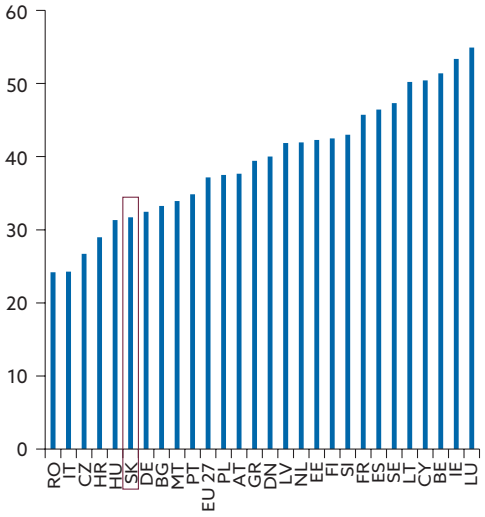
[52] Unesco: http://uis.unesco.org/en/uis-student-flow .

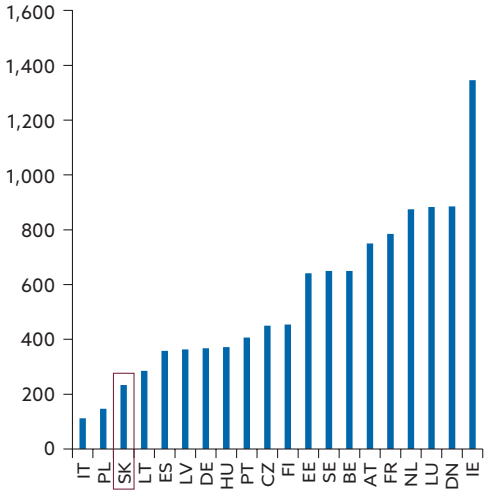
[53] Martinák, D. and Varsik, S., "Odliv mozgov II: za siedmimi horami" (Brain drain II: Behind seven mountains), *Komentár*, No 02/2021, Institute for Educational Policy, 2021 (in Slovak only).

Chart 39
Share of working immigrants with tertiary education (2022) (%)



Source: Eurostat.

Chart 40
Number of graduating foreign students per million population (2020)



Source: OECD.

Even high-quality human capital does not automatically translate into high output and innovation if it is not used appropriately. Mismatches between workers' skills and the needs of the workplace can be a problem. Inefficiencies can also arise where workers are underskilled or where their skills are not engaged at the workplace. The OECD (2015) identifies policies and institutional conditions needed to minimise such mismatches, including:

- **Developing transferable skills** to facilitate subsequent retraining.
- **Creating a more flexible system of retraining and labour allocation** that responds more quickly to structural changes in the economy.
- **Strengthening cooperation with employers and social partners in the process of developing education policies.** For instance, in the United Kingdom, Jaguar Land Rover has created a network from among a range of universities to deliver tailored courses in science and engineering for its staff.
- **Developing labour market policies** aimed at reducing workers' periods of economic inactivity. This would also include extending the activity of workers facing life situations that risk excluding them from the labour market, such as personal health issues or caring for a disabled family member or young child. Effective policies would in particular support shorter and more flexible forms of employment.
- **Creating effective labour migration regime** that meets employers' needs, considering demographic changes in the resident population. This would include, for example, creating formal recruitment channels, having suitable visa programs, improving on- and post-arrival services,

providing language training, and setting up a fast-track process for verifying residency and immigration status.

- **Establishing a mechanism to control for quality of retraining** and indicators that measure how effectively workers are allocated to positions most suited to their skills.

In the field of cutting-edge research, the migration of researchers plays an indispensable role. Universities and research teams seek experts and students from other countries for their diverse experience in researching a given topic. This system leads to greater circulation of knowledge and the improvement of research. According to the OECD (2015), the research impact of scientists who change university (or research centre) affiliation across national boundaries is, on average, 20% higher than those who never move abroad. To better engage foreign researchers and students, research institutions and universities need to bring their processes up to international standards. Some of the many ways to this include eliminating academic inbreeding (employing one's own graduates), increasing participation in the international labour market, ensuring that teaching and all internal processes are conducted in English, having a tenure-track system, ensuring adequate administrative support for grant applications, capping the number of required teaching hours, and organising international research seminars.

3.7 Innovation policies

Numerous polices that could have an impact on innovation have been discussed in the academic literature and also implemented in the real world. In this section we present a few of them.

Tax policies play a significant role in supporting innovation, according to the OECD. Tax levels, the tax mix, and the complexity of tax rules, as well as tax incentives for R&D expenditure, can affect firms' and households' decisions to save or invest, as well as firms' innovation activities.[54]

Internationally, tax relief and tax benefits are among the most widely used policies to promote innovation. According to the OECD (2022),[55] as many as 33 of the 38 OECD countries, and therefore 22 out of the 27 EU countries, offer some form of tax relief. Chart 41 shows the implied marginal R&D tax subsidy rates, which specify the notional level of tax support

[54] Some forms of taxation, such as corporate taxes, can be more detrimental to growth and innovation than others, such as property taxes. Tax policies that foster growth and innovation seek to shift the tax burden from income to consumption and/or residential real estate, and thereby to stimulate investment and innovation.

[55] OECD R&D tax incentives database, 2021 edition (updated 23 February 2022).

(before tax) per additional unit of R&D expenditure. In other words, they provide a synthetic representation of the generosity of a tax system from the perspective of a generic or model type of firm for the marginal unit of R&D expenditure.

In 2022 Slovakia was among the countries whose tax system offered the most generous R&D support. Only Poland reported a more significant increase in R&D tax support between 2011 and 2022. The increase in Slovakia is due in large part to a super-deduction for R&D expenditure. It should be noted, however, that the super-deduction is an option mainly for well-established firms. Although offering the possibility of an additional deduction, the super-deduction may not be entirely suitable for new firms and start-ups that are not profitable and have cash-flow difficulties. This issue is further examined in Box 2, where we present initial results on the effectiveness of the R&D super-deduction in Slovakia.

Results and analysis from abroad show that tax relief helps increase R&D expenditure. Evidence from multiple countries indicates that a 10% tax benefit can increase R&D expenditure by 10% (or more) in the long run.[56] It is important, however, to design such benefits correctly. Tax relief is generally less targeted and often more beneficial to larger, established firms for short-term applied research. At the same time, the way it is designed should prevent other, existing expenditure from being classed as R&D expenditure. It should be further noted that competition between countries for tax advantages may only lead only to reallocation of existing R&D expenditure between countries.[57] Tax relief on patent income (so-called patent boxes) are inefficient. They have a limited impact on patent ownership transfer, but show no impact on real inventions.[58]

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[56] Bloom, N., Van Reenen, J. and Williams, H., "A Toolkit of Policies to Promote Innovation", *Journal of Economic Perspectives*, Vol. 33, No 3, Summer 2019, pp. 163–84.

[57] Evidence is provided by, for example, Akcigit, U., Baslandze, S. and Stantcheva, S., "Taxation and the International Mobility of Inventors", *American Economic Review*, Vol. 106, No 10, October 2016, pp. 2930–2981.

[58] Gaessler, F., Hall, B.H. and Harhoff, D., "Should there be lower taxes on patent income?" *Research Policy*, Vol. 50, No 1, *50*(1), January 2021.

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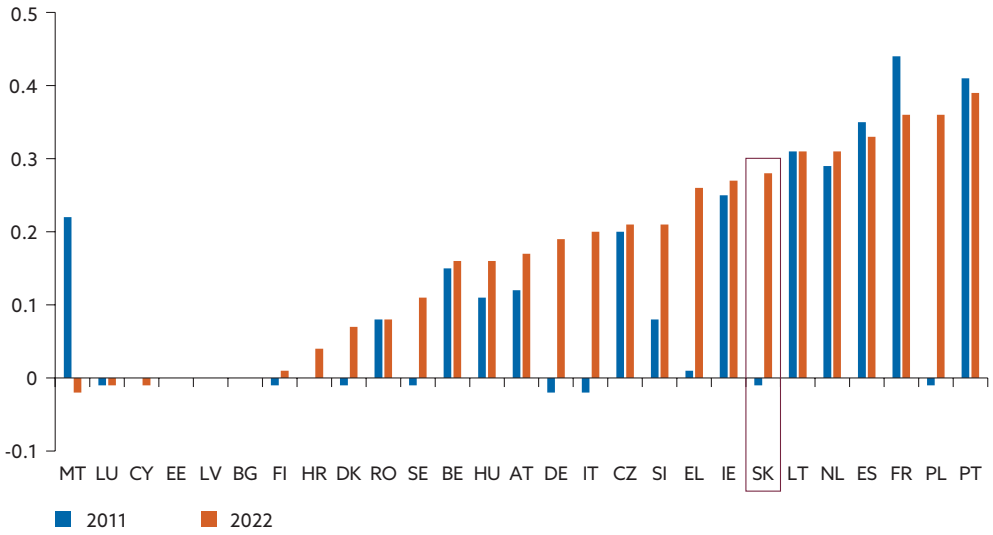
Chart 41
Implied R&D tax subsidy rates



Source: OECD.
Note: For EU27 countries apart from the Netherlands, the values are the same for small, medium-sized and large firms, hence the chart does not differentiate firms by size category. For the Netherlands, the values are 0.23 for small and medium-sized firms and 0.07 for large firms.

Box 2
Assessing the effectiveness of the super-deduction for R&D expenditure[59]

Governments have a number of tools at their disposal to support business R&D expenditure. The most commonly used around the world include direct payments or grants, accelerated depreciation of R&D assets, R&D tax reductions and tax relief, R&D tax deductions and super-deductions from the tax base for corporate tax or VAT, and patent incentives. The most common currently used in Slovakia are grants, patent incentives, and a super-deduction (SD) from the corporate tax base (EY, 2022).[60] In this box, we present an assessment of the effectiveness of the Slovak super-deduction according to the OECD methodology (Appelt et al., 2020)[61] and based on microdata from the Slovak Statistical Office's Research and Development Report, which were linked to the Slovak Financial Administration's database on applied super-deductions.

As an **effectiveness indicator** (Chart A), we use the average **incremental ratio**, which expresses how much additional business R&D expenditure was generated per euro of tax relief. We

[59] The presented results on the effectiveness of the R&D super-deduction are a preliminary output of a joint project of Národná banka Slovenska, the Slovak Government Office's Research and Innovation Authority, and the University of Economics in Bratislava.

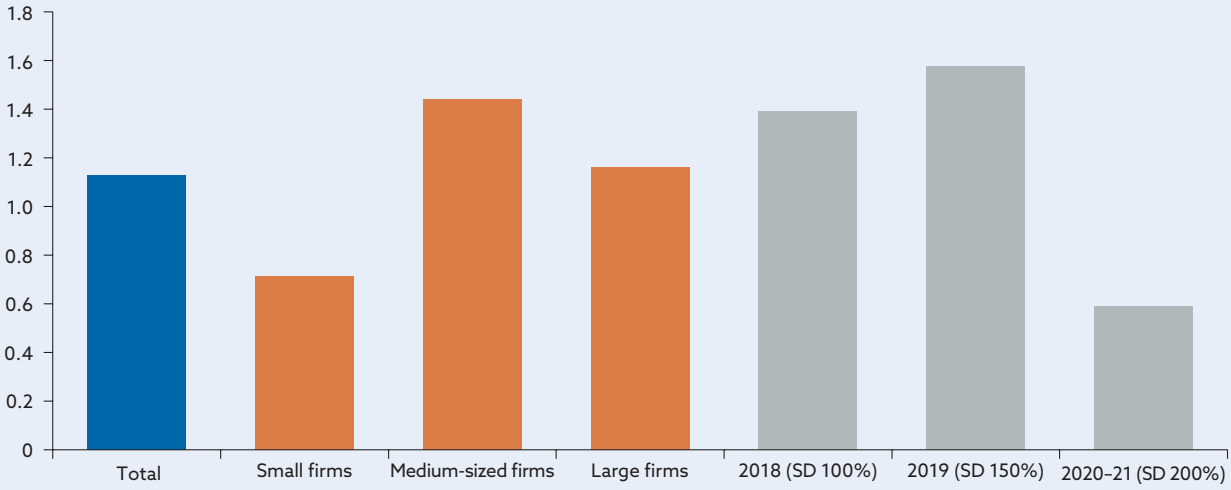
[60] *Worldwide R&D Incentives Reference Guid 2022*, EY, 22 July 2022

[61] Appelt, S., Bajgar, M., Criscuolo, C. and Galindo-Rueda, F., "The effects of R&D tax incentives and their role in the innovation policy mix. Findings from the OECD microBeRD project, 2016-19", *OECD Science, Technology and Industry Policy Papers*, No 92, OECD Publishing, Paris, September 2020.

calculated this ratio for all firms over the whole period of available data, as well as separately for selected periods between 2015 and 2021 and for groups of small, medium-sized and large firms. The decomposition **by subperiod** is in line with statutory incremental changes. The SD rate was set at 25% from 2015 to 2017 and then phased up to 100% in 2018, 150% in 2019, and 200% in 2020 and 2021, before being cut back in 2022 to its current level of 100%. The rationale for decomposing the estimate **by firm size category** is that the economic benefits and administrative costs related to the SD's application may differ according to whether a firm is small or large.[62]

Chart A

Effectiveness of the corporate tax super-deduction for business R&D (additional R&D expenditure per euro of tax support)



Source: NBS calculations.
Note: The first four columns present the average value for the years 2015 to 2021. Firms broken down by size: small – up to 49 employees; medium-sized – from 50 to 249 employees; and large – 250 employees or more. Results for 2015-2017 are not shown owing to the lower reliability of estimations at the outset of the programme.

The results show that the R&D **super-deduction can be an effective tool** to support business R&D activities in Slovakia. The overall estimate for the period under review was comparable with Czechia, where the programme design was similar (Figure B). The effectiveness appears to be highest for medium-sized firms and lowest, approximately half as high, for small firms (Chart A). Regarding the statutory setting of the SD rate, its phasing-up from 100% to 150% brought only a slight increase in effectiveness, and the 200% rate actually resulted in

[62] Evidence for this is provided by the high concentration of SD claims among large firms. Indeed, around one-half of the total volume of SDs was claimed by ten of the almost 500 participating firms (Šnircová, 2023).
Šnircová, J., "Superodpočet výdavkov na výskum a vývoj 2021: konečné výsledky" (Super-deduction of R&D expenditure 2021: Final results), Slovak Credit Bureau, February 2023 (in Slovak only).

a decline in effectiveness (Chart A). However, the 200% rate coincided with the COVID-19 pandemic, which probably also affected business R&D expenditure. An SD rate of between 100% and 150% seems appropriate if the policy objective is primarily to support large firms. In claiming the super-deduction, many SMEs are also affected by significant administrative costs and uncertainty associated with changes in the system. Newly established firms that are not yet profitable also have difficulty in tapping R&D support and may be able to make additional use of the super-deduction only after a few years, when some of their key R&D steps are already behind them.

Chart B

Effectiveness of tax stimulus for R&D in OECD countries

Sources: Appelt et al. (2020), and own calculations for Slovakia.

These **estimates should, however, be treated with some caution**, as about half of the entities that benefited from the SD in recent years did not complete the SO SR's Survey on R&D. The reasons for non-participation in the statistical survey may be related to the young age of these firms, to the SD being claimed for non-standard R&D expenditure, or to the inconsistency of the firms' R&D activities over time. In other words, the efficiency estimates presented can be associated mainly with firms that have an established R&D track record and are engaged in this activity on a consistent basis.

Our **methodology** is based on a study by Appelt et al. (2020), which estimates a panel regression equation with fixed effects for firms:[63]

$$logY_{it} = \beta_1 Recipient_{it} + \beta_2 \log size_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

[63] For the sake of simplicity, contrary to Appelt et al. (2020), our analysis does not reweight observations according to the matching of SD-claiming firms with other firms (an approach called 'coarsened exact matching').

where Y_{it} is the firm's total intramural and extramural R&D expenditure; $Recipient_{it}$ is a binary dummy for SD-claiming firms; $size_{it}$ is the value of sales; β_1 and β_2 are the estimated regression coefficients; γ_i is an individual fixed effect that does not vary over time; δ_t is a time fixed effect of individual years; and ε_{it} are the residuals. Using the estimated coefficient β_1, the average incremental ratio is calculated with the following formula:

$$IR := \frac{(\exp(\beta_1) - 1)}{\overline{TSRD}}$$

where $\overline{TSRD} = \frac{1}{N}\sum_{i=1}^{N}\frac{TS_i}{Y_i}$ is the average ratio of tax support (TS_i) to total R&D expenditure (Y_i) across the group of SD-claiming firms.

We used **microdata** from the SO SR's Survey on R&D for the years 2009 to 2021, which the SO SR made available in anonymised form as a panel database. The R&D survey data were matched with information on SD claims from the database of the Financial Administration of the Slovak Republic. The number of firms recorded in that database in 2021 was around 650, of which some 220 were SD claimants. Not included in that database in that year were around 260 firms that claimed the SD but did not complete the R&D survey.

Government research grants, unlike tax benefits, allow for more targeted R&D support for different types of institutions (universities, private sector) and for different sectors (e.g. green innovation, social innovation). It goes without saying that without a thorough process for the selection of which projects to support, there is a risk of abuse and inefficient allocation of funds. For smaller countries, like Slovakia, where linkages between individual actors can be extensive, it is advisable to use project evaluations from international grant schemes to avoid potential conflicts of interest. The basics of good practice also include system stability where uncertainty about rules on grant allocation and follow-up funding is minimised. Another challenge is how to properly evaluate the impact of grant funding. Public research grants are typically (and understandably) aimed at the most promising researchers and projects or at the most important societal issues. It is therefore difficult to ascertain whether the award of a grant is not merely a substitute for private sector funding that would have been spent on the project (the so-called crowding-out effect). On the other hand, a grant award may send a positive signal that helps attract additional funding from the private sector (the crowding-in effect)

Research grants can help address one of the main market failures – lack of knowledge distribution. In particular, well-designed grants made to academics engaged in basic research are more likely to lead to knowledge dis-

tribution to other actors than are grants for applied research on a product that is close to market.[64],[65] One key aspect is how intellectual property rules are formulated in these situations. Granting a sizeable share of ownership rights directly to researchers instead of to the institution (e.g. university) where they conducted their research increases the rate of innovation as well as of patenting and start-up creation.[66,67]

Clustering is one way to support the distribution of knowledge. The basis for successful clusters is functioning cooperation and dialogue between firms, the public sector and the non-governmental sector. The academic literature provides mixed results on the effectiveness of clusters, though more recent studies lean towards their having a positive impact.[68] The OECD recommends significant building-up of laboratories and clusters based on public-private partnerships, even for leading innovator countries such as Germany.[69] A frequent recommendation is not to build clusters and new institutions that could result in greenfield clusters. However, the OECD (2018)[70] points out that the establishment of the Institute of Science and Technology Austria in Austria in 2009 was an institutional milestone in fostering innovation.

In regard to the promotion of innovation, the OECD also emphasises financing opportunities, policies to support the growth of young firms, and business experimentation,[71] as well as integration into global value chains. Policies that facilitate access to finance, such as venture capital support, government grants, and loan programmes, can promote innovation by lowering financial barriers for firms. It is also important to have policies that specifically target and encourage growth among young innovative firms.[72] Increasingly important for innovation is integration into global value chains (GVCs), which allow firms to access global markets, collabo-

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64 Jaffe, A.B., "Real Effects of Academic Research", *The American Economic Review*, Vol. 79, No 5, December 1989, pp. 957-970.

65 Valero, A. and Van Reenen, J., "The economic impact of universities: Evidence from across the globe", *Economics of Education Review*, Vol. 68, February 2019, pp. 53–67.

66 Lach, S. and Schankerman, M., "Incentives and Invention in Universities", *The RAND Journal of Economics*, Vol. 39, No 2, Summer 2008, pp. 403–433.

67 Hvide, H.K. and Jones, B.F., " University Innovation and the Professor's Privilege", *American Economic Review*, Vol. 108, No 7, July 2018, pp. 1860–1898.

68 Madaleno, M., Nathan, M., Overman, H. and Waights, S., "Incubators, Accelerators and Regional Economic Development", *Discussion Paper Series*, No 11856, Institute of Labor Economics (IZA), September 2018.

69 *OECD Reviews of Innovation Policy: Germany 2022 – Building Agility for Successful Transitions*, OECD Publishing, Paris, 2022.

70 *OECD Reviews of Innovation Policy: Austria 2018*, OECD Publishing, Paris, 2018.

71 See also Kerr, W.R., Nanda, R. and Rhodes-Kropf, M., "Entrepreneurship as Experimentation", *Journal of Economic Perspectives*, Vol. 28, No 3, Summer 2014, pp. 25–48.

72 These policies may include measures such as the provision of mentoring programmes, incubators, accelerators and funding opportunities tailored to the needs of young firms. By

rate with international partners and benefit from knowledge and technology transfer

Through public procurement, the state can be a leader and exemplar in innovation focused on meeting public needs. In situations where the government is a first user of innovation, it can assume the risks associated with the deployment of new and untested technologies. Innovators thus gain knowledge that can reduce investment risk and help disseminate innovations in the market. Innovative public procurement has positive impacts on the economy.[73] Experience to date shows that innovative procurement needs to be part of mission-oriented solutions if it is to reach its full potential.[74]

The mission-oriented approach to innovation has recently been gaining in popularity and importance.[75] It is a way to bring together various actors to address the most significant wide-ranging societal issues, such as how to prevent ecological disasters or address the climate crisis. Examples of good practice show that this approach has a chance of success, especially in economies with decentralised actors, active project selection, tolerance of inevitable setbacks, and organisational flexibility. It is essential to have a robust selection of missions based on in-depth analysis of economic and societal grounds, as selection can easily be influenced by lobbying and political preferences.

The most important supply-side measure is to ensure sufficient human capital necessary for innovation. Increasing supply leads to a higher number of innovations and also lowers the cost of hiring innovative workers, especially in the private sector. Around the world, many different policies have emerged to increase the number of innovators. One of the most common such policies is to increase the number of STEM students, in which area Slovakia is underperforming. Analyses indicate that this is a way to increase the number of innovators, especially in chemistry, medicine and information technology, but that it can also lead to significant reallocation of graduates to other, less innovative sectors.[76]

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supporting the growth and development of these firms, policymakers can foster a dynamic ecosystem of innovation and entrepreneurship.

73 Fleming, L. Greene, H., Li, G. Marx, M. and Yao, D., "Government-funded research increasingly fuels innovation", *Science*, Vol. 364, No 6446, June 2019, pp. 1139–1141.

74 Chiappinelli, O., Giuffrida, L.M. and Spagnolo, G., "Public Procurement as an Innovation Policy: Where do we Stand?", *ZEW Discussion Papers*, No 23-002, Centre for European Economic Research (ZEW), April 2023.

75 Mazzucato, M., *Mission-oriented research & innovation in the European Union*, European Commission, 2018.

76 Giorcelli, M. and Bianchi, N., "Reconstruction Aid, Public Infrastructure, and Economic Development: The Case of the Marshall Plan in Italy", November 2021. Available at SSRN: https://ssrn.com/abstract=3153139.

Migration is another effective measure to increase the human capital needed for innovation. Research[77] from abroad shows that a one percent increase in the immigrant university graduates' population share can increase patents per capita by 9–18 percent and provide additional positive externalities for the rest of the population.

One of the most effective measures is to remove barriers to talented people becoming innovators. Data shows that children from low-income families, women and minorities are less likely to become innovators. Bell, Chetty, Jaravel, Petkova, and Van Reenen (2019) show that in the United States, children from high-income (top 1%) families are ten times as likely to become inventors as those from below-median income families. An important result of their research is the observation that a significant majority of this difference is due to exposure to innovation during childhood and that only a small part of the difference can be explained by inventive ability. A significant part of the innovation policy mix should therefore include systematic work with marginalised communities and the low-income segment of society, through better schools, mentoring, and inspiring examples of innovator role models.

There is now a wide range of applicable policies to support innovation. When selecting such policies, it is important to take into account the different time frames in which they operate, their impact on inequalities (e.g. income) in society, and society's general stance towards innovation adoption and knowledge diffusion. The table below, adapted from Bloom, Van Reenen and Williams (2019), presents core innovation policies, measures of the quality and conclusiveness of evidence about their impact and effectiveness, their time frame, and their potential effect on inequality.

[77] Hunt, J. and Gauthier-Loiselle, M., "How Much Does Immigration Boost Innovation?", *American Economic Journal: Macroeconomics*, Vol. 2, No 2, April 2010, pp. 31–56.

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Table 6 Innovation policy toolkit

Policy	Quality of evidence	Conclusiveness of evidence	Net benefit	Time frame	Effect on inequality
Direct R&D grants	Medium	Medium	++	Medium run	Increase
R&D tax credits	High	High	+++	Short run	Increase
Skilled immigration	High	High	+++	Short to medium	Decrease
Universities: STEM supply	Medium	Medium	++	Long run	Decrease
Trade and competition	High	Medium	+++	Medium run	Increase
Intellectual property reform	Medium	Low	?	Medium run	?
Mission-oriented policies	Low	Low	+	Medium run	?

Source: Adapted from Bloom, Van Reenen and Williams (2019).
Note: The table represents the authors' subjective evaluation of the source study based on a survey of the literature. 'Net benefit' expresses the magnitude of the benefits minus the costs, with +++ denoting the highest net benefit and - - - the lowest. '?' indicates that the impact is unknown. The short-run time frame is 3–4 years; the medium run, 5–9 years; and the long run, ten years or more.

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4 Recommendations

Sound public finances are essential for the further development of the Slovak economy. The pandemic, the war in Ukraine and the energy crisis, together with extensive government compensation measures, have impaired the country's fiscal performance. In addition, we are facing the challenge of an ageing population, which will put increasing pressure on public finances. It is these finances that are currently the most vulnerable area of the Slovak economy. The new government formed after the September 2023 general election will therefore face the difficult task of how to restore public finances. The government should focus social policy on the most vulnerable groups of the population and avoid blanket fiscal measures. Strengthening value-for-money principles and continuing to implement expenditure limits in the budget process can help. Further improvements in tax collection are essential, and it is appropriate to rebalance the tax mix so that the environmental and property taxation component increases at the expense of income taxation.

Reviving the process of convergence with more advanced economies will require transitioning to an innovation-based economy. Efforts to reduce the administrative burden on business, to digitalise public administration and to reform the judiciary should contribute to improving the business environment, a prerequisite for increasing business innovation. It is essential to continue reforms in the education system and in research funding and organisation as well as to continue increasing R&D expenditure. In the long term, it is necessary to address the underperformance of students, to prepare students for the labour market of the future, to significantly increase the number and quality of STEM graduates, and, above all, to improve the utilisation of human potential from low-income and minority groups. In the short term, notable progress can be made by stemming the brain drain, attracting foreign talent, simplifying employment and entrepreneurship for skilled third-country nationals, and ensuring significant improvement in knowledge diffusion.

Slovakia faces the challenge of combining the green transition and economic convergence. The war in Ukraine and the energy crisis have amplified the urgency of reducing dependence on fossil fuels and, in the short term, diversifying fossil fuel imports. There must be accelerated uptake of renewable energy sources, such as wind, solar and geothermal energy. This could be helped by simplifying administrative procedures for integrating renewables into the energy mix. It will also, however, be necessary to modernise the electricity grid. The green transition will necessitate

faster renovation of buildings as well as the decarbonisation of industry and transport.

The pandemic highlighted weaknesses in our health system and exacerbated shortcomings in healthcare. Reforms supported by RRP investments offer opportunities for better healthcare coordination and specialisation, but there are also risks associated with their practical implementation. The shortage of healthcare staff is another major issue. Increasing their remuneration could help stabilise their number. However, the government should consider additional measures, such as increasing capacity in secondary schools and HEIs in relevant areas of healthcare and simplifying the recognition of foreign qualifications. At the same time, the €1.5 billion in RRP investment allocated to healthcare remains subject to significant risks in relation to absorption capacity. If used efficiently, these funds represent an opportunity to improve the quality of the Slovak health system.

The more efficient uptake of EU structural funds and EU RRF funds (via the RRP) represents both a challenge and an opportunity for Slovakia. The disbursement of EU funds in Slovakia is a long-standing problem due to inefficient management and a low absorption rate, which threatens the uptake of the remaining funds allocated to Slovakia under the 2014–2020 programming period. Similarly, RRP investments have progressed slowly so far, even though €1.93 billion of Slovakia's total RRF allocation of €6.4 billion has already been committed, subject to the successful meeting of reform milestones. In parallel to this, €15 billion in funding allocated under the new 2021–2027 programming period is now being disbursed.[78] Efficient absorption of EU structural and RRF funds thus represents an opportunity that can provide a significant development boost to the Slovak economy. At the same time, it is important that EU funds do not simply replace public investment from national sources, but rather serve as additional investment aimed at reducing the country's underperformance in the most problematic areas.

[78] *The EU's 2021-2027 long-term budget and NextGenerationEU: facts and figures*, European Commission, Directorate-General for Budget, Publications Office of the European Union, 2021.

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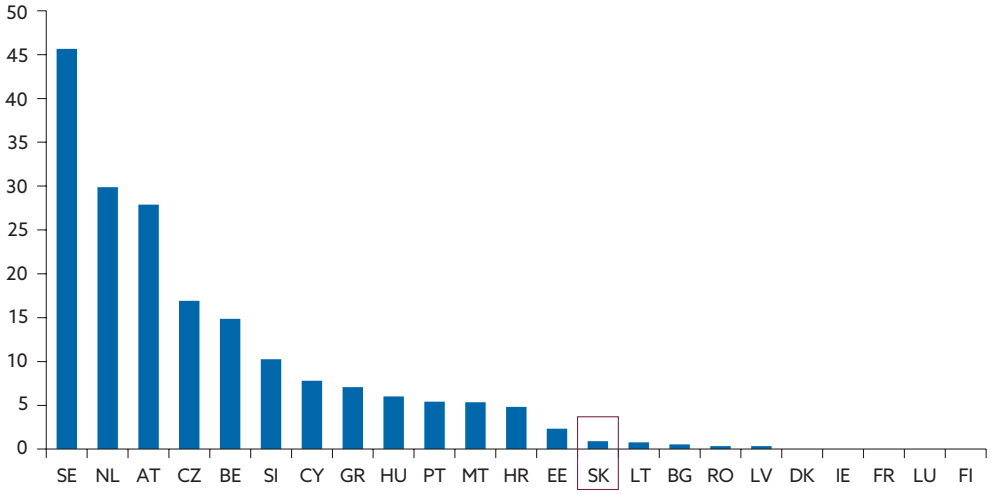
Chart 42

Absorption of RRF funds (via the RRP) in 2021 and 2022 (percentage of total allocation)



Sources: ECB, EC, and NBS calculations.
Note: After revision in 2022 and including the REPowerEU Plan. Data for Germany, Spain, Italy and Poland are not available.

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5 Annex of tables

5.1 Economic performance

Table 7 Factors of economic growth

Category	Indicator		2010	2017	2018	2019	2020	2021	2022
Outcome indicator	GDP per hour worked	SK	26.5	27.7	28.1	29.1	31.2	33.0	33.5
	(PPP units) Sources: Eurostat, NBS calculations	EU average	31.5	37.0	37.8	38.7	40.3	42.1	44.0
Additional indicators	Total factor productivity	SK	6.0	1.5	2.0	1.1	2.2	4.2	-1.7
	(annual percentage change) Source: AMECO	EU average	2.0	2.3	1.3	1.0	-1.1	3.0	1.0
	Capital stock per employee	SK	3.6	0.6	0.9	2.4	3.3	2.1	0.0
	(annual percentage change) Sources: DF ECFIN, AMECO	EU average	3.3	-0.2	0.0	1.2	3.9	0.0	-0.6
	Fixed capital formation	SK	8.6	2.9	2.8	6.7	-10.9	3.5	5.9
	(annual percentage change) Source: Eurostat	EU average	-3.3	6.3	4.3	8.5	-2.8	3.9	5.3

Category	Score	2010	2017	2018	2019	2020	2021	2022
Outcome indicator	GDP per hour worked	-0.41	-0.65	-0.67	-0.68	-0.57	-0.54	-0.60
Additional indicators	Total factor productivity	1.94	-0.44	0.38	0.03	0.97	0.45	-1.12
	Capital stock per employee	0.16	0.50	0.45	0.40	-0.19	0.67	0.31
	Fixed capital formation	1.23	-0.61	-0.26	-0.09	-1.11	-0.04	0.08

Table 8 Economic openness

Indicator		2010	2016	2017	2018	2019	2020	2021	2022
Export performance	SK	75	93	94	95	92	86	93	
(BPM6, percentage of GDP) Source: United Nations	EU average	59	68	70	70	70	66	72	
Foreign direct investment inflow	SK	1.9	0.9	4.2	1.5	2.4	-2.2	0.1	2.6
(percentage of GDP) Source: OECD	OECD average	4.1	3.7	2.0	-1.2	9.4	2.0	2.5	-8.0
Foreign value added embodied in domestic exports	SK	45	48	49	48				
(percentage of exports) Source: OECD	OECD average	27	27	28	28				
Domestic value added embodied in foreign exports	SK	18	19	19	19				
(percentage) Source: OECD	OECD average	19	20	20	20				
Re-exported intermediate imports	SK	67	74	75	74				
(percentage) Source: OECD	OECD average	45	47	48	48				

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Table 8 Economic openness (continued)

Score	2010	2016	2017	2018	2019	2020	2021	2022
Export performance	0.46	0.68	0.67	0.70	0.59	0.51	0.58	
Foreign direct investment inflow	-0.20	-0.48	0.27	0.14	-0.18	-0.87	-0.45	0.17
Foreign value added embodied in exports	-1.59	-1.82	-1.83	-1.75				
Domestic value added embodied in foreign exports	-0.26	-0.19	-0.23	-0.24				
Re-exported intermediate exports	-1.46	-1.65	-1.69	-1.61				

Table 9 Innovation capacity

Indicator		2015	2016	2017	2018	2019	2020	2021	2022
R&D expenditure – business sector	SK	26	21	21	27	33	31	31	34
(standardised index: EU 2015 = 100)	EU average	72	72	71	72	74	76	79	84
R&D expenditure – public sector	SK	52	69	115	44	45	42	40	48
(standardised index: EU 2015 = 100)	EU average	81	80	82	71	72	75	77	83
Innovators	SK	44	44	44	39	39	45	45	59
(standardised index: EU 2015 = 100)	EU average	98	98	98	110	110	138	138	141
Attractive research systems	SK	37	39	42	45	45	49	53	61
(standardised index: EU 2015 = 100)	EU average	94	98	101	106	108	113	117	124
Knowledge-intensive services exports	SK	42	42	40	41	48	50	48	63
(standardised index: EU 2015 = 100)	EU average	77	77	77	79	80	80	82	97
High-tech product exports	SK	127	131	134	132	134	137	141	134
(standardised index: EU 2015 = 100)	EU average	86	90	92	89	90	92	95	90
Intellectual assets	SK	44	41	43	45	48	46	46	50
(standardised index: EU 2015 = 100)	EU average	84	85	86	87	84	83	83	84
Linkages	SK	54	56	65	64	70	78	68	68
(standardised index: EU 2015 = 100)	EU average	123	126	134	142	149	169	172	172
Scientific publications among the top 10% most cited publications worldwide	SK	25	23	26	29	25	31	32	38
(standardised index: EU 2015 = 100)	EU average	80	82	80	82	82	80	82	82

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Table 9 Innovation capacity (continued)

Score	2015	2016	2017	2018	2019	2020	2021	2022
R&D expenditure – business sector	-0.84	-0.95	-0.95	-0.86	-0.78	-0.86	-0.90	-0.92
R&D expenditure – public sector	-0.77	-0.28	0.85	-0.69	-0.67	-0.82	-0.93	-0.83
Innovators	-1.00	-1.00	-1.00	-1.23	-1.23	-1.43	-1.43	-1.37
Attractive research systems	-0.93	-0.95	-0.96	-0.99	-1.01	-1.03	-1.07	-1.02
Knowledge-intensive services exports	-0.84	-0.87	-0.94	-0.95	-0.80	-0.76	-0.85	-0.90
High-tech product exports	1.32	1.37	1.42	1.50	1.54	1.59	1.65	1.58
Intellectual assets	-1.15	-1.29	-1.27	-1.25	-1.12	-1.14	-1.20	-1.13
Linkages	-1,01	-1.00	-0.99	-1.11	-1.13	-1.18	-1.33	-1.34
Scientific publications among the top 10% most cited publications worldwide	-1.16	-1.27	-1.22	-1.23	-1.28	-1.21	-1.29	-1.14

Source: The European Commission's European innovation scoreboard (EIS).

Table 10 Digital technology and infrastructure

Indicator		2015	2017	2018	2019	2020	2021	2022
Robot density in manufacturing	SK	79	151	165	169	175		
(number of robots per 10,000 workers) Source: IFR	IFR member countries' average	200	240	266	286	285		
Broadband connectivity	SK		26	27	28	32	41	50
(score: 0–100) Source: European Commission	EU average		27	29	32	37	45	56
Integration of digital technology	SK		19	22	23	24	26	28
(score: 0–100) Source: European Commission	EU average		23	25	28	30	34	37
Digital public services	SK		36	39	42	46	50	52
(score: 0–100) Source: European Commission	EU average		47	51	55	59	64	68

Score	2015	2017	2018	2019	2020	2021	2022
Robot density in manufacturing	-1.05	-0.54	-0.51	-0.55	-0.62		
Broadband connectivity		-0.11	-0.29	-0.66	-0.61	-0.47	-0.77
Integration of digital technology		-0.51	-0.43	-0.55	-0.65	-0.70	-0.78
Digital public services		-0.51	-0.43	-0.55	-0.65	-0.70	-0.78

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Table 11 Institutional quality and business environment

Indicator		2010	2016	2017	2018	2019	2020	2021
Voice and accountability	SK	0.91	0.96	0.91	0.84	0.86	0.88	0.91
(score: from -2.5 to +2,5)	EU average	1.10	1.08	1.07	1.05	1.05	1.07	1.08
Political stability	SK	1.05	0.72	0.91	0.74	0.67	0.63	0.56
(score: from -2.5 to +2,5)	EU average	0.76	0.67	0.70	0.69	0.72	0.71	0.74
Government effectiveness	SK	0.78	0.83	0.70	0.61	0.58	0.54	0.53
(score: from -2.5 to +2,5)	EU average	1.11	1.08	1.07	1.07	1.05	1.02	1.02
Rule of law	SK	0.56	0.62	0.54	0.50	0.52	0.67	0.71
(score: from -2.5 to +2,5)	EU average	1.12	1.08	1.07	1.06	1.07	1.06	1.07
Control of corruption	SK	0.25	0.18	0.13	0.26	0.21	0.44	0.24
(score: from -2.5 to +2,5)	EU average	0.98	0.97	0.94	0.95	0.95	0.98	0.97
Regulatory quality	SK	1.00	0.89	0.82	0.81	1.01	0.79	0.87
(score: from -2.5 to +2.5)	EU average	1.20	1.14	1.14	1.15	1.19	1.12	1.12
Enforcing contracts – time	SK	565	775	775	775	775	775	
(days)	EU average	587	639	645	645	645	645	
Enforcing contracts – cost	SK	30.6	30.6	30.4	20.5	20.5	20.5	
(percentage of contracts)	EU average	20.7	20.6	20.8	20.3	20.3	20.3	
Resolving insolvency – time	SK	4	4	4	4	4	4	
(years)	EU average	2.2	2.0	2.0	2.0	2.0	2.0	
Resolving insolvency – cost	SK	18	18	18	18	18	18	
(percentage of debt)	EU average	10.9	10.6	10.6	10.6	10.6	10.6	
Starting a business – time	SK	28.5	26.5	26.5	26.5	26.5	21.5	
(days)	EU average	17.8	13.2	12.7	12.4	13.3	12.2	
Starting a business – cost	SK	2.0	1.5	1.1	1.1	1.0	1.0	
(percentage of average income),	EU average	5.9	4.3	4.2	3.7	3.5	3.2	

Score	2010	2016	2017	2018	2019	2020	2021
Voice and accountability	-0.59	-0.33	-0.46	-0.56	-0.50	-0.51	-0.45
Political stability	0.70	0.13	0.57	0.15	-0.17	-0.28	-0.74
Government effectiveness	-0.54	-0.46	-0.68	-0.80	-0.84	-0.81	-0.85
Rule of law	-0.91	-0.77	-0.90	-0.94	-0.93	-0.65	-0.63
Control of corruption	-0.89	-1.00	-1.07	-0.87	-0.94	-0.70	-0.95
Regulatory quality	-0.51	-0.51	-0.65	-0.72	-0.43	-0.71	
Enforcing contracts – time	0.08	-0.47	-0.43	-0.43	-0.43	-0.43	
Enforcing contracts – cost	-1.54	-1.75	-1.66	-0.03	-0.03	-0.04	
Resolving insolvency – time	-1.46	-1.98	-1.98	-1.98	-1.98	-1.98	
Resolving insolvency – cost	-1.45	-1.56	-1.56	-1.56	-1.56	-1.56	
Starting a business – time	-0.83	-1.38	-1.52	-1.63	-1.37	-1.09	
Starting a business – cost	0.65	0.62	0.72	0.64	0.64	0.62	

Source: World Bank.

Table 12 Labour market characteristics

Category	Indicator		2010	2017	2018	2019	2020	2021	2022
Outcome indicator	Employment rate	SK	60.4	68.1	69.5	70.4	69.5	69.4	71.3
	(percentage) Source: Eurostat	EU average	62.7	67.5	68.8	69.7	68.7	69.9	71.5
Additional indicators	Participation rate	SK	70.5	74.1	74.4	74.7	74.5	74.6	76.1
	(percentage) Source: Eurostat	EU average	70.1	73.3	73.9	74.3	73.9	74.9	75.9
	Hours worked per employee	SK	1,805	1,714	1,704	1,692	1,572	1,583	
	(hours per year) Source: OECD	OECD average	1,723	1,709	1,702	1,692	1,610	1,643	
	Employment rate of age group 15–74	SK	53.8	59.2	60.1	60.6	59.5	60.8	62.2
	(percentage) Source: Eurostat	EU average	56.7	59.9	60.9	61.6	60.7	61.3	62.8
	Employment rate of older workers, age group 55–64	SK	41.5	54.6	55.9	58.8	60.2	60.6	64.1
	(percentage) Source: Eurostat	EU average	44.5	54.6	56.9	58.4	59.0	60.7	62.7
	Employment rate of women, age group 15–39	SK	46.8	51.5	51.5	51.2	49.7	56.7	57.7
	(percentage) Source: Eurostat	EU average	56.1	59.0	59.8	60.2	58.5	60.0	62.0
	Part-time employment rate	SK	2.6	4.1	3.4	3.2	3.2	3.1	3.1
	(percentage) Source: Eurostat	EU average	13.3	13.9	13.6	13.5	13.1	13.1	13.0
	Youth employment rate, age group 15– 24	SK	20.8	27.0	27.6	25.0	22.8	20.8	21.3
	%, Eurostat	EU average	31.3	33.2	34.1	34.3	31.6	32.7	34.6
	Young people aged 15–24 not in employment, education or training	SK	14.1	12.1	10.2	10.3	10.7	11.0	9.6
	(percentage) Source: Eurostat	EU average	12.2	10.4	9.6	9.4	10.2	9.9	9.1
	Employment rate of persons with less than upper-secondary education	SK	28.6	37.3	36.4	36.1	34.0	26.9	31.3
	(percentage) Source: Eurostat	EU average	50.3	52.6	54.0	54.7	53.9	54.0	55.7
	Long-term unemployment rate	SK	10.6	5.8	4.6	3.8	3.7	3.9	4.0
	(percentage) Source: Eurostat	EU average	4.4	3.6	2.9	2.4	2.3	2.5	2.2
	Participation rate of persons aged over 65	SK	1.6	3.6	4.0	4.6	4.5	4.4	4.9
	(percentage) Source: Eurostat	EU average	5.6	6.2	6.5	6.8	6.8	7.2	7.7
	Adult participation in learning	SK	3.1	3.4	4.0	3.6	2.8	4.8	12.8
	(percentage) Source: Eurostat	EU average	9.4	11.2	11.4	11.7	10.1	12.6	13.7

Table 12 Labour market characteristics (continued)								
Category	Score	2010	2017	2018	2019	2020	2021	2022
Outcome indicator	Employment rate	-0.38	0.10	0.11	0.12	0.14	-0.08	-0.04
Additional indicators	Participation rate	0.07	0.17	0.11	0.07	0.11	-0.06	0.03
	Hours worked per employee	0.39	0.02	0.01	0.00	-0.20	-0.31	
	Employment rate of age group 15–74	-0.56	-0.13	-0.16	-0.20	-0.25	-0.10	-0.11
	Employment rate of older workers, age group 55–64	-0.32	0.00	-0.09	0.04	0.12	-0.01	0.15
	Employment rate of women, age group 15–39	-1.26	-0.98	-1.02	-1.13	-1.06	-0.37	-0.48
	Part-time employment rate	-1.22	-1.06	-1.10	-1.09	-1.10	-1.09	-1.07
	Youth employment rate, age group 15– 24	-0.82	-0.49	-0.50	-0.71	-0.67	-0.88	-0.94
	Young people aged 15–24 not in employment, education or training	-0.43	-0.43	-0.16	-0.28	-0.16	-0.31	-0.15
	Employment rate of persons with less than upper-secondary education	-2.12	-1.91	-2.16	-2.39	-2.49	-2.98	-2.67
	Long-term unemployment rate	-2.36	-0.83	-0.72	-0.65	-0.69	-0.76	-1.16
	Participation rate of persons aged over 65	-1.10	-0.83	-0.77	-0.67	-0.71	-0.78	-0.73
	Adult participation in learning	-0.83	-0.99	-0.95	-0.96	-1.00	-0.94	-0.10

Table 13 Programme for International Student Assessment (PISA)						
Indicator		2006	2009	2012	2015	2018
Reading	SK	466	477	463	453	458
(score)	OECD average	485	491	493	490	487
Science	SK	488	490	471	461	464
(score)	OECD average	495	498	498	491	489
Mathematics	SK	492	497	482	475	486
(score)	OECD average	490	492	490	487	489
Score		2006	2009	2012	2015	2018
Reading		-0.56	-0.52	-1.10	-1.43	-1.14
Science		-0.18	-0.23	-0.84	-1.00	-0.93
Mathematics		0.04	0.15	-0.25	-0.37	-0.10

Source: OECD.

Table 14 Quality of human capital

Indicator		2010	2017	2018	2019	2022	2021	2022
Mean years of schooling	SK	12.3	12.8	12.9	12.9	12.9	12.9	
(years) *Source: UNDP*	EU average	11.6	12.1	12.2	12.2	12.3	12.3	
Early leavers from education and training	SK	4.7	9.3	8.6	8.3	7.6	7.8	7.4
(percentage) *Source: Eurostat*	EU average	12.0	9.3	9.0	8.9	8.7	8.2	8.1
Early childhood education and care	SK	76.9	78.2	82.2	82.6	83.2	83.0	
(percentage) *Source: Eurostat*	EU average	89.9	92.7	92.9	93.4	94.0	93.5	
Population aged 25–64 with at least upper secondary educational attainment	SK	91.0	91.4	91.7	91.4	92.7	93.3	93.7
(percentage) *Source: Eurostat*	EU average	74.7	80.0	80.7	81.4	82.3	83.0	83.4
Population aged over 25 with tertiary educational attainment	SK	17.3	23.1	24.6	25.8	26.8	27.9	29.2
(percentage) *Source: Eurostat*	EU average	26.2	32.5	33.5	34.4	35.5	36.7	37.4
Qualification mismatch rate	SK	10.0	22.2	23.7	22.6	22.5	22.9	23.4
(percentage) *Source: Eurostat*	EU average	17.1	20.2	20.5	20.5	19.9	20.1	20.4
Skills mismatch rate	SK	10.0	22.2	23.7	22.6	22.5		
(percentage) *Source: Eurostat*	EU average	17.0	20.1	20.4	20.4	19.7		
Employment rate of recent graduates	SK	69.4	81.5	83.4	83.9	82.8	79.5	83.9
(percentage) *Source: Eurostat*	EU average	76.5	79.7	81.8	82.1	79.5	80.1	82.7
Public expenditure on early childhood education and care	SK	106	179	193	216			
(USD at constant prices; per capita at PPP) *Source: OECD*	EU average	252	309	318	329	246.6	202.9	
Connection to the internet – all types of households	SK	67.5	81.3	80.8	82.2	85.8	90.0	90.7
(percentage) *Source: Eurostat*	EU average	66.2	84.2	86.0	87.9	89.6	91.8	92.2
Connection to the internet –households with children	SK	85.8	97.0	94.6	96.3	91.5	97.2	99.0
(percentage) *Source: Eurostat*	EU average	84.4	96.5	97.0	97.7	98.0	98.8	98.9
Digital skills	SK		0.4	0.4	0.4	0.4	0.4	0.4
(score: 0–100) *Source: European Commission*	EU average		0.4	0.4	0.5	0.5	0.5	0.5

Score	2010	2017	2018	2019	2022	2021	2022
Mean years of schooling	0.56	0.62	0.64	0.63	0.60	0.60	
Early leavers from education and training	1.15	-0.01	0.11	0.16	0.31	0.13	0.21
Early childhood education and care	-1.43	-2.57	-1.71	-1.93	-1.96	-1.84	
Population aged 25–64 with at least upper secondary educational attainment	1.02	0.94	0.95	0.90	0.98	1.04	1.06
Population aged over 25 with tertiary educational attainment	-1.09	-1.15	-1.07	-1.02	-1.01	-0.98	-0.88
Qualification mismatch rate	1.00	-0.28	-0.46	-0.29	-0.38	-0.42	-0.46
Skills mismatch rate	1.00	-0.29	-0.47	-0.31	-0.39		
Employment rate of recent graduates	-0.76	0.18	0.18	0.21	0.39	-0.07	0.16
Public expenditure on early childhood education and care	-0.76	-0.56	-0.53	-0.47			
Connection to the internet – all types of households	0.09	-0.35	-0.85	-0.98	-0.79	-0.46	-0.46
Connection to the internet – households with children	0.12	0.14	-1.04	-0.72	-3.56	-1.67	0.03
Digital skills		-0.64	-0.53	-0.55	-0.44	-0.38	-0.43

5.2 Economic vulnerabilities

Table 15 Internal equilibrium

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicators	Output gap	SK	0.3	-0.4	-0.5	0.4	2.0	2.0	-2.8	0.3	0.0
	(percentage of potential GDP) Source: AMECO	EU average	-2.8	-1.7	-1.0	0.5	1.2	1.5	-5.1	-1.0	0.6
	Private sector debt	SK	65.1	80.2	87.9	89.8	90.5	91.0	94.7	93.9	93.4
	(percentage of GDP) Source: Eurostat	EU average	152.7	147.3	144.6	138.5	134.8	133.0	139.1	134.5	114.4
	Non-performing loans	SK		4.4	4.6	3.7	3.2	2.9	2.5	2.0	
	(percentage) Source: Eurostat	EU average		10.4	9.1	7.5	5.9	4.9	4.1	2.7	
Additional indicators	Private sector credit flow	SK	23.5	14.9	19.2	19.2	20.4	15.7	13.5	11.7	15.5
	(percentage of GDP over three years) Source: Eurostat	EU average	18.1	5.1	7.2	9.0	10.4	11.1	12.5	16.4	13.2
	Real house prices (three-year percentage change)	SK	-6.5	6.6	14.6	17.9	17.3	16.4	19.6	17.4	11.9
	Source: Eurostat	EU average	-11.3	3.4	9.7	12.1	13.1	12.8	13.6	16.1	11.8
	Banking leverage	SK	10.4	9.0	9.2	9.3	9.5	9.6	9.7	10.4	
	(assets-to-equity multiple) Source: Eurostat	EU average	15.4	12.3	12.2	11.6	11.7	11.9	12.5	12.9	
	Banks' exposures to domestic sovereign debt	SK	18.6	14.3	12.7	10.1	9.5	8.9	10.2	10.5	10.3
	(percentage of GDP) Sources: ECB, NBS calculations	EU average	15.6	15.8	14.8	13.3	13.0	12.2	14.4	13.1	11.7
	Banking sector profitability (ROE)	SK	8.6	6.6	3.7	5.9	6.4	5.0	4.3	5.8	
	(percentage) Source: ECB	EU average	-2.4	4.4	6.3	6.6	8.1	7.3	3.3	6.9	

Category	Score	2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicators	Output gap	0.89	0.71	0.44	0.48	-0.07	0.19	0.80	0.89	1.00
	Private sector debt	1.35	0.84	0.75	0.69	0.66	0.62	0.65	0.59	0.43
	Non-performing loans		0.56	0.43	0.40	0.34	0.29	0.33	0.39	
Additional indicators	Private sector credit flow	-0.31	-0.56	-0.81	-0.85	-0.88	-0.45	-0.06	0.20	-0.27
	Real house prices	-0.32	-0.26	-0.42	-0.60	-0.49	-0.42	-0.74	-0.13	-0.01
	Banking leverage	0.97	0.88	0.84	0.68	0.67	0.73	0.91	0.87	
	Banks' exposures to domestic sovereign debt	-0.37	0.17	0.25	0.42	0.43	0.44	0.49	0.33	0.19
	Banking sector profitability (ROE)	0.32	0.27	-0.38	-0.13	-0.38	-0.57	0.20	-0.18	

Notes: The output gap score was calculated from the gap's absolute value. Banking sector indicators include data for foreign bank branches.

Table 16 External equilibrium

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicators	Real effective exchange rate (PPI-deflated)	SK	2.7	-3.1	-5.1	-5.2	-0.8	-0.2	1.0	-2.1	-1.2
	(three-year percentage change) Source: ECB	EU average	-0.9	-2.8	-3.4	-2.4	2.4	1.0	0.4	0.3	2.6
	Nominal unit labour costs	SK	8.0	2.5	4.0	7.8	11.3	14.2	15.4	12.5	13.4
	(three-year percentage change) Source: Eurostat	EU average	9.4	2.0	2.6	4.1	7.5	8.6	12.2	9.3	11.7
Additional indicators	Export market shares	SK	3.8	3.9	7.1	4.9	2.0	1.3	7.4	-2.9	
	(five-year percentage change) Source: Eurostat	EU average	0.3	0.0	5.2	12.0	10.3	10.2	12.7	7.8	
	Terms of trade	SK	-6.0	-3.2	-2.3	-1.6	-1.7	-2.0	-2.1	-2.6	-5.9
	(five-year percentage change) Source: Eurostat	EU average	1.3	1.4	3.2	3.5	2.6	2.3	2.0	-0.1	-2.1
	Current account balance	SK	-4.8	0.3	-1.2	-2.2	-2.3	-2.5	-1.7	-1.8	-3.4
	(three-year average, percentage of GDP) Source: Eurostat	EU average	-2.4	1.7	1.7	1.7	1.6	1.5	1.2	1.0	0.1
	Net investment position	SK	-11	-14	-15	-15	-17	-14	-15	-14.7	-18.5
	(percentage of GDP) Source: Eurostat	EU average	-90	-162	-155	-159	-150	-164	-160	-174.9	-139.5
	Net external debt	SK	20	28	29	32	34	32	31	30.8	33.0
	(percentage of GDP) Source: Eurostat	EU average	-95	-31	-39	-44	-50	-75	-81	-90.9	-68.6

Category	Score	2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicators	Real effective exchange rate (PPI-deflated)	-0.99	0.07	0.37	0.92	1.19	0.37	-0.25	0.74	0.63
	Nominal unit labour costs	0.20	-0.07	-0.20	-0.52	-0.51	-0.84	-0.51	-0.60	-0.21
Additional indicators	Export market shares	0.20	0.30	0.13	-0.45	-0.51	-0.56	-0.34	-0.81	
	Terms of trade	-1.18	-2.25	-2.13	-2.03	-1.84	-1.73	-1.22	-0.77	-0.82
	Current account balance	-0.43	-0.49	-0.99	-1.31	-1.20	-1.08	-0.73	-0.70	-0.78
	Net investment position	0.23	0.21	0.20	0.20	0.19	0.19	0.18	0.18	0.16
	Net external debt	-0.21	-0.17	-0.19	-0.21	-0.22	-0.22	-0.22	-0.24	-0.27

Note: A positive value for the real effective exchange rate denotes exchange rate appreciation.

Table 17 Fiscal sustainability

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicator	Sustainability of public finances (S2 indicator)	SK	10.4	3.5	2.4	2.4	2.5	3.8	7.7	10.6	11.3
	(percentage of GDP) Source: European Commission	EU average	6.8	2.2	2.1	1.9	2.3	2.4	2.4	3.8	3.3
Additional indicators	Gross public debt	SK	40.6	51.7	52.3	51.5	49.4	48.0	58.9	61.0	57.8
	(percentage of GDP) Source: Eurostat	EU average	60.6	71.1	70.3	67.5	65.6	63.3	75.3	72.6	67.8
	Gross public debt with a residual maturity of less than one year	SK	4.7	3.6	4.4	2.1	3.4	3.8	3.6	3.8	4.8
	(percentage of GDP) Source: ECB	EU average	11.5	11.4	11.7	10.3	11.0	10.3	12.5	11.4	11.1
	Gross public debt with a residual maturity of one to five years	SK	17.2	16.6	12.5	9.8	12.2	11.8	17.3	19.1	18.0
	(percentage of GDP) Source: ECB	EU average	23.0	22.8	22.8	21.7	20.6	20.3	23.8	22.6	21.5
	Ten-year government bond yields	SK	3.9	0.9	0.5	0.9	0.9	0.3	0.0	-0.1	2.1
	(percentage) Source: Eurostat	EU average	4.8	1.9	1.6	1.6	1.5	0.8	0.4	0.5	2.6

Category	Score	2010	2015	2016	2017	2018	2019	2020	2021	2022
Outcome indicator	Sustainability of public finances (S2 indicator)	-0.87	-0.66	-0.15	-0.26	-0.07	-0.55	-1.83	-1.88	-2.19
Additional indicators	Gross public debt	0.61	0.50	0.46	0.42	0.41	0.40	0.37	0.28	0.26
	Gross public debt with a residual maturity of less than one year	0.78	0.93	0.85	1.02	0.90	0.85	0.96	0.90	0.75
	Gross public debt with a residual maturity of one to five years	0.47	0.60	0.99	1.14	0.77	0.78	0.55	0.30	0.33
	Ten-year government bond yields	0.47	0.53	0.58	0.48	0.52	0.52	0.51	0.59	0.32

5.3 Social inclusion

Table 18 Risk of poverty or social exclusion by economic activity; risk of material deprivation

Indicator		2016	2017	2018	2019	2020	2021	2022
Risk of poverty – population	SK	17.1	15.8	15.2	14.8	13.8	15.6	16.5
(percentage)	EU average	23.4	22.6	21.5	20.9	20.6	20.7	21.0
Risk of poverty – employed	SK	8.9	8.0	7.4	5.7	6.3	8.4	9.0
(percentage)	EU average	11.9	11.4	10.5	10.1	10.0	10.0	10.0
Risk of poverty – not employed	SK	24.2	23.1	21.5	24.0	22.2	22.5	22.8
(percentage)	EU average	34.7	34.2	33.8	33.4	33.3	32.9	34.4
Risk of poverty – retired	SK	11.8	12.4	10.6	12.3	12.3	13.4	13.1
(percentage)	EU average	21.0	21.6	22.3	22.6	22.7	22.2	24.4
Material deprivation	SK	15.5	13.5	12.3	11.4	9.7	9.2	10.5
(percentage)	EU average	17.2	15.8	14.2	12.8	12.4	11.3	12.2

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Table 18 Risk of poverty or social exclusion by economic activity; risk of material deprivation (continued)							
Score	2016	2017	2018	2019	2020	2021	2022
Risk of poverty – population	0.82	0.96	1.02	1.07	1.21	0.92	0.79
Risk of poverty – employed	0.44	0.56	0.62	0.93	0.86	0.34	0.21
Risk of poverty – not employed	1.18	1.23	1.33	1.11	1.31	1.28	1.25
Risk of poverty – retired	0.74	0.72	0.86	0.78	0.83	0.73	0.83
Material deprivation	0.14	0.20	0.19	0.16	0.30	0.25	0.19

Source: Eurostat.

Table 19 Risk of poverty by type of household								
Indicator		2016	2017	2018	2019	2020	2021	2022
Risk of poverty – one adult aged under 65	SK	27.2	29.8	26.5	28.6	23.4	27.2	27.7
(percentage)	EU average	37.0	37.0	35.1	34.1	33.0	33.2	33.6
Risk of poverty – one adult aged over 65	SK	14.6	15.9	15.8	24.2	31.3	32.5	30.0
(percentage)	EU average	32.9	34.1	35.9	36.6	37.7	36.7	39.6
Risk of poverty – one adult with one dependent child	SK	40.1	46.3	42.3	38.0	37.4	35.2	46.5
(percentage)	EU average	46.9	45.4	44.2	42.0	40.7	42.5	41.0
Risk of poverty – two adults with one dependent child	SK	12.4	11.3	13.7	12.0	12.3	14.0	18.4
(percentage)	EU average	17.2	16.6	15.2	14.6	13.8	13.6	14.6
Risk of poverty – two adults with two dependent children	SK	17.1	15.5	16.2	11.3	11.3	11.5	11.6
(percentage)	EU average	17.8	16.6	15.1	14.2	14.5	14.2	13.6
Risk of poverty – two adults with three or more dependent children	SK	37.7	37.1	36.9	38.0	38.0	37.8	43.8
(percentage)	EU average	34.2	32.1	29.3	28.8	29.8	29.5	27.4
Score		2016	2017	2018	2019	2020	2021	2022
Risk of poverty – one adult aged under 65		1.51	1.16	1.32	0.97	1.66	0.96	1.11
Risk of poverty – one adult aged over 65		0.96	0.95	1.04	0.67	0.35	0.24	0.53
Risk of poverty – one adult with one dependent child		0.66	-0.12	0.30	0.56	0.46	0.87	-0.64
Risk of poverty – two adults with one dependent child		0.71	0.90	0.30	0.56	0.37	-0.08	-0.77
Risk of poverty – two adults with two dependent children		0.08	0.14	-0.15	0.44	0.50	0.44	0.26
Risk of poverty – two adults with three or more dependent children		-0.20	-0.31	-0.60	-0.67	-0.59	-0.65	-1.15

Source: Eurostat.

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Table 20 Expenditure on social exclusion

Indicator		2010	2015	2016	2017	2018	2019	2020
Social protection expenditure	SK	18.1	17.9	18.3	18.2	17.9	17.8	19.6
(percentage of GDP)	EU average	24.2	23.2	23.1	22.6	22.5	22.5	25.8
Old-age expenditure	SK	6.6	7.1	7.2	7.2	7.1	7.1	7.8
(percentage of GDP)	EU average	9.2	9.5	9.4	9.3	9.2	9.2	10.1
Disability expenditure	SK	1.5	1.5	1.6	1.6	1.5	1.5	1.6
(percentage of GDP)	EU average	2.0	1.8	1.8	1.8	1.7	1.7	1.9
Family policy expenditure	SK	1.7	1.6	1.6	1.6	1.5	1.6	1.9
(percentage of GDP)	EU average	2.2	1.9	1.9	1.9	2.0	2.0	2.2
Unemployment expenditure	SK	1.0	0.5	0.5	0.5	0.5	0.5	0.8
(percentage of GDP)	EU average	1.4	1.1	1.0	0.9	0.9	0.8	1.8
Score		**2010**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Social protection expenditure		-1.13	-0.83	-0.77	-0.71	-0.74	-0.77	-0.95
Old-age expenditure		-1.27	-0.89	-0.84	-0.79	-0.80	-0.79	-0.78
Disability expenditure		-0.52	-0.36	-0.23	-0.18	-0.26	-0.26	-0.27
Family policy expenditure		-0.51	-0.41	-0.44	-0.45	-0.61	-0.48	-0.32
Unemployment expenditure		-0.42	-0.76	-0.77	-0.74	-0.68	-0.63	-0.94

Source: Eurostat.

Table 21 Income inequality

Indicator		2010	2017	2018	2019	2020	2021	2022
Gini coefficient	SK	25.9	23.2	20.9	22.8	20.9	21.8	21.2
	EU average	29.7	29.9	29.7	29.7	29.4	29.4	29.0
Income quintile share ratio (S80/S20)	SK	3.8	3.5	3.0	3.3	3.0	3.2	3.1
(ratio)	EU average	4.8	4.9	4.9	4.8	4.7	4.8	4.7
Income quintile share ratio (S80/S50)	SK	2.0	1.7	1.6	1.7	1.6	1.6	1.6
(ratio)	EU average	2.2	2.2	2.2	2.2	2.1	2.1	2.1
Income quintile share ratio (S50/S20)	SK	2.0	2.0	1.9	2.0	1.9	2.0	1.9
(ratio)	EU average	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Score		**2010**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Gini coefficient		1.00	1.65	2.07	1.69	2.15	1.80	1.90
Income quintile share ratio (S80/S20)		0.91	1.14	1.46	1.22	1.49	1.30	1.38
Income quintile share ratio (S80/S50)		0.91	1.74	2.00	1.72	2.10	1.80	1.89
Income quintile share ratio (S50/S20)		0.79	0.59	1.04	0.74	0.95	0.71	0.89

Source: Eurostat.
Note: The table shows difference in equivalent household income, which, unlike net disposable income, takes into account the size and composition of households.

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Table 22 Gender pay gap

Indicator		2010	2016	2017	2018	2019	2020	2021
Gender pay gap – population	SK	19.6	19.0	19.9	19.7	18.1	15.5	16.4
(percentage)	EU average	14.3	14.4	13.7	12.5	12.4	11.5	11.2
Gender pay gap – 25–34 age group	SK	16.2	13.4	15.7	15.9	14.1	11.5	12.6
(percentage)	EU average	6.8	8.5	8.9	8.9	9.3	8.6	8.6
Gender pay gap – 35–44 age group	SK	27.5	24.2	24.4	24.0	22.3	20.1	19.8
(percentage)	EU average	15.0	14.5	14.3	13.9	13.5	12.7	12.4
Gender pay gap – 45–54 age group	SK	21.5	22.0	22.5	22.1	20.6	17.7	20.0
(percentage)	EU average	16.4	15.8	15.7	15.1	14.1	13.3	13.2
Gender pay gap – 55–64 age group	SK	13.5	16.8	17.1	17.3	16.3	13.1	12.9
(percentage)	EU average	15.5	13.5	13.4	13.8	11.8	10.7	9.9
Gender pay gap – over 65 age group	SK	6.7	20.6	24.4	14.9	11.7	12.7	14.2
(percentage)	EU average	19.0	17.8	16.4	16.2	13.4	12.8	11.0
Gender pay gap –under 25 age group	SK	7.3	11.1	12.8	12.3	10.4	6.9	6.7
(percentage)	EU average	2.5	6.2	6.6	5.7	5.8	5.7	6.0
Score		**2010**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Gender pay gap – population		-0.84	-0.97	-1.12	-1.38	-1.05	-0.72	-1.03
Gender pay gap – 25–34 age group		-1.57	-1.01	-1.40	-1.16	-1.00	-0.59	-0.89
Gender pay gap – 35–44 age group		-1.76	-1.60	-1.65	-1.44	-1.46	-1.24	-1.28
Gender pay gap – 45–54 age group		-0.69	-1.03	-1.14	-1.06	-1.09	-0.74	-1.15
Gender pay gap – 55–64 age group		0.19	-0.45	-0.54	-0.47	-0.65	-0.33	-0.41
Gender pay gap – over 65 age group		0.83	-0.19	-0.49	0.10	0.14	0.01	-0.27
Gender pay gap – under 25 age group		-0.88	-1.08	-1.43	-1.30	-1.00	-0.27	-0.16

Source: Eurostat.

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5.4 Health

Table 23 Health outcome indicators

Indicator		2010	2016	2017	2018	2019	2020	2021
Life expectancy at birth	SK	75.6	77.3	77.3	77.4	77.8	77	74.6
(years) *Source: Eurostat*	EU average	78.7	80	80	80.2	80.5	79.7	79.2
Preventable mortality	SK		244	239	241	231	262	
(deaths per 100,000 inhabitants) *Source: Eurostat*	EU average		188	184	182	175	201	
Treatable mortality	SK		168	174	165	164	169	
(deaths per 100,000 inhabitants) *Source: Eurostat*	EU average		111	109	108	104	107	
Infant mortality	SK	5.7	5.4	4.5	5	5.1	5.1	4.9
(deaths per 1,000 live births) *Source: Eurostat*	EU average	4.2	3.7	3.5	3.4	3.5	3.2	3.1
Newborns with low birth weight	SK	9	7.5	7.5	7.3	7.5	7.3	
(percentage) *Source: OECD*	OECD average	6.5	6.6	6.6	6.6	6.6	6.2	5.5

Score	2010	2016	2017	2018	2019	2020	2021
Life expectancy at birth	-1.02	-0.95	-0.98	-0.99	-0.97	-0.93	-1.22
Preventable mortality		-0.77	-0.78	-0.84	-0.82	-0.76	
Treatable mortality		-1.14	-1.32		-1.21	-1.12	
Infant mortality	-0.81	-1.21	-0.76	-1.34	-1.33	-1.82	-1.80
Newborns with low birth weight	-1.52	-0.6	-0.59	-0.48	-0.62	-0.78	

Table 24 Health system resources

Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Healthcare expenditure	SK		6.8	7	6.8	6.7	7	7.2	
(percentage of GDP) *Source: Eurostat*	EU average	9.1	8.2	8.3	8.2	8.2	8.3	9.2	11.7
Healthcare expenditure per capita	SK		1,508	1,443	1,390	1,401	1,498	1,480	
(EUR at PPP) *Source: Eurostat*	EU average	2,366	2,270	2,317	2,389	2,480	2,594	2,725	4,432
Inhabitants per hospital bed	SK	155	174	173	172	176	174		
Source: Eurostat	EU average	207	221	224	228	230	233		
Inhabitants per doctor	SK	298	290	288	292	284	280	273	
Source: Eurostat	EU average	302	279	274	270	255	249	250	205
Inhabitants per nurse	SK	165	176	174	177	175	174	173	
Source: Eurostat	EU average	130	130	128	126	123	127	133	68
CT examinations	SK	90	156	162	154	155	160	144	
(number per 1,000 inhabitants) *Source: OECD*	OECD average	110	132	137	142	150	159	149	164
MRI examinations	SK	34	57	61	63	70	74	68	
(number per 1,000 inhabitants) *Source: OECD*	OECD average	46	66	69	72	76	82	74	82
Number of examinations per CT scanner	SK	6,371	8,734	9,375	8,905	8,451	9,005	7,542	
Source: OECD	OECD average	6,234	6,356	6,389	6,534	7,104	7,687	6,836	4,022
Number of examinations per MRI scanner	SK	4,875	6,415	6,808	6,585	7,282	7,728	6,917	
OECD	OECD average	4,384	4,501	5,303	5,184	5,395	5,573	4,819	4,930

Table 24 Health system resources (continued)

Score	2010	2015	2016	2017	2018	2019	2020	2021
Healthcare expenditure		-0.74	-0.67	-0.74	-0.81	-0.74	-0.99	
Healthcare expenditure per capita		-0.75	-0.87	-0.98	-1.04	-1.05	-1.16	
Inhabitants per hospital bed	0.72	0.57	0.6	0.64	0.61	0.65		
Inhabitants per doctor	0.08	-0.2	-0.29	-0.46	-0.75	-0.8	-0.54	
Inhabitants per nurse	-0.71	-0.95	-0.98	-1.07	-1.1	-1.04	-0.84	
CT examinations	-0.35	0.45	0.45	0.21	0.08	0.01	-0.09	
MRI examinations	-0.44	-0.29	-0.24	-0.28	-0.21	-0.26	-0.18	
Number of examinations per CT scanner	0.04	0.74	0.91	0.71	0.33	0.3	0.16	
Number of examinations per MRI scanner	0.24	0.99	0.33	0.37	0.71	0.96	1.01	

Table 25 Selected healthcare quality indicators

Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Self-reported unmet need for medical care	SK	1.7	2.1	2.3	2.4	2.6	2.7	3.2	2.9
(percentage of population aged over 16) *Source: Eurostat*	EU average	3.6	3.5	3.2	2.5	2.7	2.5	2.3	2.2
AMI 30-day mortality	SK	8	6.3	5.8	5.9	6.3	6.3	6.5	
(deaths per 100 admissions) *Source: OECD*	OECD average	7.8	7.2	7.2	7.1	5.9	6.1	7.4	
Ischaemic stroke 30-day mortality	SK	11.5	9.4	8.8	9	8.9	8.6	9	
(deaths per 100 admissions) *Source: OECD*	OECD average	9.1	8.8	8.5	8.3	7.7	7.8	10	
Haemorrhagic 30-day mortality	SK	30.8	28.8	25.5	26.9	25.4	24	27.9	
(deaths per 100 admissions) *Source: OECD*	OECD average	24.8	23.3	24.4	23.2	22.9	22.7	26.9	
Breast cancer five-year net survival [1)]	SK	76.6	75.5						
(percentage) *Source: OECD*	OECD average	83.3	84.3						
Lung cancer five-year net survival [1)]	SK	10.5	11.2						
(percentage) *Source: OECD*	OECD average	15.3	17.1						
Immunisation of children against measles	SK	98.5	95.2	95.2	95.8	96.1	96.2	96	95.4
(percentage) *Source: OECD*	OECD average	93.6	94.8	94.5	94.5	94.8	94.3	93.7	92.6
Immunisation of children against diphtheria, tetanus and pertussis	SK	99.1	96	96.4	96.4	96.5	96.7	97	97
(percentage) *Source: OECD*	OECD average	95.1	95.1	95.1	94.9	94.8	95	94.5	93
Immunisation of children against hepatitis B	SK	99	96	96.4	96.4	96.5	96.7	97	97
(percentage) *Source: OECD*	OECD average	88.6	91.5	92.3	90.5	91	92.3	92.9	91
Immunisation of people aged over 65 against influenza	SK	23.8	13.8	13.3	13	12.5	11.5	12.8	
(percentage) *Source: OECD*	OECD average	45.3	43.4	44.5	46.1	47.3	45.4	55.3	64
Breast cancer screening rate	SK	32.7	30.4	30.8	30.7	30.4	31	27.2	
(percentage of women aged 50–69) *Source: OECD*	OECD average	58.6	57	58.2	57.8	58.8	58.3	54.6	53
Cervical cancer screening rate	SK	48.5	48.3	46	46.2	45.6	46.1	40.1	
(percentage of women aged 20–69) *Source: OECD*	OECD average	56.9	59.5	59.1	59.5	59.6	58.3	53.7	56

Table 25 Selected healthcare quality indicators (continued)								
Score	2010	2015	2016	2017	2018	2019	2020	2021
Self-reported unmet need for medical care	0.5	0.37	0.23	0.03	0.03	-0.07	-0.31	-0.33
AMI 30-day mortality	-0.04	0.21	0.29	0.27	-0.17	-0.09	0.24	
Ischaemic stroke 30-day mortality	-0.67	-0.17	-0.08	-0.17	-0.33	-0.24	0.2	
Haemorrhagic 30-day mortality	-0.79	-0.76	-0.17	-0.58	-0.34	-0.2	-0.1	
Breast cancer five-year net survival [1)]	-1.33	-1.73						
Lung cancer five-year net survival [1)]	-1.05	-1.12						
Immunisation of children against measles	1.09	0.12	0.25	0.3	0.45	0.42	0.43	0.79
Immunisation of children against diphtheria, tetanus and pertussis	1.07	0.33	0.43	0.46	0.52	0.46	0.68	0.91
Immunisation of children against hepatitis B	0.58	0.49	0.56	0.61	0.59	0.51	0.74	1.23
Immunisation of people aged over 65 against influenza	-0.88	-1.35	-1.32	-1.5	-1.65	-1.58	-2	
Breast cancer screening rate	-1.37	-1.6	-1.64	-1.89	-1.87	-1.91	-1.47	
Cervical cancer screening rate	-0.49	-0.76	-0.93	-1.03	-1.06	-0.89	-0.87	

1) The figure for 2015 represents the period 2010–2014, while the figure for 2010 represents the period 2005–2009.

Table 26 Indicators of lifestyle and other factors									
Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Premature deaths due to ambient air pollution	SK	751	646	613	614	622	636		
(deaths per million inhabitants) Source: OECD	OECD average	350	298	284	278	282	287		
Share of out-of-pocket payments	SK		18.4	18.2	18.7	18.9	19.2	18.8	14.4
(percentage) Source: Eurostat	EU average	20.9	22.3	22.3	22.2	21.7	20.9	18.7	
Smoking prevalence [1)]	SK	26			26			25	
(percentage) Source: Eurostat	EU average	29.6			26			24.6	
Obesity rate by body mass index (BMI) [2)]	SK	15.1			14.4		19.7		
(percentage) Source: Eurostat	EU average	15.8			16.8		18.1		
Alcohol consumption	SK	10.1	10.2	9.9	9.7	10.1	10.3	9.9	
(litres per inhabitant aged over 15) Source: OECD	OECD average	9	8.8	8.7	8.6	8.6	8.6	8.5	7.2
Score		2010	2015	2016	2017	2018	2019	2020	2021
Premature deaths due to ambient air pollution		-1.7	-1.72	-1.71	-1.77	-1.76	-1.8		
Share of out-of-pocket payments			0.37	0.38	0.33	0.28	0.19	0	
Smoking prevalence [1)]		0.62			0.01			-0.05	
Obesity rate by body mass index [2)]		0.19			0.7		-0.39		
Alcohol consumption		-0.4	-0.51	-0.45	-0.42	-0.58	-0.63	-0.54	

1) The figure under 2010 (2015) is for 2009. 2) The figure under 2010 (2015) is for 2008.

5.5 Environment

Table 27 Climate neutrality indicators

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Outcome indicators	Change in greenhouse gas emissions	SK	63.1	54.7	55.3	57.2	58.5	53.7	45.8	52.2
	(index: 1990 = 100)	EU average	86.4	79.6	80.6	84.7	85	79.8	70.4	74.7
	Greenhouse gas emissions per inhabitant	SK	7.6	6.5	6.6	6.8	6.9	6.4	5.4	6.2
	(tonnes per inhabitant)	EU average	9.3	8.4	8.5	8.8	8.8	8.2	7.3	7.8
Additional indicators	Energy productivity	SK	5.9	7.2	6.9	6.5	6.8	7.1	7.2	6.9
	(PPP per kilogram of oil equivalent)	EU average	6.5	8.1	8.1	8.3	8.6	9.1	9.6	10
	GHG emissions intensity of energy consumption	SK	88.9	82.5	82.6	81	81.4	77.4	73.4	75.5
	(index: 2000 = 100)	EU average	95.1	88.6	87	85.8	84.4	81.7	79.9	79.6
	Final energy consumption	SK	105	91.8	94.8	102	101	102	94.5	104.1
	(index: 2000 = 100)	EU average	109	103	106	108	110	110	101	107.1
	Share of renewable energy in the energy mix	SK	9.1	12.9	12	11.5	11.9	16.9	17.3	17.4
	(percentage)	EU average	16.4	20.3	20.4	20.9	21.5	22.4	24.4	24.5
	Share of solid fossil fuels in final energy consumption	SK	6.9	4.9	4	4.1	4.3	4.2	3.7	3.8
	(percentage)	EU average	2.7	2.3	2.2	2.1	2.1	1.9	1.8	1.8
	Average CO2 emissions per km from new passenger cars	SK	149	128	125	126	128	130	120	139.2
	(grams of CO2 per kilometre)	EU average	144	121	119	119	120	122	111	121.8
	Material consumption efficiency	SK	1.4	1.7	1.7	1.6	1.6	1.8	1.8	1.9
	(PPP per kilogram)	EU average	1.6	1.8	1.9	1.9	1.9	2	2	2.2
	Share of buses and trains in total passenger transport	SK	22.2	24.2	25.2	25.6	26.1	26.2	18.8	
	(percentage)	EU average	18.2	18.1	18.2	18	18	18	13.1	
	Share of rail in total freight transport	SK	38.5	36.6	34.6	32.9	32.6	31	28.5	32.1
	(percentage)	EU average	25.9	24.5	23.6	23.8	24.1	23.3	22	21.6

Category	Score	2010	2015	2016	2017	2018	2019	2020	2021
Outcome indicators	Change in greenhouse gas emissions	0.8	0.9	0.88	0.9	0.92	0.93	0.96	0.85
	Greenhouse gas emissions per inhabitant	0.34	0.49	0.48	0.5	0.48	0.49	0.58	0.46
Additional indicators	Energy productivity	-0.4	-0.37	-0.53	-0.67	-0.66	-0.71	-0.74	-0.86
	GHG emissions intensity of energy consumption	0.66	0.62	0.45	0.47	0.31	0.43	0.64	0.4
	Final energy consumption	0.45	1	0.89	0.49	0.52	0.46	0.39	0.18
	Share of renewable energy in the energy mix	-0.67	-0.63	-0.71	-0.79	-0.83	-0.46	-0.61	-0.58
	Share of solid fossil fuels in final energy consumption	-1.06	-0.77	-0.56	-0.61	-0.76	-0.92	-0.75	-0.81
	Average CO2 emissions per km from new passenger cars	-0.47	-0.68	-0.75	-0.89	-0.88	-0.97	-0.93	-1.05
	Material consumption efficiency	-0.21	-0.12	-0.26	-0.34	-0.42	-0.25	-0.23	-0.26
	Share of buses and trains in total passenger transport	0.84	1.42	1.6	1.69	1.91	1.99	1.54	
	Share of rail in total freight transport	0.57	0.63	0.6	0.5	0.46	0.43	0.41	0.68

Source: Eurostat.

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Table 28 Pollution indicators

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Outcome indicator	Mean population exposure to PM2.5	SK	21.5	19.3	18	18.3	18.8	15.9	15.5	
	(micrograms per cubic metre) Source: OECD	OECD average	14.9	13.7	12.9	13	13.1	12.1	11.8	
Additional indicators	Nitrate in groundwater	SK	24	19.5	16.5	16.2	18.3	16.2	18.6	
	(milligrams per litre) Source: Eurostat	EU average	24	25.2	27.4	23.7	23.9	23	20.5	
	Phosphates in rivers	SK	0.07	0.09	0.26	0.18	0.13	0.1	0.1	
	(milligrams per litre) Source: Eurostat	EU average	0.07	0.06	0.07	0.07	0.07	0.1	0.1	
	Share of industry in GDP	SK	22.6	23.5	22.4	21.4	22.1	23.8	22.2	24.3
	(percentage) Source: Eurostat	EU average	17.9	18.2	18	17.7	17.4	17.2	17.1	17.3
	Population connected to waste water treatment systems	SK			63.6	65	65.7	68.1	68.8	
	(percentage) Source: Eurostat	EU average	71.6	72.6	75.2	74.2	74.9	75.5	74.8	

Category	Score	2010	2015	2016	2017	2018	2019	2020	2021
Outcome indicator	Mean population exposure to PM2.5	-1.16	-0.94	-0.88	-0.95	-1.03	-0.74	-0.71	
Additional indicators	Nitrate in groundwater	0	0.3	0.45	0.48	0.37	0.45	0.14	
	Phosphate in rivers	0.02	-0.63	-2.83	-1.8	-1.09	-0.1	0.22	
	Share of industry in GDP	-0.88	-0.82	-0.69	-0.6	-0.77	-1.12	-0.85	-1.15
	Population connected to waste water treatment systems			-0.5	-0.42	-0.4	-0.32	-0.26	

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Table 29 Waste production indicators

Category	Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Outcome indicators	Generation of municipal waste per capita	SK	319	329	348	378	414	421	478	496
	(kilograms per inhabitant)	EU average	480	469	489	500	506	515	538	534
	Recycling rate of municipal waste	SK	9.1	14.9	23	29.8	36.3	38.5	45.3	48.9
	(percentage)	EU average	26.8	35.2	37.2	37.7	38.3	39.6	40.5	39.9
Additional indicators	Recycling rate of packaging waste	SK	45.7	64.3	65.8	65.7	66.6	67.5	70.8	
	(percentage)	EU average	59.9	63.5	65	64.4	64.1	63.4	63.7	
	Recovery rate of packaging waste	SK	47.5	66.7	69.5	68.6	69.1	69.7	74.1	
	(percentage)	EU average	70.8	74.7	76.3	75.9	75.5	75.6	76.8	
	Landfill rate of waste	SK	55		47		40		31	
	(percentage)	EU average	35.3		30.5		29		24.8	
Category	**Score**		**2010**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Outcome indicators	Generation of municipal waste per capita		1.34	1.11	1.03	0.95	0.72	0.73	0.42	0.29
	Recycling rate of municipal waste		-1.02	-1.34	-0.97	-0.55	-0.13	-0.08	0.33	0.6
Additional indicators	Recycling rate of packaging waste		-1.15	0.09	0.09	0.14	0.27	0.39	0.72	
	Recovery rate of packaging waste		-1.19	-0.48	-0.41	-0.44	-0.37	-0.31	-0.15	
	Landfill rate of waste		-0.85		-0.7		-0.48		-0.31	

Source: Eurostat.

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Table 30 Environmental policy indicators

Indicator		2010	2015	2016	2017	2018	2019	2020	2021
Implicit tax rate on energy	SK	118	191	188	185	187	189	194	180
(EUR per tonne of oil equivalent)	EU average	184	219	222	221	220	222	209	209
Environmental tax revenues	SK	2.1	2.5	2.5	2.5	2.5	2.5	2.5	2.4
(percentage of GDP)	EU average	2.6	2.7	2.7	2.7	2.6	2.6	2.4	2.4
Share of environmental taxes in public revenues	SK	7.4	7.7	7.6	7.5	7.3	7.3	7.1	6.7
(percentage)	EU average	7.7	7.6	7.6	7.4	7.2	7.1	6.7	6.4
Environmental protection investments	SK	0.4	0.8	0.4	0.4	0.4	0.3		
(percentage of GDP)	EU average	0.6	0.7	0.4	0.4	0.4	0.4	0.3	
National expenditure on environmental protection	SK	2.2	2.3	1.9	1.9	1.7	1.8		
(percentage of GDP)	EU average	1.8	2	1.8	1.8	1.9	1.9	1.7	

Score	2010	2015	2016	2017	2018	2019	2020	2021
Implicit tax rate on energy	-0.97	-0.35	-0.44	-0.45	-0.41	-0.45	-0.22	-0.4
Environmental tax revenues	-1.01	-0.31	-0.37	-0.18	-0.19	-0.11	0.07	0.11
Share of environmental taxes in public revenues	-0.14	0.04	-0.05	0.04	0.05	0.09	0.23	0.19
Environmental protection investments	-0.54	0.3	0.19	0.36	-0.02	-0.66		
National expenditure on environmental protection	0.79	0.51	0.1	0.09	-0.23	-0.16		

Source: Eurostat.