Comparative analysis of development paths in Central and Eastern European countries (V4+2) using a composite index, 1995–2020

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The study compares the development paths of six Eastern European countries (Bulgaria, Czechia, Hungary, Poland, Romania, Slovakia) over the period 1995–2020 using a composite index that was developed by the authors.
The composite index consists of four subindices (economic performance, technical infrastructure, human infrastructure, and ecological situation). The individual development indices are used to analyze the development trajectories of each country, and based on them, the six examined countries were classified into three clusters.
The calculations show that the Czechia leads the ranking, while Poland and Hungary have a similar level of development to each other, the former because of rapid catching-up and the latter because of a slowdown in development dynamics. Slovakia, Romania, and Bulgaria are in the third group, mainly because of their less developed infrastructures.

Introduction

The first democratically elected governments of the countries of Central and Eastern Europe (1990) declared their intention to join the European Economic Community, which was in line with the will of the majority of their citizens. As is known, accession took place later than expected and at different speeds (2004 for Poland, the Czechia, Slovakia, and Hungary, and 2007 for Bulgaria and Romania). The people of the region hoped that membership would bring a rapid improvement in their living conditions.

In our study, we analyze the fulfilment of former hopes and the pace of developmental catch-up in six countries of the region (Poland, Czechia, Slovakia, Hungary, Romania, and Bulgaria).

The economic situations of the six countries under study before the geopolitical changes were similar in some ways and quite different in others. Czechoslovakia (in 1968) and Hungary (in 1972) attempted to change their economic policy, but both initiatives were quickly suppressed. This had several negative effects afterward.

Gross domestic product (GDP) growth slowed in the early 1970s. Economic policy mistakes led to severe supply shortages in Poland, which the party-state tried to address by introducing a state of emergency and a ticket system (1981). Similar reasons led to the introduction of a currency regime in Romania. In Hungary, foreign borrowing was used to try to offset the growing budget deficit.

The economic and social situation of the examined countries has worsened at different rates since the early 1980s: their national income has declined, their employment and productivity indicators have weakened, and their technological standards have deteriorated.

In the 1980s, both Poland and Hungary suffered double deficits (trade and budget deficits), and both countries' trade ratios worsened. Hungary's gross public debt increased almost tenfold by 1989 (USD 20,390 million) compared with 1973 (USD 2,118 million). In contrast, Romania's public debt remained low, but this had serious consequences for living standards.

The analyzed countries were thus in different starting positions for social and economic transformation after 1989. They followed different institutional practices and paces of privatization and support for the development of a market economy.

In 1990, Romania had the lowest level of economic output (34.3% of the European Union [EU] average), followed by Poland at 39.6%, Slovakia at 43.2% (1992), and Hungary at 56.9%, while the Czechia was in the best position at 81.4%.

In our study, we seek answers to three questions:

a) Which indicators can be applied to describe the development paths of the six examined countries?
b) What are the similarities and differences between the development trajectories of the six countries between 1995 and 2020?
c) Can we demonstrate convergence with the EU average in terms of development?

Aim and model of the research

Development theory research became a focus of interest after the Second World War. Several complementary and clarifying explanations have been proposed for the causes of development and their role. Despite this (or perhaps because of it), there is still no uniformly accepted method for measuring development. All authors agree, however, that development is a complex concept, i.e., it reflects not only an increase in material goods but also the quality of life of a community (e.g. Pike et al. 2006, Giugale 2017, Kocziszky–Benedek 2012).

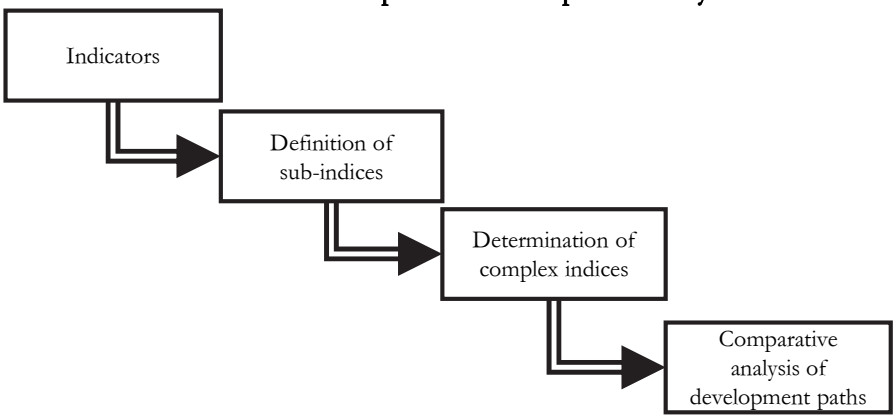
Economic development, therefore, means more and qualitatively different things (e.g., higher education, longer life expectancy in good health, better infrastructure, etc.) than increasing output (Capello–Fratesi 2012). In other words, economic growth is an important but not sufficient condition for development. Even with rapid growth,

development can be more modest, and even modest output growth can induce greater improvements in quality of life.[1]

Our comparative empirical study of six countries covered the period from 1995–2020. In the first step, we constructed a complex index based on a set of indicators to assess the development of the six countries, which can be used to determine the development of each country for a given year and thus identify their development trajectories (Figure 1).

Figure 1

Model of the comparative development analysis



Concepts and components of the composite development index

Development is a multidimensional, complex process that induces social and economic changes (Krugman 1997, Mackinnon et al. 2002, Martin 2010, Todaro–Smith 2003). Despite decades of research on the subject, the literature still lacks a consistent measure of economic development, which is not the same as GDP (although many studies still refer to it when analyzing development). There is, however, a consensus that economic, social, and environmental indicators should be considered when measuring development, but opinions differ on the list of indicators and on the methodology that should be used to integrate them.[2]

[1] There are many attempts to measure development in the literature, but none of them has been widely adopted because they are either too abstract (e.g., the human development index), too futuristic (e.g., the happiness index) or too data-intensive (e.g., the various sustainability indices).

[2] There are several complex indicators (e.g., Measure of Economic Welfare (MEW); Index of Sustainable Economic Welfare (ISEW); Genuine Progress Indicator (GPI), etc.); Social Innovation Index (SII) (Kocziszky–Szendi 2018) that consider factors beyond the economic output (GDP). The problem is that some of these are difficult to apply, lack time-series data, and therefore have limited scope for international comparison.

Table 1

The examined indicators

No.	Indicator	Data source	Database availability
	Economic performance		
1.	GDP/capita (USD, PPS[a)])	World Bank	[1]
2.	Government debt (% of GDP)	IMF	[2]
3.	Trade balance (% of GDP)	World Bank	[1]
4.	Consumer price index (%)	World Bank	[1]
5.	Investments (% of GDP)	Eurostat	[3]
6.	Labor productivity	Eurostat/World Bank	[1], [3]
7.	Patent applications per 10,000 inhabitants	World Bank	[1]
8.	Number of active enterprises per 1,000 inhabitants	Statistical Offices of the countries	[4–9]
9.	Budget deficit (% of GDP)	IMF	[2]
10.	Current account balance (% of GDP)	IMF	[2]
11.	FDI[b)] inflow (% of GDP)	UNCTAD	[10]
12.	Long-term interest rate (%)	OECD	[11]
13.	Activity rate (%)	Eurostat	[3]
14.	Employment rate (%)	Eurostat	[3]
15.	Unemployment rate (%)	Eurostat	[3]
16.	Income per household (USD, PPS)	World Bank	[1]
17.	Dependency ratio (share of population aged 0–14 years/share of the active population (15–64 years) (%)	Eurostat	[3]
18.	Gross average wages (USD)	OECD	[11]
19.	Household consumption per capita (PPP[c)], USD)	World Bank	[1]
	Human infrastructure		
20.	Doctors per 1,000 inhabitants	Eurostat	[3]
21.	Hospital beds per 1,000 inhabitants	World Bank	[1]
22.	Health care expenditures (% of GDP)	OECD	[11]
23.	Education expenditures (% of GDP)	OECD	[11]
24.	Tertiary education students per 1,000 inhabitants (head)	World Bank/Eurostat	[1], [3]
	Technical infrastructure		
25.	Secondary utility gap (the gap between the ratio of dwellings connected to the public drinking water-conduit network and the ratio of dwellings connected to the public sewerage)	Eurostat/OECD/ Statistical Offices of the countries	[3–9, 11]
26.	Built houses per 10,000 inhabitants	Statistical Offices of the countries	[4–9]
27.	Passenger cars per 1,000 inhabitants	Eurostat	[3]
28.	Length of motorway per 100,000 inhabitants	UNECE, OECD	[11], [12]
29.	Gas consumption per inhabitants	Eurostat	[3]
	Ecological environment		
30.	Waste generated per 1 inhabitant (kg)	Eurostat/Statistical Offices of the countries	[3–9]
31.	Greenhouse gas emissions (1990=100%)	Eurostat	[3]
32.	Electricity consumption per person (GWh/capita)	Eurostat	[3]
33.	Share of renewables in total energy consumption (%)	World Bank	[1]

a) Purchasing power standard. b) Foreign direct investment. c) Purchasing power parity.

Comparability between countries and objectivity (the data we selected are regularly published by national statistical offices) were important considerations in our choice of indicators to describe development.

By the indicator selection, we have assumed that a country's development is determined by its infrastructure and environmental factors, in addition to its economic output. Our complex development index is made up of 33 variables grouped into four clusters (economic performance, human infrastructure, technical infrastructure, and ecological environment) (Table 1). The composition of the given subindices was made based on the suggestions of the OECD (2008) complex index creation tool, experts of the Hungarian National Bank and the World Development Indicators database of the World Bank.

Over the analysis period, the most volatile of the above indicators are those related to economic output, i.e., specific GDP PPS, labor productivity and per capita income (Table 2).

Table 2

Mean and standard deviation of the indicators, 1995–2020

No.	Indicator	EU average	Sigma EU (st. dev.)	Average of six countries	Sigma six countries (st. dev.)
	Economic performance				
1.	GDP/capita (USD, PPS)	44,765.8	18,917.3	33,048.3	5,102.7
2.	Government debt (% of GDP)	90.1	43.9	51.6	17.9
3.	Trade balance (% of GDP)	85.6	10.1	126.0	31.4
4.	Consumer price index (%)	0.5	5.1	2.6	0.8
5.	Investments (% of GDP)	21.9	5.2	22.1	3.8
6.	Labor productivity	88,559.5	15,647.1	22,261.2	5,172.8
7.	Patent applications per 10,000 inhabitants	1.17	0.3	0.5	0.2
8.	Number of active enterprises per 1,000 inhabitants	52.2	29.4	93.3	35.1
9.	Budget deficit (% of GDP)	–6.9	2.6	–6.7	2.1
10.	Current account balance (% of GDP)	3.0	4.4	0.1	3.0
11.	FDI inflow (% of GDP)	0.7	4.9	1.6	1.8
12.	Long-term interest rate (%)	0.39	1.9	1.8	1.4
13.	Activity rate (%)	73.0	3.1	74.2	2.8
14.	Employment rate (%)	74.7	4.7	72.3	2.2
15.	Unemployment rate (%)	7.4	3.2	4.5	1.3
16.	Income per household (USD, PPS)	22,364.0	7,636.1	11,975.0	2,500.6
17.	Dependency ratio (share of population aged 0–14 years/share of the active population (15–64 years) (%)	23.5	1.0	23.4	0.9
18.	Gross average wages (USD)	2,793.5	649.3	1,267.8	245.1
19.	Household consumption per capita (PPP, USD)	16,360.0	1,976.1	15,640.7	1,691.3

(Table continues on the next page.)

(Continued.)

No.	Indicator	EU average	Sigma EU (st. dev.)	Average of six countries	Sigma six countries (st. dev.)
	Human infrastructure				
20.	Doctors per 1,000 inhabitants	2.2	1.7	34.4	7.0
21.	Hospital beds per 1,000 inhabitants	5.2	1.3	67.7	6.0
22.	Health care expenditures (% of GDP)	7.7	2.2	4.9	0.8
23.	Education expenditures (% of GDP)	4.8	1.4	4.2	0.5
24.	Tertiary education students per 1,000 inhabitants (head)	39.3	10.7	30.4	3.7
	Technical infrastructure				
25.	Secondary utility gap (the gap between the ratio of dwellings connected to the public drinking water-conduit network and the ratio of dwellings connected to the public sewerage)	0.1	20.8	11.2	3.2
26.	Built houses per 10,000 inhabitants	53.2	36.3	41.5	12.5
27.	Passenger cars per 1,000 inhabitants	560	110.4	478.7	102.2
28.	Length of motorway per 100,000 inhabitants	30.7	12.6	10.1	4.7
29.	Gas consumption per inhabitants	806.1	469.2	740.1	219.1
	Ecological environment				
30.	Waste generated per 1 inhabitant (kg)	505.0	102.6	392.5	70.1
31.	Greenhouse gas emissions (1990=100%)	79.3	21.3	63.9	12.4
32.	Electricity consumption per person (GWh/capita)	5.5	0.7	4.3	0.9
33.	Share of renewables in total energy consumption (%)	22.0	11.7	18.7	3.8

Method of the complex index measurement

The literature is not consistent regarding the construction of composite indicators (Mazziotta–Pareto 2013, Meier 2001, Michalek 2012, Sebestyén et al. 2021, Krishnan V.–Firoz C. 2022, Aguilar 2022, Győri 2023). The OECD (2018) recommendation suggests four types of nearly identical composite indicator composition methods, all based on normalization. The only difference is in the weighting of the subindices. While the weight of the components is fixed when calculating the human development index, the weight (P) can be determined by the analyst when calculating the so-called competitiveness index of the Hungarian National Bank (Table 3). (In the latter case, the standard deviation of a given sample is considered by subtracting points in proportion to the distance from the largest value.)

Table 3

Definition of composite indicators used to measure development

No.	Name	Indicators and applied methodology	Source	Notes
1	World Development Indicators (World Bank)	Six main indicator groups (poverty and inequality, people, environment, economy, states and markets, global links), 1591 indicators, 264 countries	[13]	doesn't create a complex indicator
2	E-Government Development Index (EGDI) (UN)	Three important dimensions (provision of online services, telecommunication connectivity, human capacity); Z score standardization, the weighted average of three components	[14]	EGDI = 1/3 ($OSI_{normalized}$ + $TII_{normalized}$ + $HCI_{normalized}$)
3	Culture for Development Indicators (CDIS) (UNESCO)	7 group of indicators (economy, education, governance, social participation, gender equality, communication, heritage), 22 indicators	[15]	each indicator has its calculation method
4	Human Development Index (HDI) (UN)	Three indicators (GNI[a]) per capita, life expectancy, literacy data), the geometric mean of the subindices	[16]	HDI = (I_{Health} * $I_{Education}$ * I_{Income}) 1/3
5	Nachhaltige Entwicklung (Sustainable Development Goals, SDG) (UN)	17 indicator groups for countries, measuring progress to targets	[17]	–
6	Regional Competitiveness Index (European Commission)	74 indicators in 11 pillars. three subindexes: basic, efficiency and innovation factors of competitiveness. weighted average calculation	Dijk-stra et al. (2011)	dimensions: Basic, Efficiency and Innovation. arithmetic means of the dimension scores. RCI = w_{basic} * RCI_{basic} + $w_{efficiency}$ * $RCI_{efficiency}$ + $w_{innovation}$ * $RCI_{innovation}$
7	DESI (Digital Economy and Society Index) (European Commission)	4 dimensions: human capital, connectivity, integration of digital technology, digital public services; 32 indicators, min-max normalization, the sum of the four subindices	[18]	DESI = Human capital * 0.25 + Connectivity * 0.25 + Integration of Digital Technology * 0.25 + Digital Public Services * 0.25
8	Competitiveness Report (Hungarian National Bank)	5 pillars (macroeconomics and finance, financial system, corporate sector, human capital, environment, infrastructure, public administration), 36 indicators	[19]	$\max(0; 100 - \left\{\frac{(x_{max} - x_i)}{\sigma}\right\} * P$

a) Gross national income.

There is a complex relationship and interaction between the indicator groups (Table 4).

Table 4

Relationship between the indicators

Output/dependent variable	Independent variable	Impact of independent variables on the output variable
Output (GDP/capita/PPS)	Government debt (2)	↓
	Investment rate (5)	↑
	Net export (3)	↑
	Consumption of households (19)	↑
	Population	↑
	Inflation (4)	↓
Fiscal balance	Inflation (4)	↓
	Budget deficit (9)	↓
	Government debt (2)	↓
Labor productivity	GDP/capita/PPS (1)	↑
	Activity rate (13)	↑
	Dependency ratio (17)	↓
	FDI (11)	↑
	Employment rate (14)	↑
Investments	FDI (11)	↑
	Income of the population (16)	↑
	Investment rate (5)	↑
Health care	GDP/capita/PPS (1)	↑
	Inflation (4)	↓
	Budget deficit (9)	↓
	Health care expenditures (22)	↑
	Doctors/1000 inhabitants (20)	↑
	Number of hospital beds (21)	↑
Educational infrastructure	Inflation (4)	↓
	Budget deficit (9)	↓
	Education expenditures (% of GDP) (23)	↑
Gas emissions	GDP/capita/PPS (1)	↑
	FDI (11)	↑
Electricity consumption	GDP/capita/PPS (1)	↑
	Income of the population (16)	↑
	Inflation (4)	↓
	Budget deficit (9)	↓
Waste per capita	GDP/capita/PPS (1)	↑
	Income of the population (16)	↑

Note: The indicator number is shown in parentheses.

The diversity of the index is not a problem if it is applied consistently because the index has a benchmark role, and its value changes can be used to characterize the change in the development of a country over time. An increase in the value of the index relative to the base period indicates progress, a decrease indicates decline, and stagnation indicates stability.

The indicator data in our database were transformed to a 0–100 ratio scale using the min-max normalization method. For a given indicator, the best-performing country received 100 points, while the other countries ranked based on their distance from the best-performing country. The formula used to convert the baseline indicators into scores:

$$x_{norm} = \frac{x_i - x_{min}}{x_{max} - x_{min}} * 100 \quad (1)$$

where x_{max} is the maximum among the analyzed countries' values and x_{min} is the minimum among the analyzed countries' values. The advantage of this methodology is that it does not require a normal distribution of the raw data. The scoring tracks the variance of the values of the countries in the sample and allows the optimal value to vary from indicator to indicator. For example, this means that for each indicator, it can be decided individually whether the minimum, maximum or even the sample average value is optimal.

Four subindices were determined by averaging the ratio scale values of indicators belonging to the same group.

Finally, the complex index was calculated as the arithmetic mean of the subindices, i.e., the subindices were of equal weight:

$$CI(t)_i = \frac{(EP_i(t) + HINF_i(t) + TINF_i(t) + EE_i(t))}{4}, \quad (2)$$

where CI – composite index, EP – economic performance subindex, $HINF$ – human infrastructure subindex, $TINF$ – technical infrastructure subindex, EE – ecological environment subindex, i – no. country, t – time.

The composite index has a temporal and spatial benchmark role, and its change can be used to characterize the shift in the development of a given country. An increase in the value of the index relative to the base period indicates progress, a decrease indicates decline, and stagnation indicates stability.

Trajectories of development subindices

Real economic and financial market processes

In the early 1990s, the concerned countries tried to improve their economic situation through „shock therapy" reform programs, while at the same time, they started developing the institutions necessary for a market economy, liberalized their markets, reduced the share of state ownership and began practicing privatization (Jakab–Világi 2008). As a result, their output fell sharply, and by around the middle of the decade, the decline had come to a stop.

Bulgaria's economy started from an extremely bad position on the difficult road of economic and political model change in 1990. Inflation rose to historic heights (123% and 1061%, respectively) in 1996 and 1997 because of the country's loss of its export markets, followed by privatization and the liquidation of some state-owned enterprises.

After the split of Czechoslovakia (1992), the second Slovak Republic's economic output was well below the EU average (17%). In contrast, the Czech economy managed to keep pace with EU output but failed to achieve meaningful convergence. For the other countries examined, specific output has been volatile. A notable expansion in output occurred in the late 1990s, which was interrupted by the financial crisis of 2008 and the European debt crisis of 2012 (such as the change in the EU average) (Figure A1 in the Appendix).

Following the 2008 financial crisis, real economic growth in the countries of the region has slowed, and unemployment rates have increased. To compensate for this, the Czech, Polish and Hungarian central banks played a more active role than they previously had. They sought to stop the fall in GDP by cutting interest rates and launching unconventional monetary programs (e.g., QE). Despite output growth, there has since been no convergence toward the EU average (Figure A2 in the Appendix).

The most active bank in this respect has been the Czech National Bank, which has kept its base rate virtually at zero since the end of 2012, while the National Bank of Slovakia has followed the ECB's interest rate policy. Meanwhile, economic output in Bulgaria and Romania lagged behind the countries in the region (Table 5).

Table 5

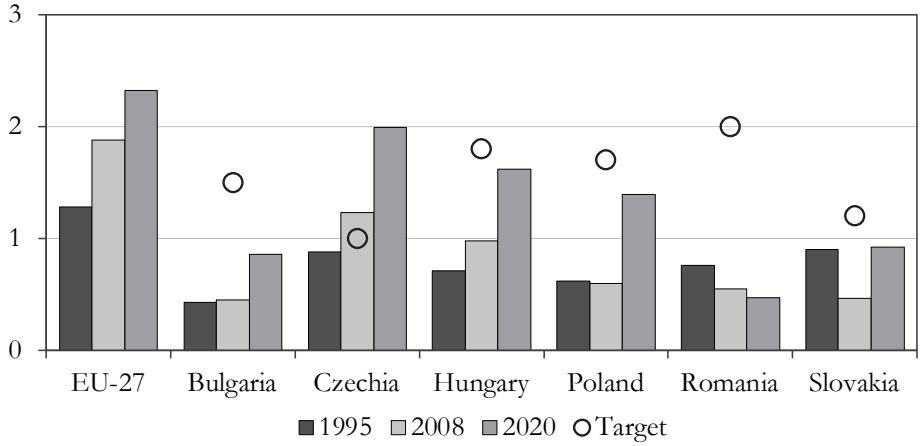
GDP per capita (EUR) compared to the EU average (%)

Country	1995	2000	2005	2010	2015	2020
European Union	100	100	100	100	100	100
Bulgaria	12	10	14	20	23	30
Czechia	30	36	49	60	58	67
Hungary	23	27	41	40	42	47
Poland	19	27	29	38	41	46
Romania	14	10	17	25	29	38
Slovakia	19	23	33	51	54	56

There are several reasons for the slow catch-up. On the one hand, R&D expenditure remains below the EU average (Figure 2), and on the other hand, the decline in the value added of agriculture has only been partly compensated by the secondary and tertiary sectors (Ciupagea 2010, Soós et al. 2020).

Figure 2

Change in R&D expenditures as a % of GDP



Source: Author created based on the Eurostat data.

Following their geopolitical changes, Bulgaria and Hungary have experienced very high public debt levels[3], while the Romanian economy (for well-known reasons) has been well below the EU average. With output growth, public debt-to-GDP ratios started to decline but increased in absolute terms (Figure A3 in the Appendix).

In the case of Romania, the low gross public debt has come at a heavy price for the population, with supply problems, a lack of investment in community infrastructure, a deterioration in the living standards of the population and a decline in the purchasing power parity of the national currency (Figure A4 in the Appendix). As a result, Romania implemented a monetary reform in 2005: 1 new RON = 10,000 old RON, while Slovakia adopted the EUR on 1 January 2009.

Countries in the region continue to have low fiscal tightening and high budget deficits.

Bulgaria joined ERM II on 10.07.2020, the Banking Union on 01.10.2020 and the Bulgarian Central Bank approved the plan to adopt the EUR on 30.06.2021, while a significant part of the banking system's loans and deposits were dominated by the EUR.[4]

[3] For an empirical discussion of the relationship between GDP growth and public debt, see e.g., Early–Rebelo (1993).

[4] After the introduction of the currency board system in Bulgaria in 1997, the leva was tied to a fixed exchange rate system, initially to the German mark and then to the EUR from 1999, so the country effectively gave up monetary policy autonomy at that time. As a result of the currency board exchange rate regime, Bulgaria's monetary policy has been subordinated to the fixed exchange rate for more than two decades. It has been argued that the introduction of the EUR would improve the country's position in terms of international investment, help to accelerate FDI inflows, improve financing conditions and have an impact on tourism. The fixed exchange rate regime prevents Bulgaria from devaluing its currency to make its exports more competitive, thus the country's economic growth path is not vulnerable to the introduction of the EUR.

Changes in demographic and income conditions

One reason for the growth deficit in the countries of the region is the monotonically declining working-age population (Figure A5 in the Appendix).

This is partly due to the decline in the intention to have children and partly to the increasing number of people working abroad, which the activity rate has not been able to compensate for (Figure A6 in the Appendix).

The increase in outputs is mainly explained by the increase in employment (Figure A7 in the Appendix), as indicated by the close correlation (Table 6).

Our analysis shows that there is a strong correlation between GDP and the employment rate (Table 6).

Table 6

Relationship between GDP and employment rates, 2000–2020

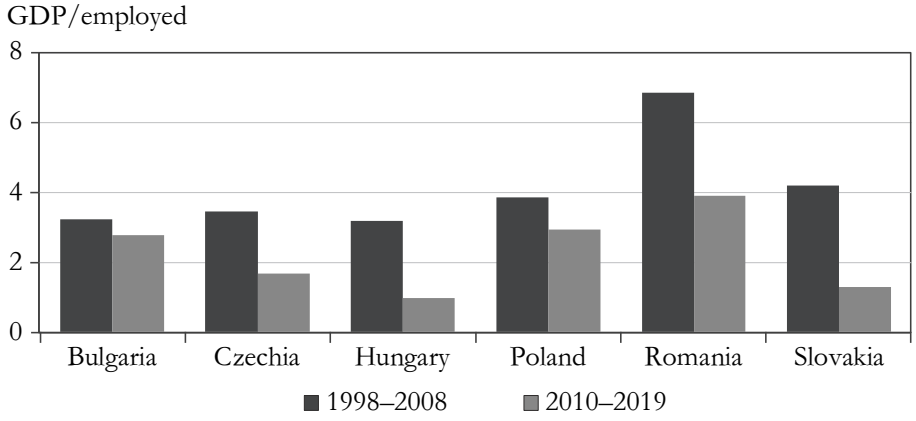
Country	Relationship	
Bulgaria	y = 358.51x – 16466	R^2 = 0.8727
Czechia	y = 924.97x – 48764	R^2 = 0.6888
Hungary	y = 386.57x – 13036	R^2 = 0.6742
Poland	y = 501.2x – 20571	R^2 = 0.9424
Slovakia	y = 974.03x – 48022	R^2 = 0.7517
Romania	y = 654.78x – 33596	R^2 = 0.313

The exception is Romania, where it is estimated that nearly 3 million workers are permanently employed abroad (exact figures are not available from the Romanian Statistical Office).

At the same time, output in all six countries is being affected by low and deteriorating productivity (Figure 3).

Figure 3

Annual growth rate of productivity (GDP/employed)



Source: Author created based on the Eurostat data.

Despite a slow trend toward catching up, household income in the countries studied has remained persistently below the EU average, and the gap has stabilized (Figure A8 in the Appendix).

The 2008 financial crisis broke this trend. Following a prolonged recovery, household income growth continued on a lower path. The rising share of retired people played a role in this.

Human infrastructure subindex

Bulgaria, the Czechia, and Slovakia have a higher number of doctors per thousand inhabitants than the EU average, while the rest of the group has a lower number (Figure A9 in the Appendix).

However, the picture is shaded by the fact that life expectancy at birth, although significantly improved, is still on average 3-5 years below the EU average.

The number of hospital beds per thousand inhabitants in the countries studied decreased between 1995 and 1998 but is still persistently higher than in the EU, which is closely linked to the poorer health status of the population and the low effectiveness of health prevention (Figure A10 in the Appendix).[5]

Technical infrastructure subindex

Technical infrastructure (as in the previous three indicator groups) is a key element of the sustainable development path (Crescenzi–Rodríguez-Pose 2012). Its development attracts investment in economic development, improves mobility and increases people's perception of well-being.

The technical infrastructure in the group of countries under study has traditionally been less developed than the Western European average. A change occurred in the mid-1990s with the dynamic expansion of telephone and car ownership (Figure A11 in the Appendix).

At that time, transport infrastructure and housing conditions improved significantly. However (except for Poland), household consumption of gas is still higher than the EU average, especially in Hungary.

Environmental pressure subindex

The lower economic output than the EU average results in lower pressure on the environment (Figure A12 in the Appendix).

Since the early 1990s, the use of fossil fuels (coal, lignite, and anthracite) has been monotonically decreasing, and all countries have started to change their energy mix

[5] On the links between human infrastructure and development, see e.g., Bach et al. (1994), or Baten (1997).

(Figure A13 in the Appendix). As a result, greenhouse gas emissions have decreased (Figure A14 in the Appendix).

However, there was no significant reduction in the amount of waste per inhabitant. Despite the commitment of all governments to the circular economy, this has not yet led to a significant breakthrough (Figure A14 in the Appendix).

Characteristics of the complex development paths

Among the four subindices, there is a characteristic difference in the subindex of economic performance (Figure A15 in the Appendix). The indicator for the Czech economy (except for 1996 and 1997) has been consistently within the range of 70–80% and has even managed to exceed this level for a short period after 2018.

In contrast, the Slovak economic index declined monotonically, especially after 2013, while the Hungarian, Romanian and Bulgarian indices showed strong volatility over this period (Figure A15 in the Appendix).

Romania has the worst human infrastructure index of the studied countries. The fact that a significant portion of the working-age population goes abroad to work plays a decisive role in this. Regrettably, Hungary's human infrastructure subindex has also worsened monotonically since 2008 (Figure A16 in the Appendix).

It should be noted that in the analyzed countries, the contributions of different indicators to the components' values are not equal. E.g.: in Romania besides the hospital beds only education expenditures appear as significant in 1995 which has radically changed to 2020. Compared to this, in the Czechia, Hungary or Slovakia, all five components are more or less significant (Hungary can be mentioned as the most balanced from them). The expenditure side of human infrastructure can be verified in Slovakia and the Czechia as the most intensive, while tertiary education seems to have the highest contribution in Poland.

The technological infrastructure component shows an improvement in Poland, while there is a relative decrease in Hungary and a persistently low level in Bulgaria (Figure A17 in the Appendix).

Regarding the composition of the technical infrastructure component, Bulgaria, the Czechia and Slovakia are almost homogenous regarding the share of given indicators, while in the other countries, a significant shift occurred to 2020 regarding the dates. In Hungary, the shift was toward the relatively advantageous motorway network, while in Romania, gas consumption has reached the highest contribution among technical infrastructure.

There was no significant improvement in the value of the Romanian subindex for environmental pressures. This is mainly due to an increase in the amount of waste. The other countries covered by the study (except for the Czechia) show strong fluctuations (Figure A18 in the Appendix).

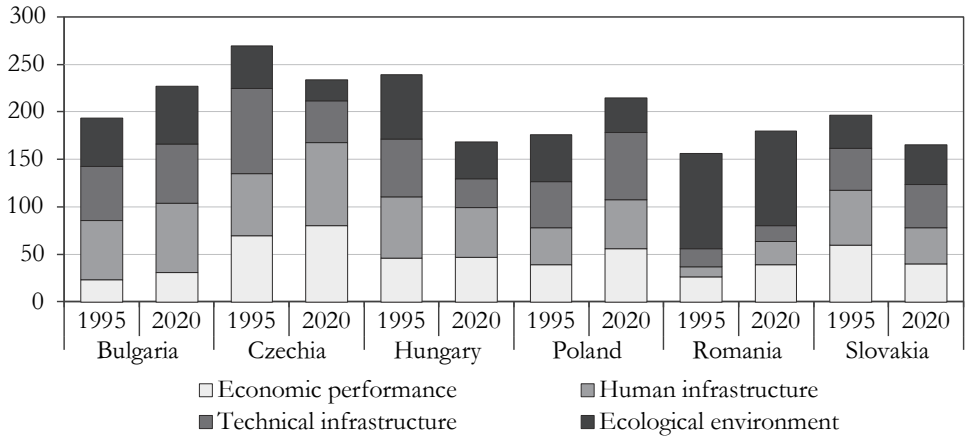
In the case of the ecological environment, the structure of the component is quasihomogenous among the six county areas. This means that almost every indicator has a significant contribution to the dispersion of this subindex. The exceptions are the Czechia, where only greenhouse gas emissions and renewables have significance, while in Poland, greenhouse gases and renewables have almost zero contribution to the subindex value.

The Czechia's complex development index path is (unsurprisingly, given the above) consistently the most favorable (Figure A19 in the Appendix).

Romania and Bulgaria have experienced the biggest changes in their development levels over the period due to both their low baseline values and their economic growth. For the other countries, the development index has been volatile. This is also confirmed by the subindex data for the start and end points of the study (Figure 4).

Figure 4

Components of the complex development index



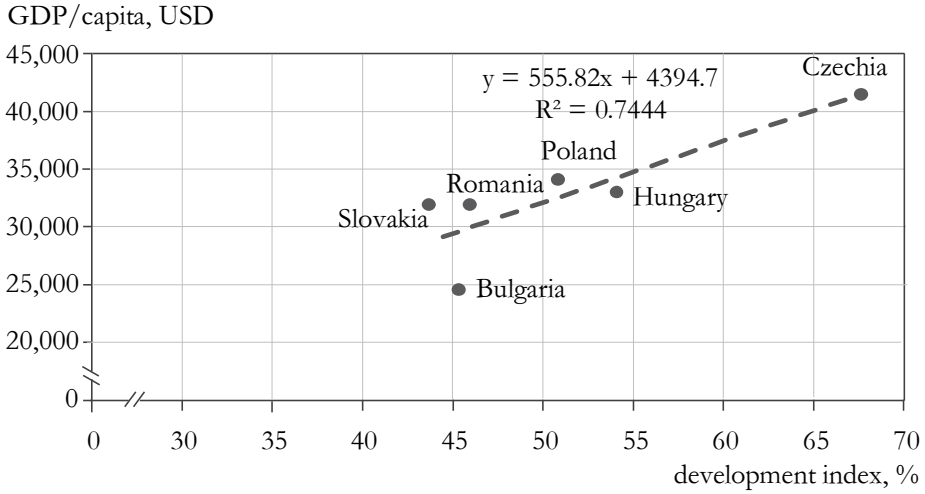
Summary and conclusions

The analysis of the development paths of the six countries examined demonstrates once again that development is a multidimensional concept, of which economic growth is only one factor, albeit an important one. In other words, economic growth is a necessary but not a sufficient condition for development. Output growth must be accompanied by improvements in demographics, income, human infrastructure, and environmental conditions.

There is a strong correlation between economic growth and the development index of the analyzed country group, so the „tide effect" seems to be at work. That is, as GDP improves, so does the development index of a given country (Figure 5).

Figure 5

Correlation between GDP per capita and development index, 2020



Our analyses show that this spillover effect was partially in effect between 1995 and 2020, but the rate of economic expansion exceeded the change in the pace of development in all six countries.

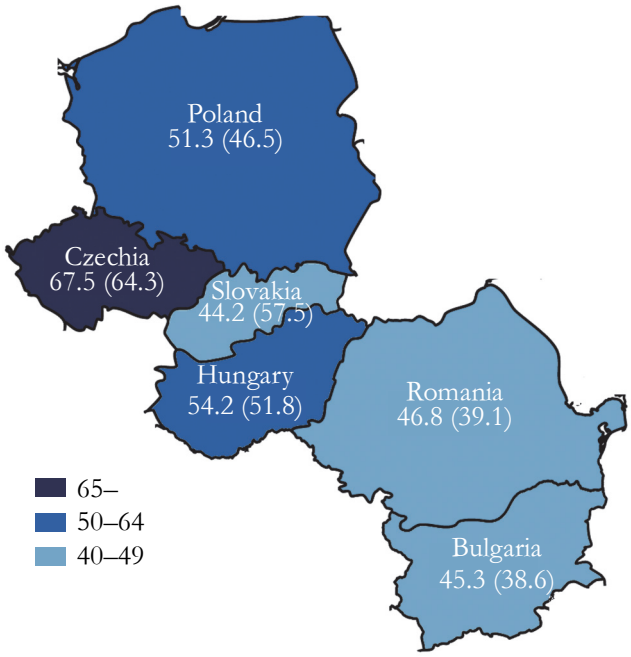
Based on the complex development index (1995–2020), the six countries under study can be grouped into three clusters (Figure 6).

The Czechia has consistently outperformed the other examined countries in terms of the complex development index, which is why it was placed in the first group. Hungary and Poland are in the second group, with Poland starting from a lower level and overtaking Hungary. Bulgaria, Slovakia, and Romania seem to be consistently lagging behind the other three countries in the analysis. The pace of progress in this group of countries was disrupted in 2019. This is partly due to the Covid-19 epidemic and partly due to deteriorating productivity and dependence on external markets. The „golden decade" of 2010–2020 appears to be over. We predict slowing output and rising inflation and interest rates for all the examined countries.

The outlook for the development path of the examined group of countries between 2021 and 2025 is unfavorable. The Russian-Ukrainian war disrupted the postpandemic recovery process. The pace of economic growth is being held back by disruptions in long supply chains, oil and gas supplies, and rapid repricing of steel and rare earth metals. At the same time, inflationary pressures are intensifying (as confirmed by the analyses of the central banks of the countries concerned). Government action to compensate for these trends is leading to unfavorable developments in budget deficits. In addition to rising inflationary pressures and slowing economic growth, lower-than-EU average productivity and structural problems have a negative impact on the trends that determine development.

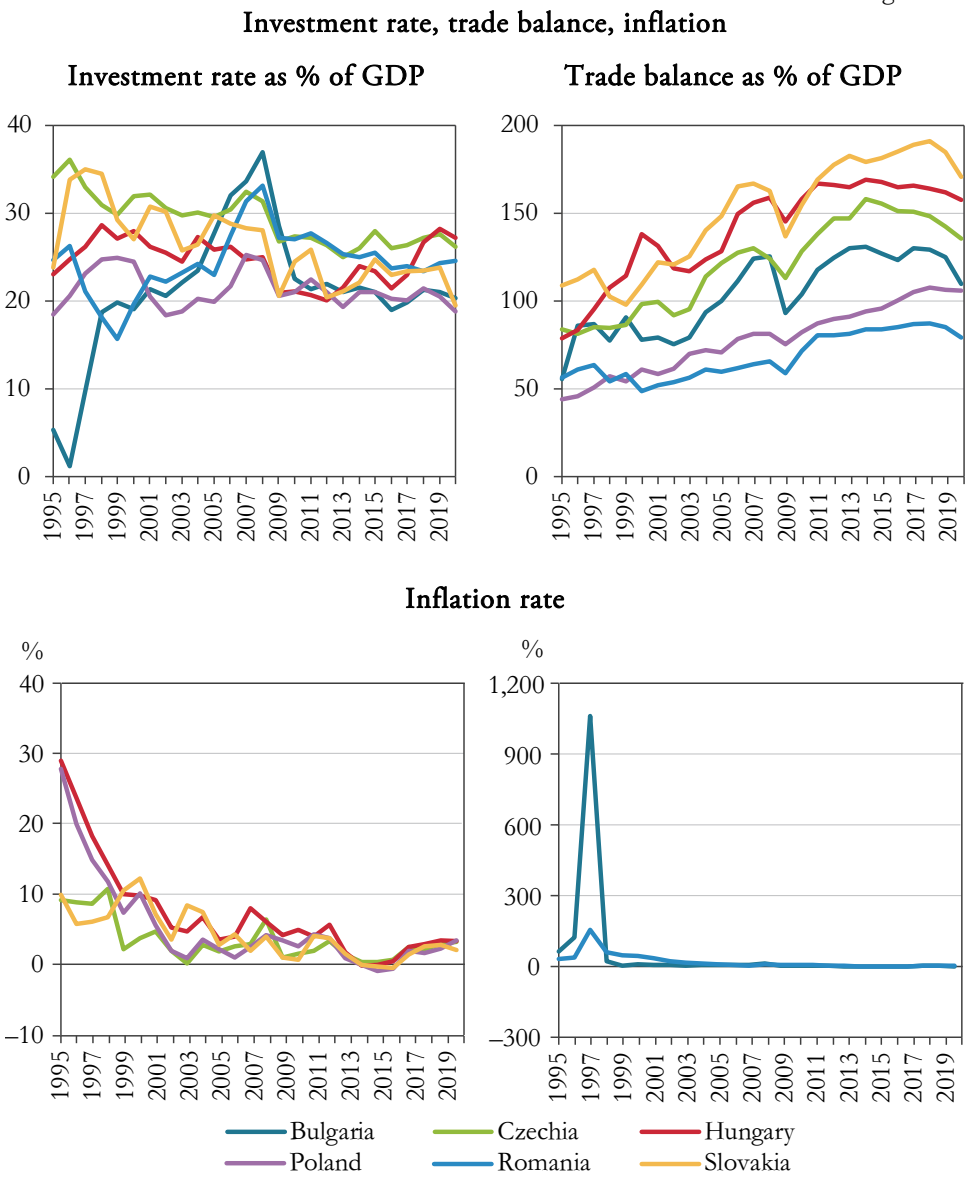
Figure 6

Clusters based on the complex development index



APPENDIX

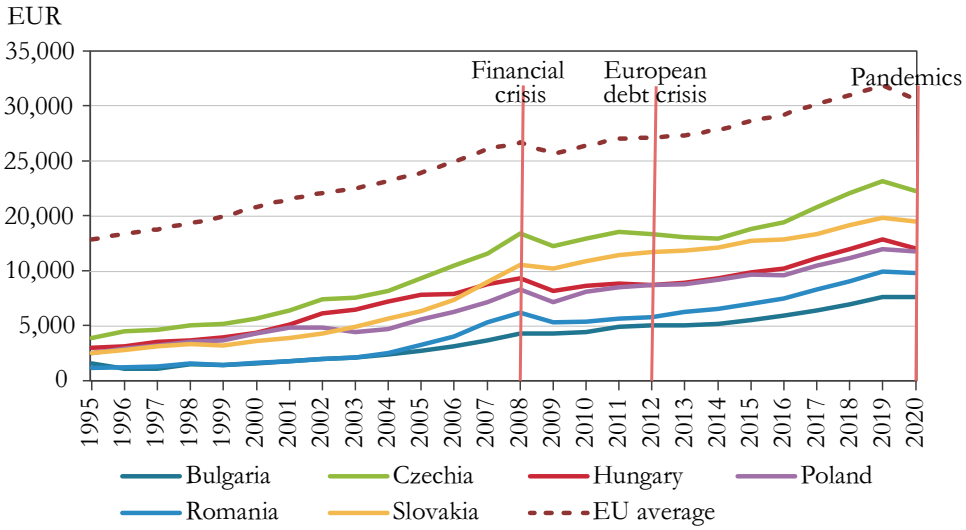
Figure A1



Source: Author created based on IMF data.

Figure A2

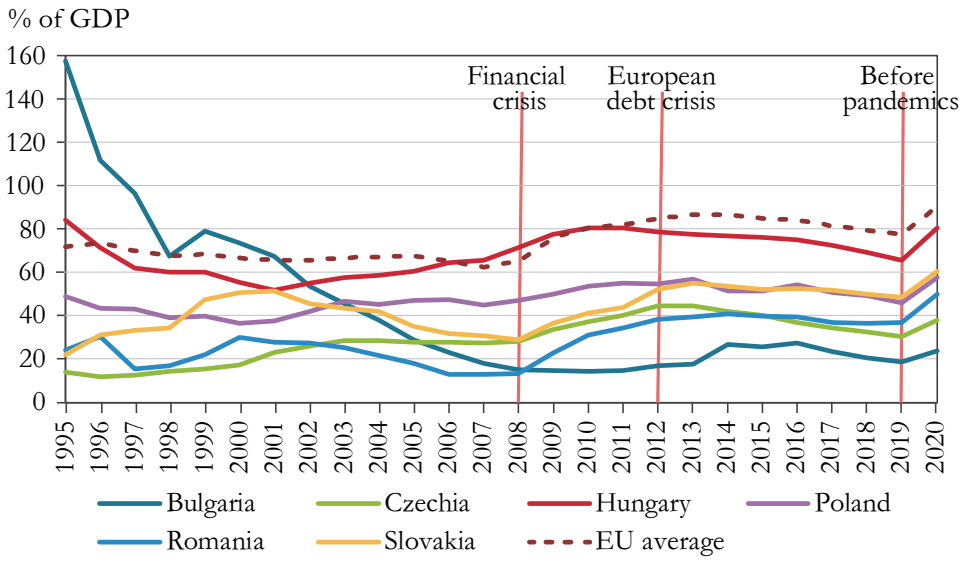
Change in GDP/capita



Source: Author created based on the Eurostat data.

Figure A3

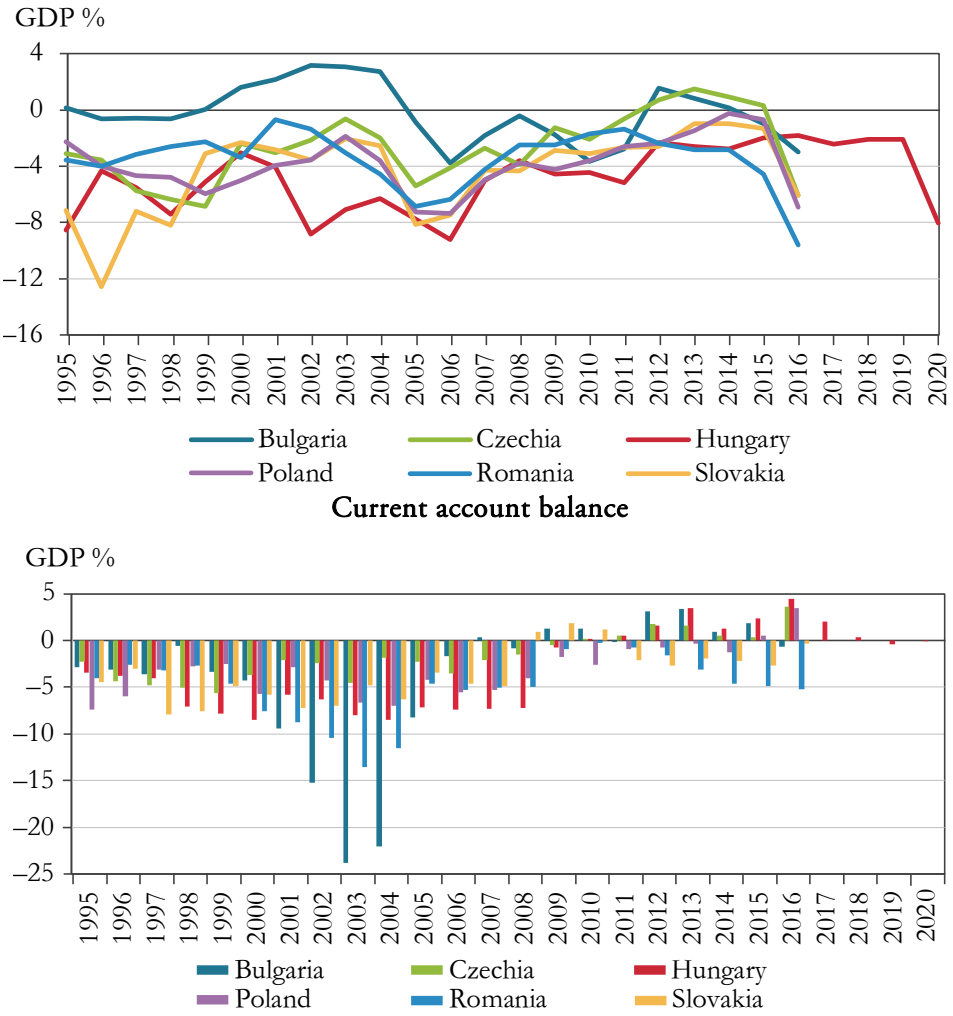
Change in gross government debt



Source: Author created based on IMF data.

Figure A4

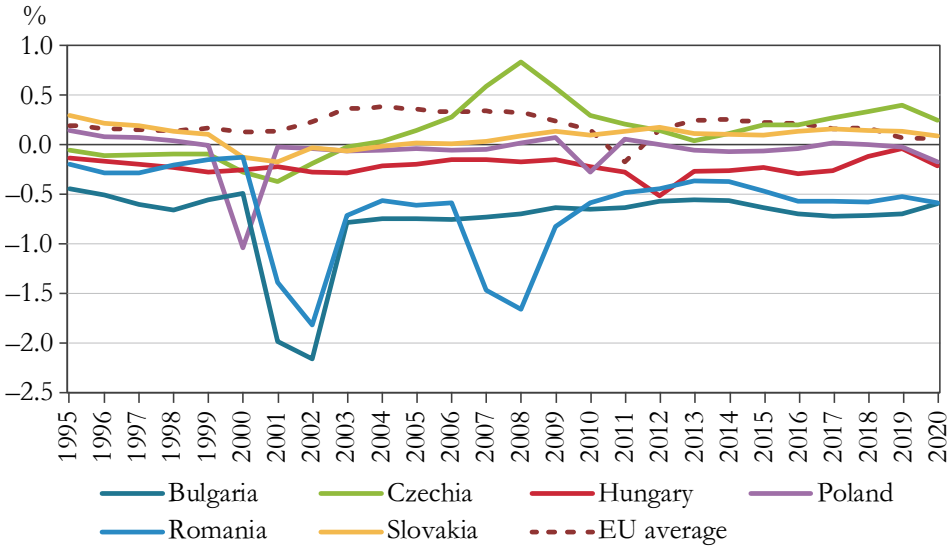
Budget deficit and current account balance



Source: Author created based on IMF data.

Figure A5

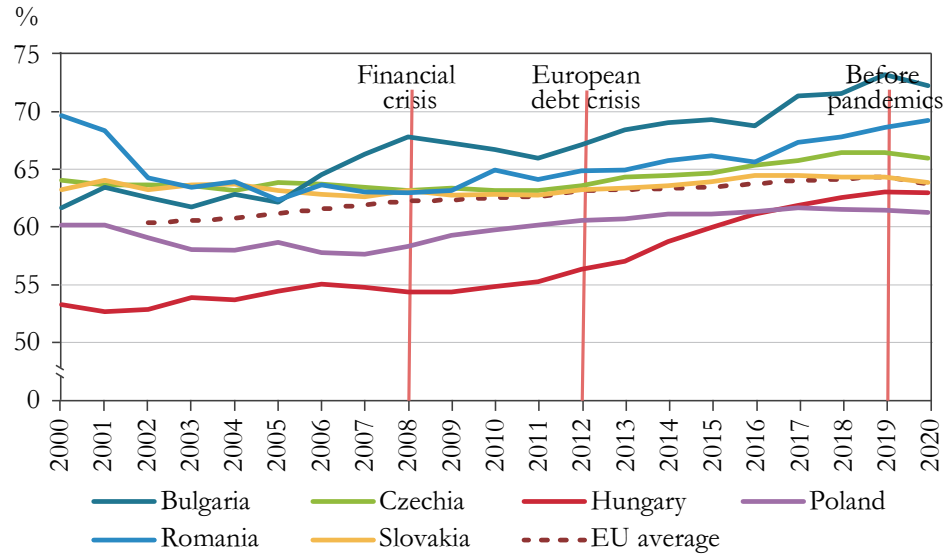
Population growth rate



Source: Author created based on World Bank data.

Figure A6

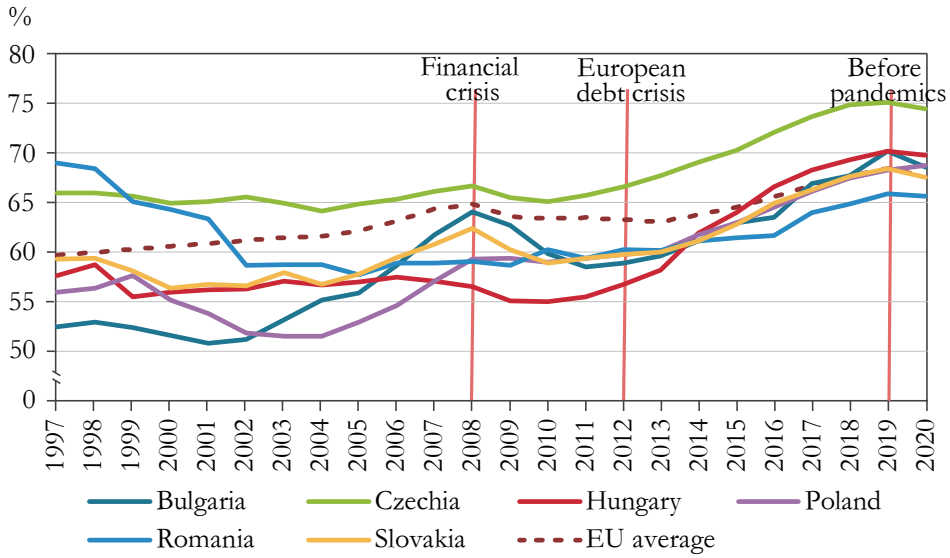
Activity rate of the population aged 15–74



Source: Author created based on the Eurostat data.

Figure A7

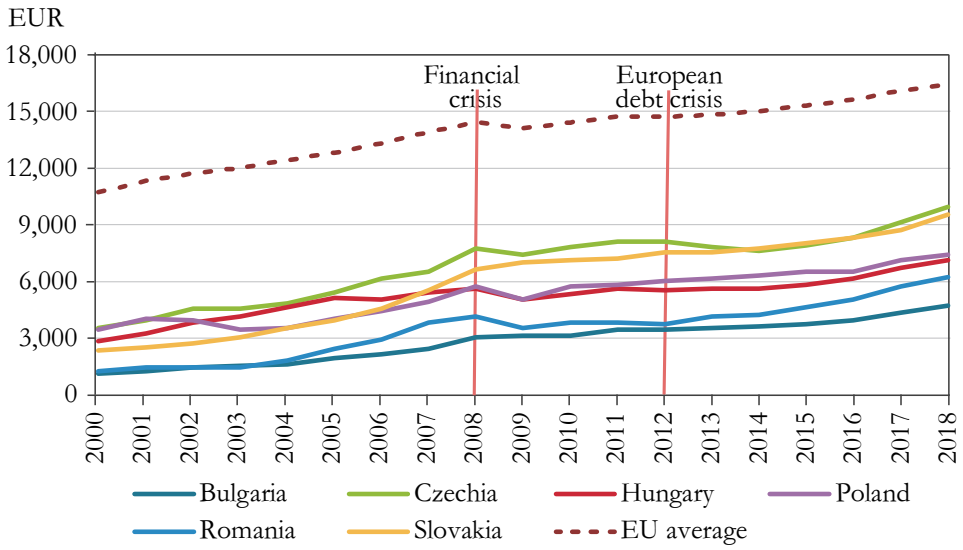
Employment rate in the 15-64 age group



Source: Author created based on the Eurostat data.

Figure A8

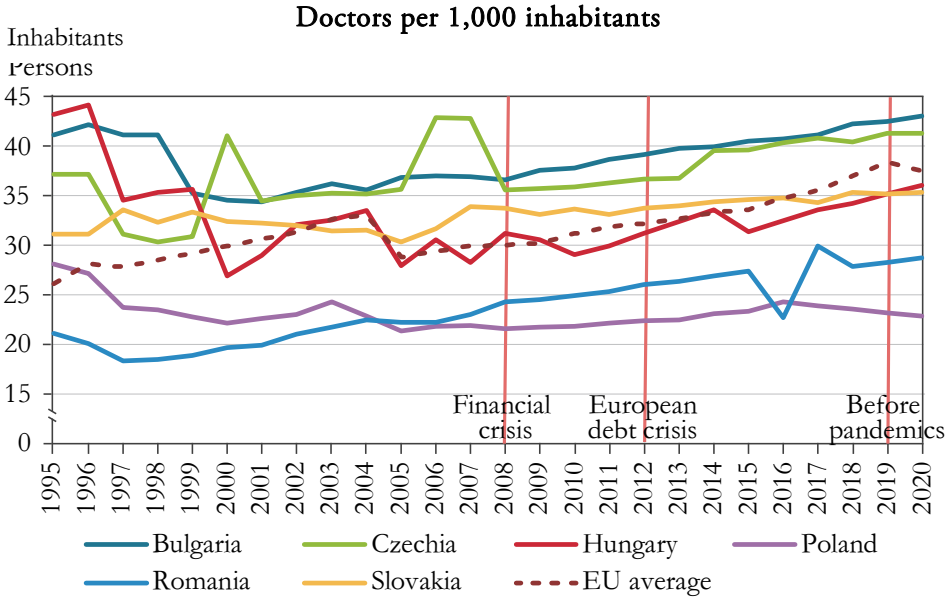
Change in the income of the households



Source: Author created based on the Eurostat data.

Figure A9

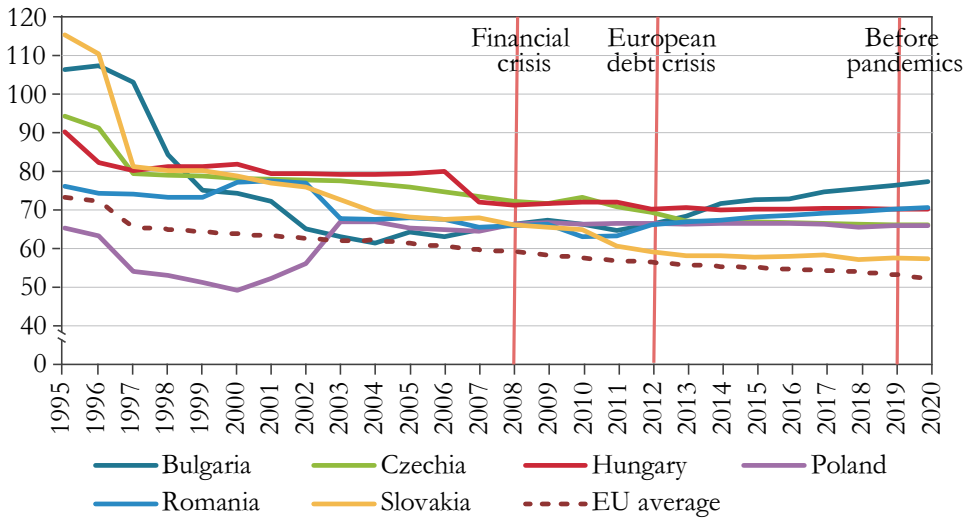
Doctors per 1,000 inhabitants



Source: Author created based on the Eurostat data.

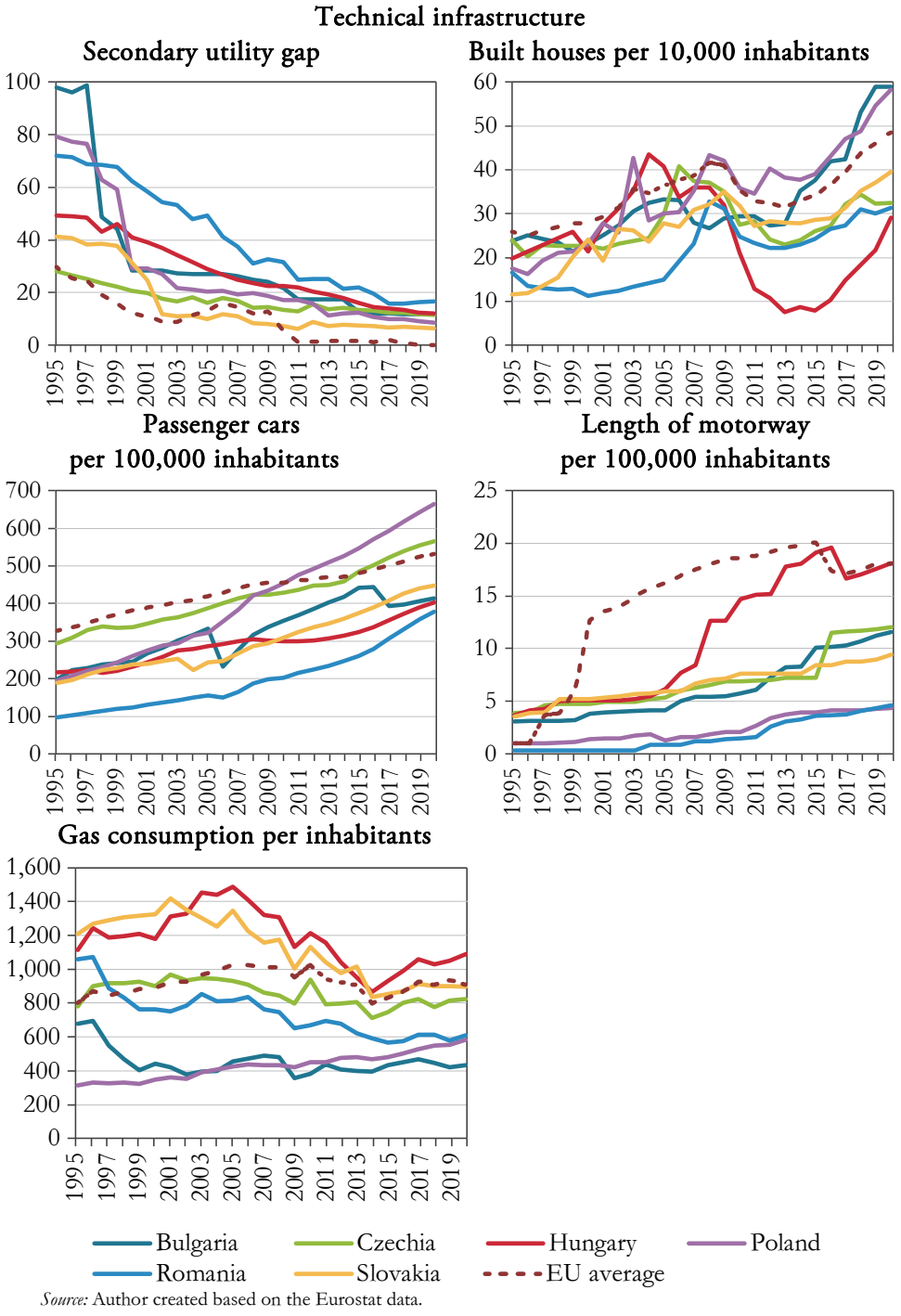
Figure A10

Number of hospital beds per thousand inhabitants



Source: Author created based on the Eurostat data.

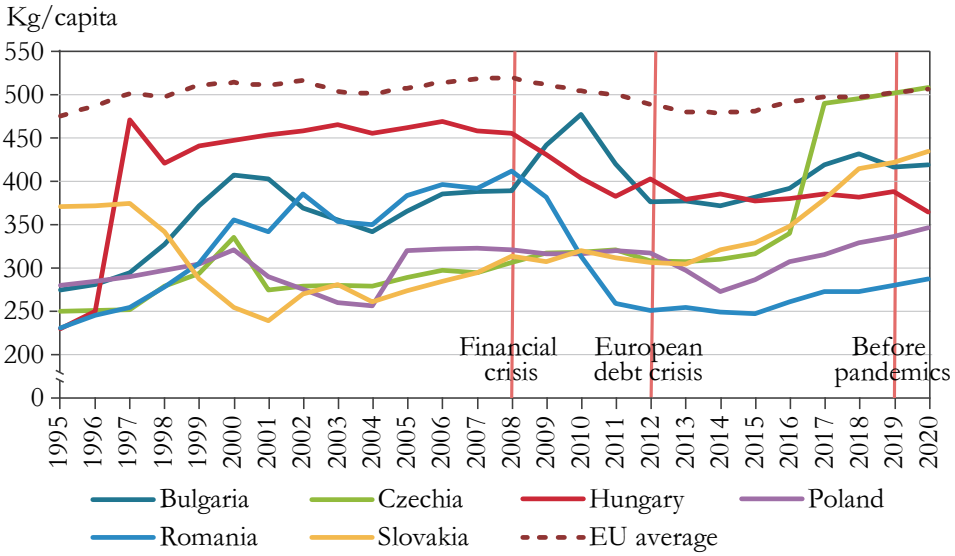
Figure A11



Source: Author created based on the Eurostat data.

Figure A12

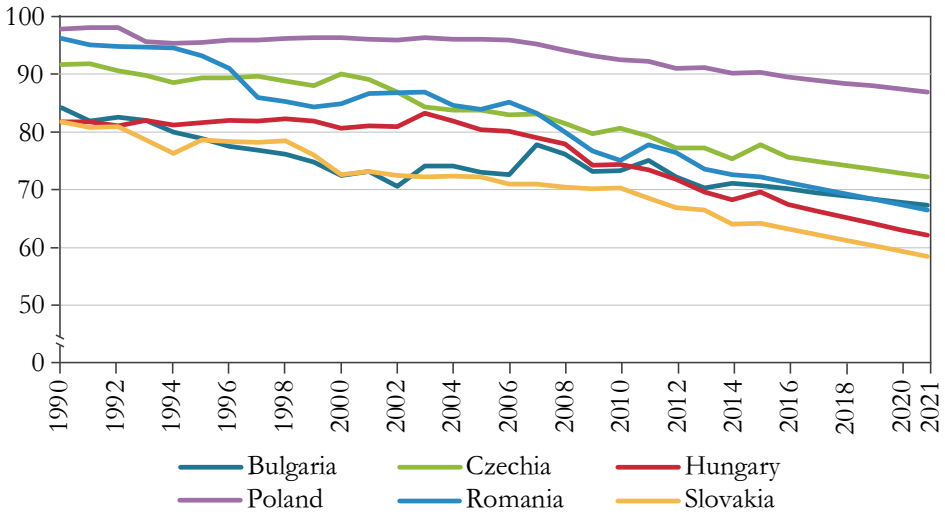
Amount of waste generated



Source: Author created based on the Eurostat data.

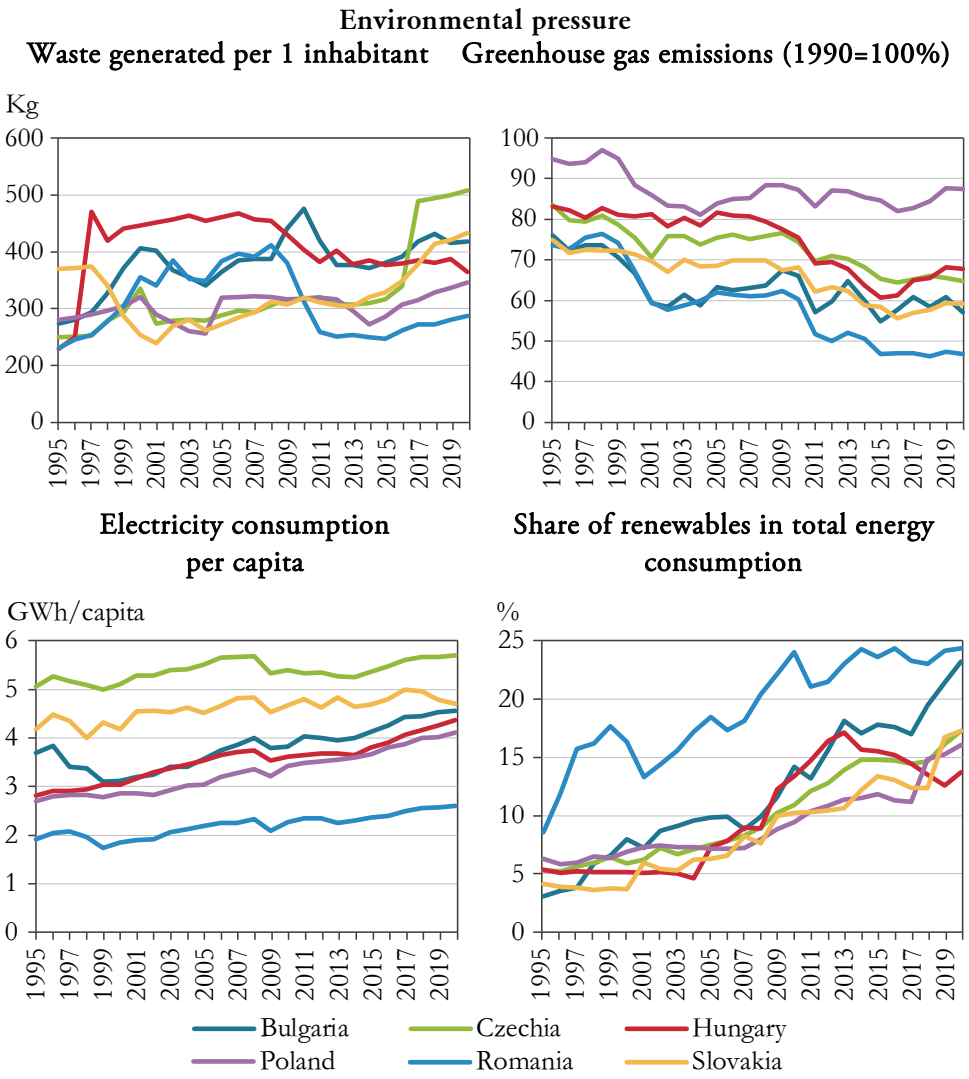
Figure A13

Fossil fuel consumption



Source: Author created based on the World Bank data.

Figure A14



Source: Author created based on the Eurostat data.

Figure A15

Change in economic performance component

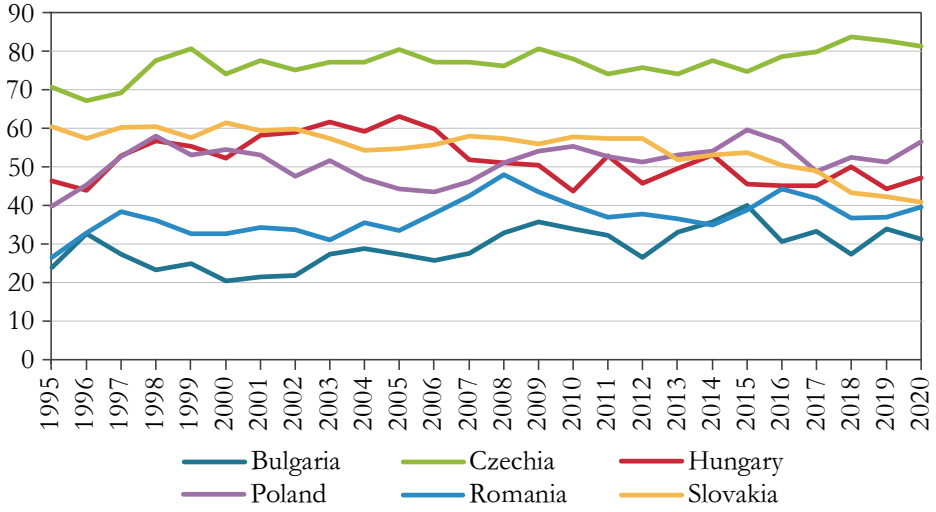


Figure A16

Change and composition of the human infrastructure component

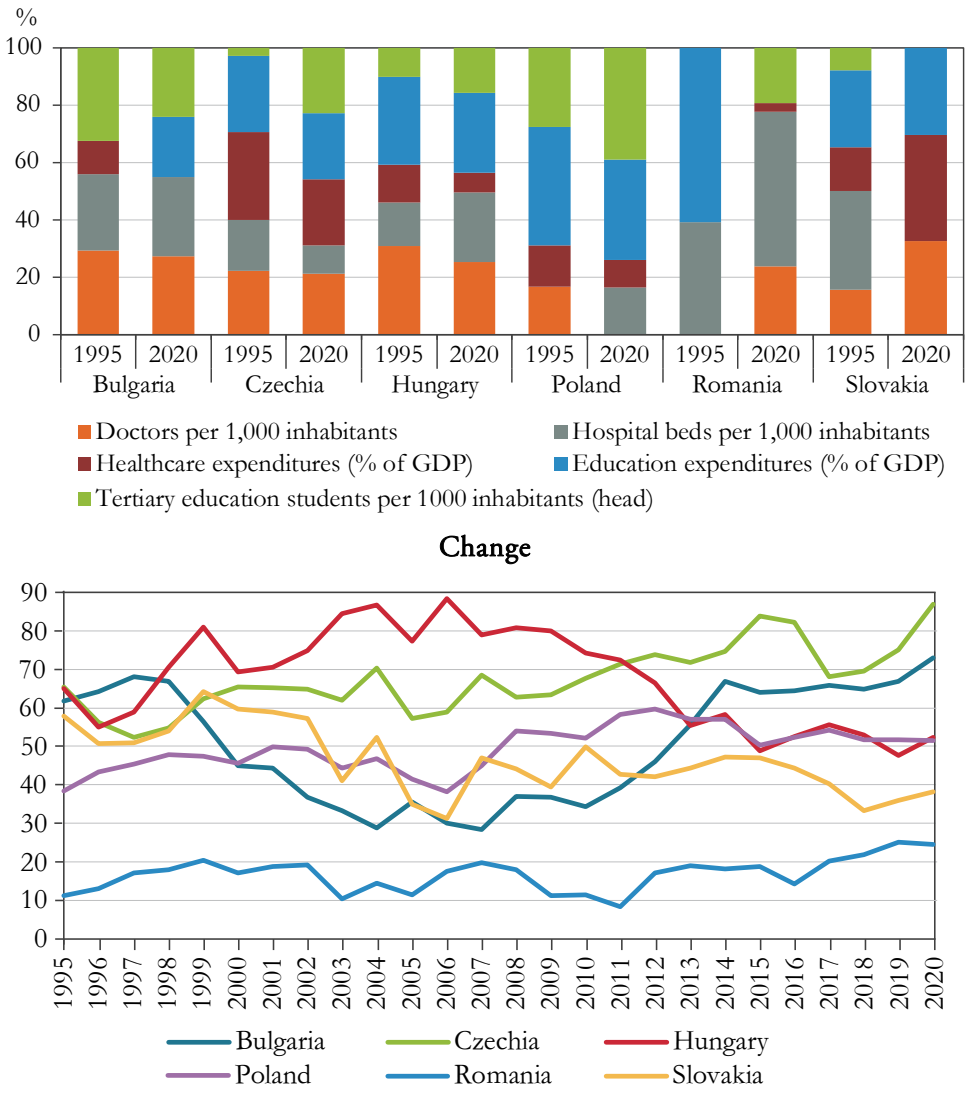
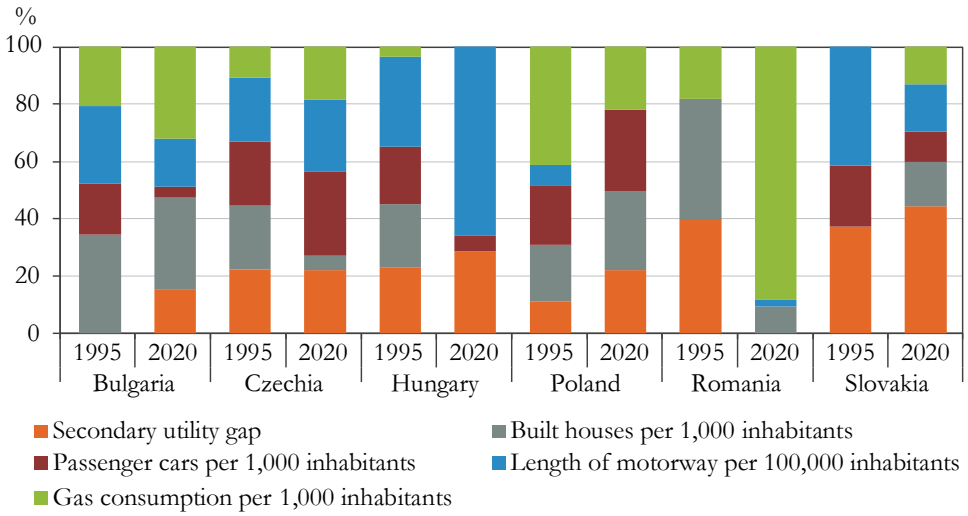


Figure A17

Change and composition of the technical infrastructure component

Composition



Change

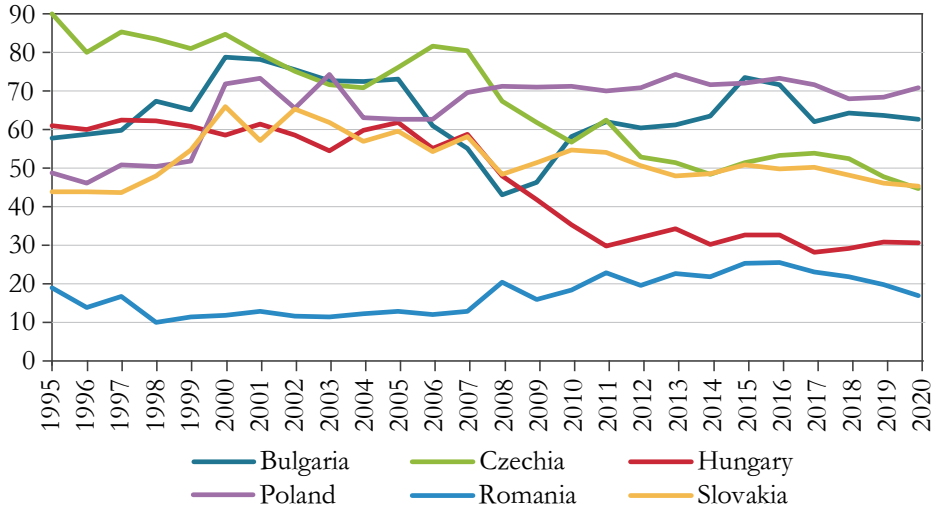


Figure A18

Change and composition of the ecological environment component

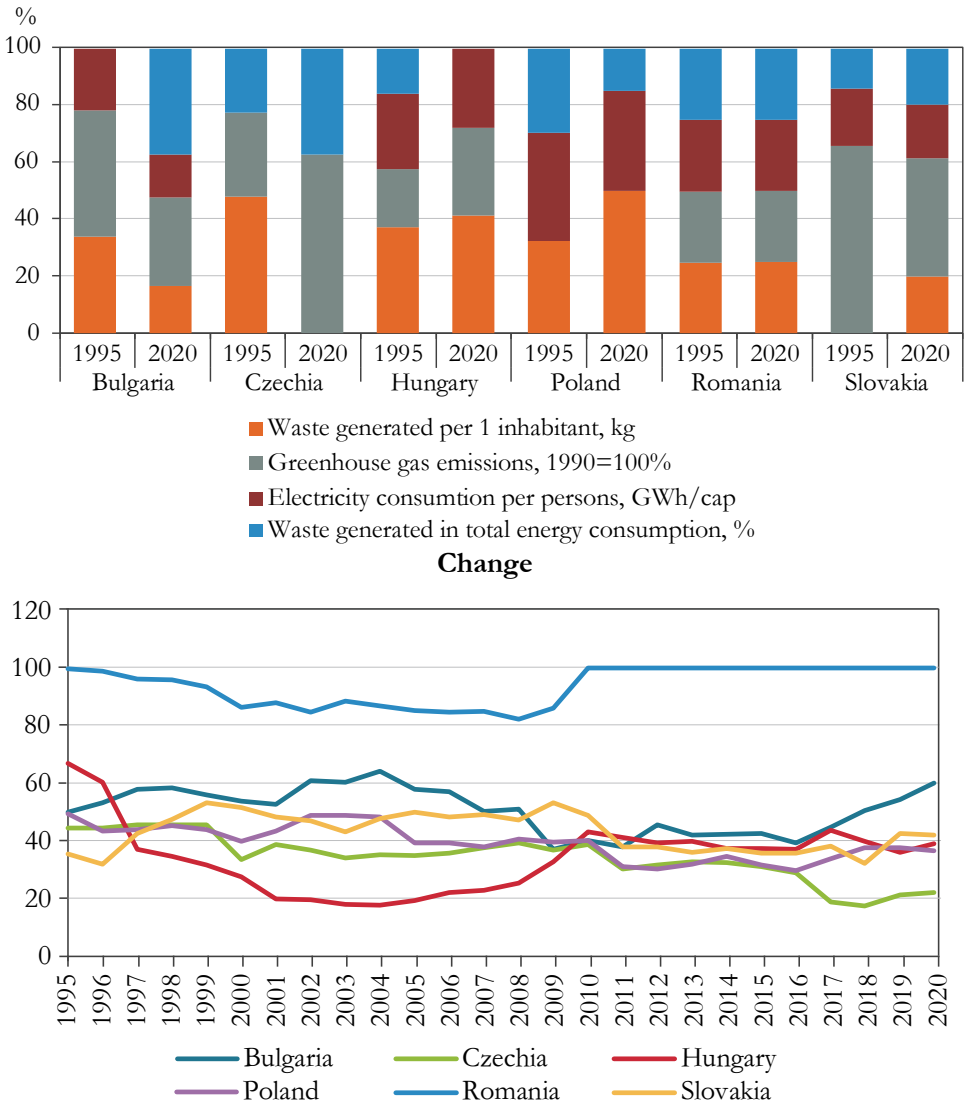
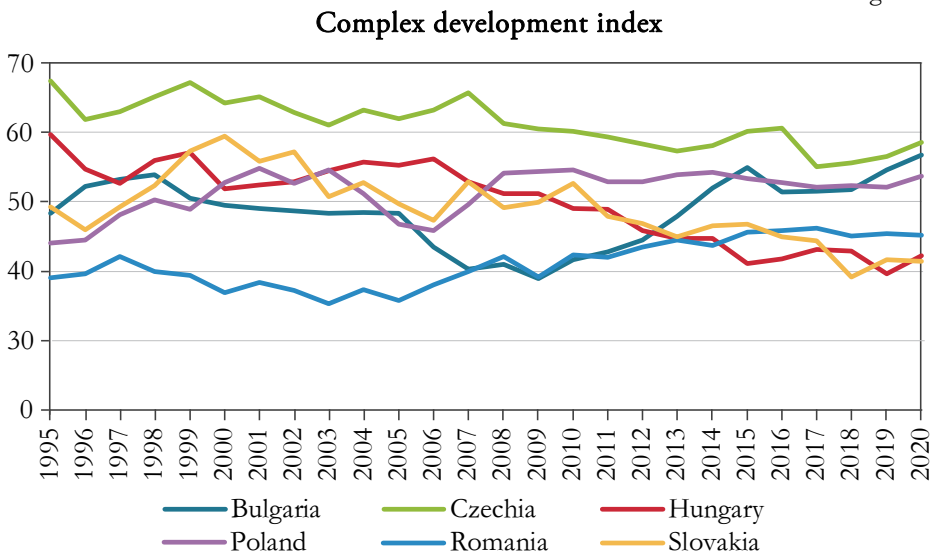


Figure A19



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