György Kocziszky[9]- Dóra Szendi[10]

Analysis of the expected development paths of Central-Eastern European countries between 2022 and 2025

The study attempts to determine the development paths of six Central and Eastern European countries (Bulgaria, Czech Republic, Hungary, Poland, Slovakia, Romania) for the period 2022–2025 using a time-series complex development index developed by the authors. In addition to expected economic output, the index takes into account the level of human and technical infrastructure affecting the quality of life of the population, as well as environmental impacts. The autoregressive model used in the study is a single-sector model with panel data and considers the path dependence of the projected changes and the risks from external shocks. The latter are incorporated into the projections using expert estimates. Our analyses show that, except for the Czech Republic, the members of the country group under review are mainly on diverging development paths until 2025. Only the Czech Republic is expected to converge towards the EU development path.

Key words: macro econometrics, estimation, forecast, development path, path-dependency
JEL code: R23

https://doi.org/10.32976/stratfuz.2023.13

1. Introduction

European economies are facing a difficult period, with the Russian-Ukrainian war disrupting the post-COVID recovery, which has and will have a serious impact on labour, energy and financial markets, supply chains and the living environment.

In our changing world, the countries of Central and Eastern Europe are in a unique position. The transformation that has taken place over the last 30 years has been beneficial for their economic growth and development. Their specific output has increased, their housing and infrastructure conditions have improved, and their income and employment figures have improved. Meanwhile, their societies have aged. However, rapid convergence towards the EU average has not been achieved. Understandably, therefore, researchers are paying increasing attention to the economic and social policy causes and consequences of this. But the governments concerned are also looking for answers to the question: what economic policy instruments can be used to speed up convergence, which has been slower than hoped for?

The study of growth and development is not new. In the 1950s, the analyses of the so-called “third-world countries” began dealing with it from several aspects (political science, world economics, etc.). International organisations (e.g., the UN, OECD, EU), governments and research institutes have taken stock of the factors determining development and the possibilities of influencing them. However, there is still no uniform methodology for measuring development (as well as economic growth), assessing, forecasting, and monitoring it.

In this paper, we seek to answer three questions:

1) How can territorial development be measured using a complex index (the result of aggregating indicators with different units of measurement)?
2) What model can be used to analyse ex-ante trends in development indicators, particularly in the current turbulent economic climate?

[9] professor emeritus, University of Miskolc
[10] associate professor, University of Miskolc

3) How might the development of the six Central and Eastern European countries evolve between 2022 and 2025?

Our paper consists of three parts. In the first part we briefly summarise the methods used in short-term macroeconomic forecasting, and in the second part we present the indicators of the model we use, the methodology of the complex development index and the logical process of our forecasting. The goodness of fit of the model is tested on the 1995–2021 database. Finally, in the third section, we briefly analyse the characteristics of the baseline and risk development paths of the country group under study and compare them with the results of an earlier ex-post study.

2. Research methodology

Development and growth is an area of special importance in economics, not least because of the causal relationship between economic development and quality of life (Headey et al., 2008). It is no coincidence that the spatial development documents of the European Union and its member states pay special attention to supporting holistic development processes and monitoring the results achieved (EU, 2012; EU, 2015a; EU, 2015b; EU, 2018).

The reference to the development of national economies is common in the economics literature, despite the fact that the definition of the concept and the methodology of measuring it are far from uniform. This is confirmed by the fact that some publications still identify development with growth in gross domestic product. Other documents (e.g., the Europe 2020 strategy (EC, 2020)) aim to promote integrated growth, which is essentially a synonym for development (considering the factors that determine development, such as employment, training, energy use and innovation). The only consensus is that economic, social, and environmental indicators should be considered when measuring territorial development, but opinions differ on what these indicators should be and the methodology for integrating them (BMZ, 2012). As a result, there are several complex indicators that consider factors other than economic output (GDP). The problem is that their application is not possible in the absence of time-series data, making international comparisons difficult.

The prediction of development and of development trajectories relies on three bodies of literature that are rich in themselves. Firstly, there is development theory research, which uses empirical methods to examine the differences between developed (centre) and catching up (semi-periphery, periphery) countries (regions). Secondly, path dependence, which focuses on the impact of past events on current and future social and economic trends. Thirdly, the objective, mathematical-statistical, and econometric methods used in forecasting. In this study we cannot (for reasons of scope) undertake a detailed presentation of these, so we only highlight the relevant ideas.

The literature is far from uniform on the methodological basis and reliability of short-term forecasts. Some authors therefore question the justification of the forecasts, especially after the 2008 financial crisis. Despite the mostly justified criticisms (Heilemann, 2009; Zimmermann, 2009), however, analysts are tireless in their forecasting, not least because of the growing demand from economic and social policymakers for at least an understanding of expected trends (Koll, 2009).

Since the late 1970s, partial economic forecasts have appeared in the literature, such as for the labour market (e.g., Fehr, 2011; IAB, 2010), economic output (Kirchgässner and Savioz, 2001; Gillmann et al. 2019; Fehr, 2011; Sedillot and Pain, 2003; Mourougane, 2006), etc.) and then national economic forecasts have appeared in the literature since the late 1970s, essentially based on three methods or combinations of them.

The subjective type (e.g., Delphi method, historical analogy) relies on the knowledge and holistic approach of forecasting experts (Tiberius et al. 2022). There are time series and panel econometric methods, most of which assume an equilibrium or near-equilibrium state of the economy. Most of the models used are autoregressive (AR, ARMA, ARIMA, DSGE), i.e., they incorporate trends from the previous period (e.g., Cripps, 2014; Seto et al. 2016). They assume institutional and systemic invariance, so that the characteristics of the future event series can be derived from a sufficiently long time-series sample, because it is assumed that the average characteristics of the previous period also hold. The path length of the event series can be substantially affected by the following factors (Ackermann, 2001; Eckey et al., 2007; Martin, 2010):

- the timeframe of the observation;
- exogenous shocks (e.g., blockade, embargo, institutional, world market, etc.) and endogenous shocks (e.g., innovation, human resource development, etc.);
- self-exciting propensity, i.e., the commitment to continue along the development paths already taken (e.g., technical, technological, organisational, etc.);
- stability in a near-equilibrium state;
- lack of capacity to change.

In addition to many benefits (e.g.: survival of values, continuation of improvements, etc.), the lock-in effect also entails risks (e.g.: perpetuation of bad practices, loss of willingness to change, inflexibility, becoming comfortable, etc.).

Prediction with evolutionary algorithms starts with several models, selects the one that produces the best results, and then combines the properties of the selected models to construct a new model whose properties can be varied randomly (heuristically) (Barto and Dietterich, 2004; Biau and D'Elia, 2010; Jung et al. 2018).

Mixed (combined) models add an expert panel to some statistical procedure to investigate changes over the time horizon under study. This method is used by the OECD (Sedillot and Pain, 2003; Mourougane, 2006) and in the Hungarian central bank's inflation forecasts (MNB, 2022).

Most models are limited in their ability to take exogenous shocks into account, or provide consistent, unbiased estimates under strong constraints (e.g., homoscedasticity, independence, zero expected error) (e.g., Fehr, 2011; Fenz and Spitzer, 2005). The methods differ not only in the time horizon over which they rely on past events, but also in their ability, if so, to deal with turbulence (e.g., financial crises, pandemic shocks, etc.) within the ex-ante time horizon under consideration (random or cyclical recurrence).

3. Forecasting model

Our model for forecasting the level of development consists of five basic steps (Figure 1):

- construction and quantification of indicators to describe development;
- determination of the estimator function and parameter estimation;
- normalisation of indicator values, quantification, and verification of sub-indices;
- determination of the time-series values of a complex index of territorial development, mapping of development paths.

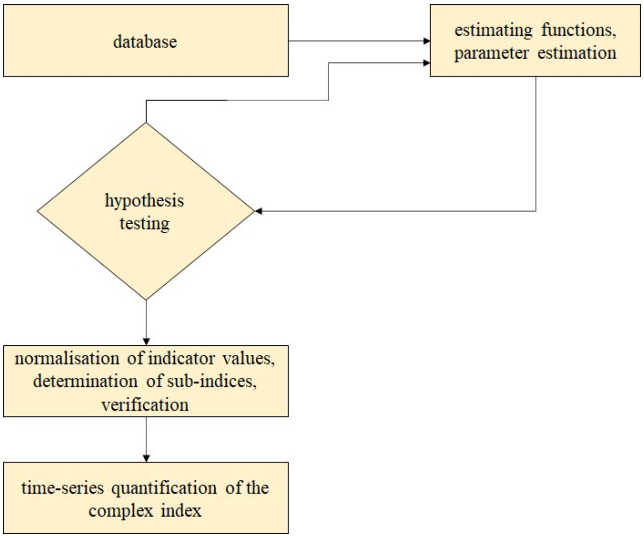

Figure 1: The logical process of forecasting
Source: own editing

In building our model, we have sought to consider the external and internal shocks to the national economy. The model is structured in five blocks (real economy, technical infrastructure, human, environmental, fiscal, and monetary) (Figure 2).

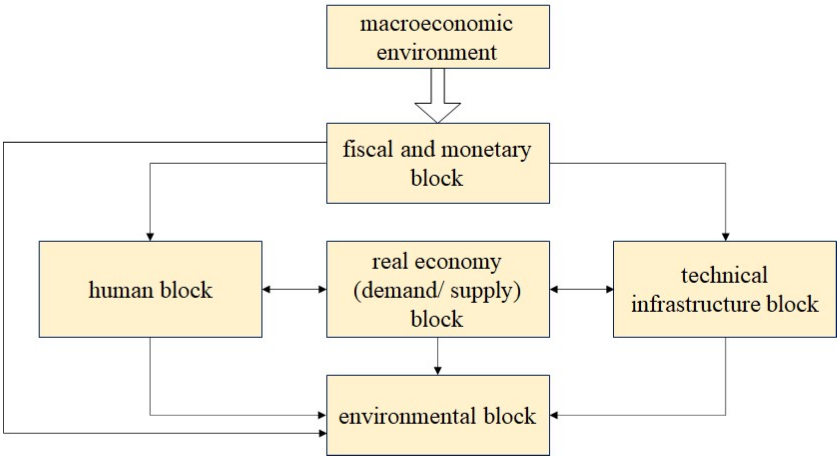

Figure 2: Structure of the forecasting model
Source: own editing

The model operates as a one-sector model, coherent with post-Keynesian economics. Accordingly, the fiscal and monetary stimulus increases output by expanding investment and consumption, improves human and technical infrastructure, and has an impact on environmental pressures.

3.1 Database of the model

Economic development means more and qualitatively different (e.g., higher education, longer life expectancy in good health, etc.) than expanding output (Kocziszky and Szendi, 2021). In other words, economic growth is an important but not sufficient condition for development (Kocziszky and Benedek, 2012). Even with rapid growth, more modest development can be achieved, or even modest output growth can induce greater improvements in quality of life (Gillmann et al. 2019).
In selecting the indicators to describe development, important considerations were comparability between countries and objectivity (the data we selected are regularly published by the national statistical offices), on the one hand, and the relevance of the expected results, on the other. As different indicators can lead to distortions, the indicators were chosen on the basis that a country's development is determined by infrastructure and environmental factors in addition to economic output. Social well-being is influenced by the quality of services and the environment. The five sets of indicators (real economy, fiscal and monetary, human, technical infrastructure, state of the environment) interact with each other.
Accordingly, our database consists of 37 variables, which can be used to construct five sub-indices (economic output, fiscal and monetary situation, human, technical infrastructure, and ecological environment) (Table 1). The choice of indicators was based on international practice (mainly OECD and EU) for the most frequently monitored data, which are annual series and are available from national statistical offices and the Eurostat database.

Table 1: Indicators of the model

block	no	indicator
real economy block	1.	GDP/capita (USD, PPS)
	2.	trade balance (% of GDP)
	3.	investments (% of GDP)
	4.	labour productivity
	5.	patent applications per 10,000 inhabitants
	6.	number of active enterprises per 1000 inhabitants
	7.	FDI inflow (% of GDP)
	8.	activity rate (%)
	9.	R&D expenditures (% of GDP)
	10.	unemployment rate (%)
	11.	income per household (USD, PPS)
	12.	dependency ratio (share of the population aged 0–14 years/ share of the active population (15–64 years) (%)
	13.	gross average wages (USD)
	14.	household consumption per capita (PPP, USD)
fiscal and monetary block	15.	government debt (% of GDP)
	16.	consumer price index (%)
	17.	budget deficit (% of GDP)
	18.	current account balance (% of GDP)
	19.	long-term interest rate (%)
	20.	exchange rate (%/year)
human block	21.	doctors per 1000 inhabitants
	22.	hospital beds per 1000 inhabitants
	23.	healthcare expenditures (% of GDP)
	24.	education expenditures (% of GDP)
	25.	tertiary education students per 1000 inhabitants
	26.	population growth (%)

technical infrastructure block	27.	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)
	28.	newly built houses per 10,000 inhabitants
	29.	passenger cars per 1000 inhabitants
	30.	length of motorway per 100,000 inhabitants
	31.	natural gas consumption per inhabitant
	32.	price of gas (euro/100 m^3)
ecological environment block	33.	waste generated per inhabitant (kg)
	34.	greenhouse gas emissions (1990=100%)
	35.	electricity consumption per person (GWh/cap)
	36.	share of renewables in total energy consumption (%)
	37.	price of electricity (euro/kWh)

Source: own editing

3.2 Blocks and estimators of the model

Our model predicts single-sector, short-term (4-year time horizon) processes. Therefore, variables containing unit roots are trend filtered. Using a Hodrick-Prescott (H-P) filter, the trend was decomposed into two components, growth, and cyclical. (The smoothness parameter of H-P is defined by the ratio of the standard deviation of the cyclical and growth components $\left(\sqrt{\lambda^2} = \frac{\sigma_c}{\sigma_g}\right)$. On this basis, $\lambda = 1600$ was chosen.)

Given that some of our indicators are expressed as a percentage of GDP, shocks may have a feedback effect on the equilibrium level of some of the variables. The data series are estimated one by one using the least squares method.

Real economy block

Output is modelled using aggregate consumption (C), investment (I) and net exports (NE) data on the consumption side.

Due to the shift in global power relations, the external trade balance is of particular importance for the group of countries under study, showing a medium-strong correlation with the number of active enterprises, labour productivity and FDI inflows. Available statistics for the real economy block show strong path dependence, both after the 2008 crisis and the 2019 pandemic. We have incorporated this observation into the macro equations for the block (Table 2).

Table 2. Macro-equations of the real economic block

macro-equations
▪ $\boldsymbol{specific\ output = constant + \beta_1 aggregate\ consumption + \beta_2 aggregate\ investment + \beta_3 net\ export + \beta_4 population + \varepsilon(t)}$ ▪ $\boldsymbol{aggregate\ consumption = constant + \beta_5 household\ income + \beta_6 employment\ rate + \beta_7 real\ interest\ rate + \beta_8 budget\ deficit + \varepsilon(t)}$ ▪ $\boldsymbol{aggregate\ investment = constant + \beta_9 export + \beta_{10} real\ interest\ rate + \beta_{11} output\ gap + \beta_{12} budget\ deficit + \beta_{13} average\ exchange\ rate + \varepsilon(t)}$ ▪ $\boldsymbol{aggregate\ net\ export = constant + \beta_{14} average\ exchange\ rate + \beta_{15} real\ interest\ rate + \beta_{16} output\ gap + \beta_{17} FDI + \varepsilon(t)}$

Source: own editing

The model uses specific real output as follows: $specific\ real\ output = output/(population * deflator)$.
Aggregate ("household" and "public") consumption is mainly influenced by family income, real interest rates, employment (Okun's law), and the age structure of the population, where

$$real\ interest\ rate(t) = \frac{1 + nominal\ interest\ rate(t)}{1 + inflation\ rate(t)} - 1$$

Rising real interest rates strengthen the exchange rate, reduce inflation and investment expectations, and thus labour demand. Thus, consumption and specific output are expected to be lower, as well as inflation.

The model takes aggregate investment as a function of exports, the real interest rate, the annual average exchange rate, the budget deficit, the output gap and the annual average exchange rate.
Aggregate net exports are affected by the average exchange rate, the real interest rate, and the output gap. The output $\text{gap}(t) = \overline{GDP}(t-1) - GDP(t-1)$ is defined as the difference between average output ($\overline{GDP}$ – trend value of output) and actual output.
Increasing net exports tend to improve the exchange rate, reduce the real interest rate, and have a beneficial effect on the current account, ultimately on the growth of specific GDP, and through this on public investment in infrastructure, and ultimately on development.

Technical infrastructure
The quantitative and qualitative possibilities and constraints of access to infrastructure always have an impact on the development (economic output, accessibility, housing conditions, etc.) of a given region, varying from one historical period to another. The post-socialist countries under study were lagging behind the European average before 1989. It is no coincidence that, following the regime changes, governments in the region made infrastructure development a priority of economic and social policy objectives (Table 3).

Table 3. Macro-equations of the technical infrastructure block

macro-equations
▪ $\boldsymbol{passenger\ cars\ per\ 1000\ inhabitants = constant + \beta_{18} household\ income + \beta_{19} real\ interest\ rate + \beta_{20} number\ of\ employees + \varepsilon(t)}$
▪ $\boldsymbol{built\ houses\ per\ 10,000\ inhabitants = constant + \beta_{21} household\ income + \beta_{22} real\ interest\ rate + \beta_{23} employment\ rate + \beta_{24} population + \varepsilon(t)}$
▪ $\boldsymbol{length\ of\ motorway\ per\ 100,000\ inhabitants = constant + \beta_{25} budget\ deficit + \beta_{26} GDP + \beta_{27} passenger\ cars\ per\ 1000\ inhabitants + \varepsilon(t)}$
▪ $\boldsymbol{gas\ consumption\ per\ inhabitants = constant + \beta_{28} average\ price\ of\ gas + \beta_{29} household\ income + \beta_{30} built\ houses\ per\ 10,000\ inhabitants + \beta_{31} GDP + \varepsilon(t)}$

Source: own editing

In our model, the development of technical infrastructure is described by quantitative characteristics (number of cars per thousand inhabitants, number of houses per ten thousand inhabitants, and length of motorway per hundred thousand inhabitants, as well as utility supply and gas consumption).

The evolution of the number of cars per thousand inhabitants is a function of the number of employed persons, the real interest rate and household income.

In the countries of the region, the acquisition of independent house has traditionally been a major social factor expressing well-being. The destruction of residential property during the Second World War, particularly in the major cities, upset the supply and demand situation in the housing market in the longer term, creating a permanent demand market. The resulting deficit survived the post-1989 regime changes, and the frictions created by the demand market disappeared slowly over the past 30 years. The annual evolution of the number of newly built houses remains volatile for the countries under review. Analyses show that this is mainly due to the impact of household income, real interest rates, employment rates and demographic trends.
Similar considerations have led to the inclusion of the length of motorway per 100,000 inhabitants in the technical infrastructure block, which influences the development trajectory due to its spatial structure (e.g., Meinel and Reichert, 2004; Hesse et al. 1998). All the countries studied aim to close the gap in this respect mainly through public budgets. The amount of resources available depends primarily on the size of output and the budget deficit, while the demand depends on the number of cars per thousand inhabitants.

Human infrastructure
Quality of life is fundamentally influenced by the quantity and quality of human infrastructure available to the population. In line with international literature, we have included four factors in our analysis (OECD, 2014; BFS, 2022).
The role of the state in the development of human infrastructure remains crucial for the group of countries under study, i.e., the growth rate of specific GDP and the reduction in the budget deficit. The state of public education infrastructure (including the number of classrooms) influences social and economic processes through several channels (e.g., skills, willingness to work, etc.) (Peterson, 2014).
The literature confirms a clear link between health care and social and economic processes (Starfiel and/Birnn, 2007; Eurostat, 2017; Burla et al., 2022). Care can be analysed from the demand side on the one hand and from the supply side on the other. One indicator of access to care is the number of doctors per thousand inhabitants, which is a function of public engagement, economic activity and family income (Table 4).

Table 4. Macro-equations of the human infrastructure block

macro-equations
▪ $\boldsymbol{number\ of\ school\ classrooms\ per\ thousand\ inhabitants = constant + \beta_{32} education\ expenditures\ in\ the\ share\ of\ GDP + \beta_{33} budget\ deficit + \varepsilon(t)}$ ▪ $\boldsymbol{doctors\ per\ thousand\ inhabitants = constant + \beta_{34} healthcare\ expenditures\ in\ the\ share\ of\ GDP + \beta_{35} unemployment\ rate + \beta_{36} budget\ deficit + \beta_{37} household\ income + \varepsilon(t)}$ ▪ $\boldsymbol{education\ expenditures\ in\ the\ share\ of\ GDP = constant + \beta_{38} GDP + \beta_{39} budget\ deficit + \beta_{40} employment\ rate + \varepsilon(t)}$ ▪ $\boldsymbol{tertiary\ education\ students\ per\ thousand\ inhabitants = constant + \beta_{41} GDP + \beta_{42} education\ expenditures\ in\ the\ share\ of\ GDP + \beta_{43} employment\ rate + \varepsilon(t)}$

Source: own editing

The consensus in the literature is that education is a key factor in the modern economy. Therefore, there is a tendency for spending on education infrastructure to increase household incomes and ultimately the specific output of the economy, improving the level of development of a country (OECD, 2022).
The budget plays a major role in sustaining higher education. Higher levels of education and qualifications tend to support the development of a given geographical unit.

Environmental block
According to international analyses, economic output growth increases environmental pressures (waste per capita, greenhouse gas emissions) and electricity consumption per capita (Table 5).

Table 5. Macro-equations of the environmental block

macro-equations
▪ $\boldsymbol{waste\ generated\ per\ inhabitant = constant + \beta_{44} specific\ output + \beta_{45} household\ income + \varepsilon(t)}$
▪ $\boldsymbol{electricity\ consumption\ per\ person = constant + \beta_{46} specific\ output + \beta_{47} number\ of\ houses + \beta_{48} household\ income + \beta_{49} price\ of\ electricity + \varepsilon(t)}$
▪ $\boldsymbol{greenhouse\ gas\ emmissions = constant + \beta_{50} specific\ output + \beta_{51} household\ income + \beta_{52} number\ of\ active\ enterprises + \beta_{53} population + \varepsilon(t)}$
▪ $\boldsymbol{share\ of\ renewables\ in\ total\ energy\ consumption = constant + \beta_{54} specific\ output + \beta_{55} household\ income + \varepsilon(t)}$

Source: own editing

The amount of solid waste generated depends to a large extent on the output of the economy, income levels and the quality of life.
The amount of electricity used is determined by the specific output of the economy, the price of electricity, the income of households and the number of houses.
When projecting greenhouse gas emissions, the literature generally considers income, GDP forecasts and economic activity in addition to expected population (ITM, 2020).

Fiscal and monetary block
The model considers five exogenous indicators (public debt, inflation, current account balance, central bank base rate, budget deficit), whose ex-post values are based on Eurostat data and ex-ante values on expert estimates.

Public debt (% of GDP): An increase in the budget deficit has a long-term downward effect on investment and, through it, on economic output, which increases public debt and reduces growth potential.
Rising inflation has a negative impact on real GDP, ceteris paribus on family incomes, and can affect the base rate of the central bank and through it the interest rate on commercial loans, which can reduce the willingness to invest, and thus ultimately have a negative impact on development.
The current account balance, which is influenced by the size of net exports and specific output, and through this the range of tasks that can be supported by the state, ultimately has an impact on development.

The size of the base rate, its trend of change, is influenced by the cyclical position of the economy, the level of inflation and the state of financial stability. A falling base rate supports the rise in the level of development through consumption and investment.
Inflation improves the fiscal deficit in the short run, but has a high social cost, and thus ultimately has a negative impact on development.

3.3 Sub-indices and the logic for determining the composite index

The indices have a benchmark role; the changes in their values can be used to characterise the change in the development of a given region over time, with growth relative to the base period indicating progress, decline representing a decline, and stagnation indicating stability.
The data of the indicators in our database have been transformed into a time-series ratio scale from 0 to 100, using the distance to frontier (DTF) normalisation method. For a given indicator, the best performing country received 100 points, while the other countries ranked lower depending on the size of their gap from the best performing country. (Only countries at least 4 standard deviations from the best performing country can receive 0 points.) The correlation used to convert the baseline indicators into scores is the following (when the higher value of the indicator is the more favourable (e.g., output, employment, etc.)):

$$x_{norm} = \frac{x_i - x_{min}}{x_{max} - x_{min}} * 100\ ,$$

and if the higher value of the indicator is unfavourable (e.g., environmental pressures, unemployment, etc.):

$$x_{norm} = \frac{x_i - x_{max}}{x_{min} - x_{max}} * 100\ ,$$

where x_{max} is the maximum among the values in the study area, and x_{min} is the minimum among values. The advantage of this methodology is that it does not require a normal distribution of the raw data. The scoring follows the dispersion of the values of the areas in the sample and allows the value considered to be optimal to vary from indicator to indicator. Thus, for each indicator it can be decided individually whether its minimum, maximum or even sample average value should be optimal.
Based on the ratio scale values of the indicators belonging to the same group, four sub-indices (economic output, human infrastructure, technical infrastructure, ecological situation) were defined by arithmetic averaging, i.e.:

$$SI_j = \left(\sum_{i=1}^{n} x_{norm}\right)/n_i$$

$$CI_j = \frac{\left(\sum_{j=1}^{m} SI_j\right)}{m}\ ,$$

where SI_j is the sub-index of block j, CI is the complex index.

3.4 Ex-post testing of the model

Our model was tested using the 1995–2021 dataset of the group of countries under study. The comparison of the development indices of the country group estimated by the econometric model ($\widehat{I_i}$) and those determined from the actual data (I_i) was determined by the mean percentage error (MAPE), which defines the deviations in percentage form.

$$MAPE = \left(\frac{1}{n}\sum_{t=1}^{n}\left|\frac{I_t - \widehat{I_t}}{I_t}\right|\right) * 100$$

Our calculations show that the function approximates the ex-post values of the database well (Table 6).

Table 6. Difference between estimated and actual indices (MAPE, %)

MAPE/country	Bulgaria	Czechia	Hungary	Poland	Romania	Slovakia
real economy sub-index	0.37	0.06	0.09	0.17	0.03	0.04
human sub-index	1.01	-0.75	1.03	2.66	0.08	1.17
infrastructural sub-index	0.92	4.06	2.17	2.21	0.65	-0.92
ecological sub-index	1.68	5.68	2.72	5.58	1.83	-1.09
aggregate index	0.84	1.35	0.87	2.58	0.71	-0.38

Source: own editing

4. Forecasting results

Our ex-ante analysis was based on the econometric model presented above. The shock after 2022 was considered by an expert panel. Shocks, as the literature shows, are of limited duration, due to fiscal and monetary interventions on the one hand, and the persistence of consumption at the expense of household savings on the other (according to Heilemann (2019), analysis of crises in the FRG between 1966 and 2013 shows that, for example, the average recovery period was 3.1 quarters). Recovery begins thereafter. In most cases, however, this leads to a lower path than before.

Changes in energy and commodity prices, embargoes, etc. are represented by changes in inflation, budget deficits and public debt. Given the fact that these data are given with a year-to-date impact, the panel is also suitable for incorporating downside and upside risk paths.

The expert panel identified four risks over the forecast horizon:

- Geopolitical risks, which have an impact through several channels at the same time (natural gas, oil, commodity price increases), especially in the case of the CEECs (Central Eastern European Countries) neighbouring the war zone;
- Increasing budget deficits due to the wave of refugees resulting from the war;
- Increases in public debt;
- Global economic slowdown, rising inflationary pressures, tightening monetary policy behaviour of central banks.

In our model, the inflation rate, the size of public debt and the budget deficit are determined by the central banks of the countries concerned and by expert consultations.

Key findings of the expert panel: Due to the Russian-Ukrainian war and poor weather conditions, inflation will increase at different rates for the group of countries from 2022 onwards. Over the time horizon under consideration, inflationary pressures are expected to ease only from 2024 onwards (Table 7). The rise in inflation has brought an increase in central bank base rates, which has led to a decline in trade loans (and hence in investment willingness) and consumption. The Hungarian economy is particularly affected by this over the forecast horizon due to the high inflation outlook.

Table 7. Expected change in inflation rate (%) in the countries under review (year/year)

country	inflation (%)			
	2022	2023	2024	2025
Hungary	18.7	9.0–11.5	5.0–7.5	3.5–4.5
Poland	14.2	12.3–14.0	6.2–7.0	3.5–4.2
Bulgaria	18.7	14.0–15.0	6.3–6.5	5.3–5.5
Romania	16.3	10.5–11.5	5.0–5.3	4.3–4.9
Czech Republic	9.8	10.5–11.0	9.5–10.9	8.6–9.0
Slovakia	15.6	9.6–10.5	7.0–7.4	6.9–7.5

Source: expert forecast based on documents from the central banks of the countries concerned

A similar, but more moderate, negative trend is expected for the government debt (Table 9) and the budget deficit (Table 8).
The balance sheet indicators for the group of countries under review worsen (to varying degrees, however) from 2022 onwards. The main reason is a further increase in energy and commodity prices. Balance of payments deficits (especially in Hungary, Romania, and Slovakia) are accompanied by an unfavourable financing structure: high deficits will be financed by increasing debt inflows. In the Czech Republic and Poland, financing needs may be financed by non-debt sources (net FDI) as well as debt (Table 8).

Table 8. Budget deficit projections (% of GDP)

country	budget deficit			
	2022	2023	2024	2025
Hungary	8.0	6.9–7.2	4.9–5.5	4.0–4.3
Poland	4.3	4.9–5.8	5.8–6.2	5.3–6.0
Bulgaria	4.2	5.1–5.4	5.9–6.2	4.9–5.0
Romania	6.72	6.4–7.1	7.0–7.2	6.5–7.0
Czech Republic	8.5	6.1–6.8	6.8–7.2	6.3–6.6
Slovakia	6.5	4.9–5.5	6.0–6.1	5.3–5.8

Source: expert forecast based on documents from the central banks of the countries concerned

The equilibrium position of the economies under review is expected to reach its minimum in 2023, after which a slow improvement will be observed. The main risk to fiscal balances is related to changes in energy prices.
The gross government debt-to-GDP ratio of the countries decreases in line with the decline in the budget deficit over the period under review (Table 9).

Table 9. Government debt projections (% of GDP)

country	government debt			
	2022	2023	2024	2025
Hungary	76.8	77.1–79.0	79.9	76.2
Poland	53.8	55.1–58.2	60.2	60.1
Bulgaria	52.7	54.0–56.8	40.1–49.1	32.1
Romania	48.8	54.9–59.2	58.3	60.3
Czech Republic	41.9	47.1–51.2	50.8	52.1
Slovakia	63.1	59.0–61.0	63.2	68.2
EU	88.1	90.1–92.4	92.8	91.6

Source: expert forecast based on documents from the central banks of the countries concerned

We forecast a rapid recovery in the real economy, driven by interest rate increases in the countries involved, which will have a positive impact on technical infrastructure. At the same time, the labour market will not experience a significant drop in employment, while a greater focus will be placed on greening economies.
The baseline path is set at the median of the experts' estimates for 2023–2025 (Figure 3), from which the risk paths deviate symmetrically by 8–10% up and down.

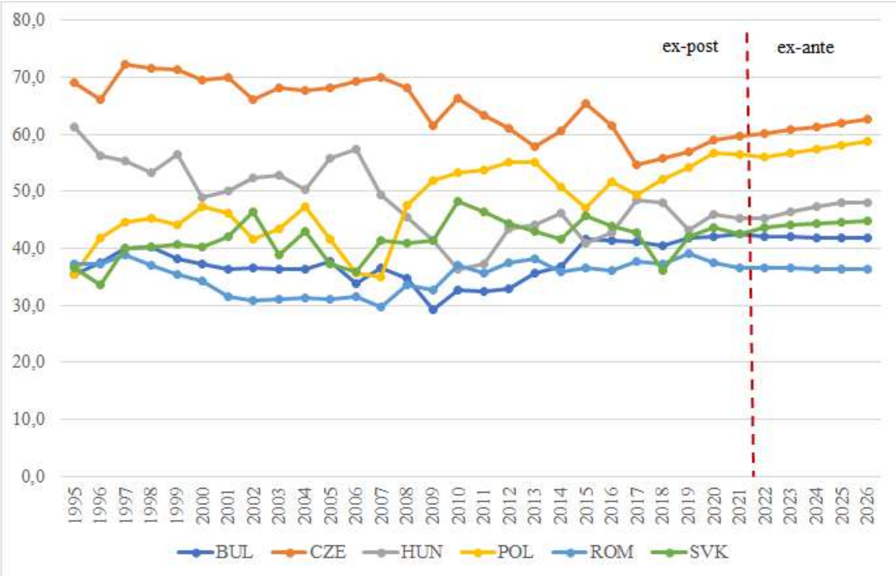

Figure 3: Development paths of the countries in the region
Source: own editing

The development paths of the region under study are converging. Bulgaria and Romania are expected to show a slow down in their catching-up, mainly for infrastructure and environmental reasons (Table 10).

Table 10. Expected trends in development paths (2022–2025)

country	equation	R^2
Bulgaria	y = -0.06x + 42.12	69.23
Czech Republic	y = 0.605x + 59.537	99.35
Hungary	y = 0.708x + 44.876	90.73
Poland	y = 0.659x + 55.417	99.75
Romania	y = -0.03x + 36.53	75.0
Slovakia	y = 0.255x + 43.533	96.38

Source: own editing

In our model, this problem was addressed by using a range of forecasts for the expected path of the inflation rate, the budget deficit and public debt. The risks were considered to be bidirectional (upside and downside). Thus, we obtained different (fan) trajectories from the baseline.

5. Summary

Over the past 50 years (especially after 2008), the reliability of economic forecasts has been criticised, mainly because they have failed to predict imbalances and the resulting economic crises.

Clearly, there is no such thing as a 'pinpoint' economic forecast. For some time, we should expect the forecasts to give conditional results.

For economic policymakers, despite the criticisms, it is essential to know the expected trajectories of future social and economic processes and how they can be influenced, even if their accuracy is debatable. It is therefore more important to understand expected trends rather than point-in-time outcomes. This can indicate and signal the direction of intervention and the consequences of its impact.

The model presented in our study allows for a short-term, ex-ante study of the economic, human, technical infrastructure and environmental conditions affecting development. Estimates of expected inflation, public debt, exchange rate, budget deficit and energy prices improve the analytical power of the model results.

Our preliminary research shows that the initial (1995–2021) development trajectories of the countries in the region were still determined by the shocks of the transition period that started after 1990 (privatisation, sectoral decline, widening social disparities, etc.), which is reflected in the substantial differences in their development paths. The reasons for this were, on the one hand, public expectations in terms of social and welfare provision and, on the other, economic policy. This is supported by our ex-post analysis. The inflationary pressures resulting from the pandemic in 2020 and the Russian-Ukrainian war from 2022, and the resulting inflationary pressures, will have a negative impact on the real economies of all countries in the region, and on the development of closely related infrastructure and ecological indicators, to varying degrees. This also causes a break in the trend of their aggregate development indices. According to our current model calculations, forward movement of the economy is mainly driven by inflationary pressures, changes in fiscal and monetary indicators in line with inflation, and, on this basis, public and private sector investment. Our calculations show that for countries with low investment rates (below 18%), it is not possible to expect a meaningful change in development levels. Sustaining high investment expansion rates can be supported by EU funds on the one hand and foreign working capital on the other. At the same time, investment in the real economy should not increase the specific ecological burden (energy demand, environmental damage). Once the trend returns to normal (this is expected to take 2–3 years), the development paths of the Czech Republic and Poland are expected to return to their original trend, while for Romania, Bulgaria, Hungary and Slovakia it is expected to take longer.

List of references

ACKERMANN, R. (2001): *Pfadabhängigkeit, Institutionen und Regelkonform*. Mohr Siebeck, Tübingen.

BARTO, A. – DIETTERICH, T. G. (2004): *Reinforcement Learning and its Relationship to Supervised Learning*. Handbook of Learning and Approximate Dynamic Programming, pp. 47-64.

BERNDT, E. R. (1991): *The Practice of Econometrics: Classic and Contemporary*. Addison Wesley, Reading.

BFS (2022): *Indikatoren der Lebensqualität*. Bundesamt für Statistik. bfs.adminch/bfs/de

BIAU, O. – D'ELIA, A. (2010): *Euro Area GDP Forecasting Using Large Survey Datasets: A Randon Forest Approach.* Euro indicators Working Papers.

BMZ (2012): Territoriale Entwicklung im ländlichen Raum. Bundesministerium für wirtschaftliche Zusammenarbeit. Berlin.

BURLA, L. – WIDMER, M. – ZEITNER, C. (2022): *Zukünftiger Bestand und Bedarf an Fachärztinnen und -ärzten in der Schweiz*. OBSAN Bericht, Neuchätel.

CRIPPS, F. (2014): *Macro-model scenarios and implications for European policy*. in Eatwell, John, Terry McKinley, and Pascal Petit, eds. Challenges for Europe in the World of 2030. Farnham, Surrey: Ashgate Publishing.

EC (2020): Handbook of Territorial and Local Development Strategies. European Commission, Brussels.
ECKEY, H. F. – SCHWENGLER, B. – TÜRCK, M. (2007): *Vergleich von deutschen Arbeitsmarktregionen*. IAB-Discussion Paper, No. 3/2007.
EU (2012): Europäische Erhebung zur Lebensqualität (EQLS). European Foundation for the Improvement of Living and Working Conditions. https://www.eurofound.europa.eu/de/surveys/european-quality-of-life-surveys
EU (2015a): Agenda 2000. Eine stärkere und erweiterte Union. https://eur-lex.europa.eu/DE/legal-content/summary/agenda-2000-for-a-stronger-and-wider-union.html
EU (2015b): Politische Strategien für ein besseres Leben. https://www.europarl.europa.eu/summits/lis1_de.htm
EU (2018): Die 28 Mitgliedstaaten der EU. Brüssel. https://european-union.europa.eu/principles-countries-history/country-profiles_de
EUROSTAT (2017): *Statistiken zur Gesundheitsversorgung*. 29. June 2017.
FEHR, H. (2011): *Berechnungen des langfristigen Produktionspotenzials unter Berücksichtigung verschiedener altersbedingter und bildungsspezifischer Produktivitätsprofile*. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Wiesbaden, Arbeitspapier Nr. 02.
FENZ, G. – SPITZER, M. (2005): *AQM: The Austrian Quarterly Model of the Oesterreichische Nationalbank*. Working Papers 104. Österreichische Nationalbank, Wien.
GILLMANN, N. – LEHMANN, R. – NAUERTH, J. A. – PONATTU, D. – RAGNITZ, J. – SONNENBURG, J. – WEBER, M. (2019): *Wachstum und Produktivität 2035.* ifo Institut, Dresden Studien, Nr. 84.
HEADEY, B. – MUFFELS, R. – WOODEN, M. (2008): Wealth and happiness revisited – growing national income does go with greater happinness. *Social Indicators Research*, 64, pp. 1-27.
HEILEMANN, U. (2009): Déja Vu: Prognose in der Kriese. Wirtschaftsdienst, Nr. 2, pp. 90-95.
HEILEMANN, U. (2019): Rezessionen in der Bundesrepublik Deutschland von 1966 bis 2013. Wirtschaftsdienst, Nr. 8, pp. 546-551.
HESSE, M. – MEYERHOFF, J. – PETSCHOW, U. (1998): *Verkehrsinfrastrukturen und wirtschaftliche Entwicklung*. Institut für ökologische Wirtschaftsforschungs, Berlin.
IAB (2010): *Regionale Arbeitsmarktprognosen der Arbeitslosen und sozialversicherungspflichtig Beschäftigten*. Nr. 2, Nürnberg.
ITM (2020): *Nemzeti energia- és klímaterv.* Innovációs és Technológiai Minisztérium, Budapest.
JUNG, J. K. – PATNAM, M. – TER-MARTIROSYAN, A. (2018): *An Algorithmic Crystal Ball: Forecasts-based on Machine Learning.* IMF Working Paper No. 2018/230, pp. 1-33.
KIRCHGÄSSNER, G. – SAVIOZ, M. (2001): Monetary Policy and Forecasts for Real GDP Growth. *German Economic Review*. 2 (4), pp. 339-365.
KOCZISZKY, GY. – BENEDEK, J. (2012): Contributions to the issues of regional economic growth and equilibrium as well as the regional policy. *Hungarian Geographical Bulletin* 61 (2): 113-130.
KOCZISZKY, GY. – SZENDI, D. (2021): Comparative Analysis of the Economic Development Paths of Hungarian Counties. *PUBLIC FINANCE QUARTERLY* 66 : Special edition, 2021/2, pp. 7-30.
KOLL, W. (2009): Welche Rolle spielen Prognosen? Wirtschaftsdienst, Nr. 2. pp. 79-86.
KUMAR, S. M. – WOO, J. (2010): *Public Dept and Growth*. IMF Working Paper. WP/10/174.
MARTIN, R. (2010): Roepke Lecture in Economic Geography - Rethinking Regional Path Dependence: Beyond Lock-in to Evolution. *Economic Geography*, 86: 1-27. https://doi.org/10.1111/j.1944-8287.2009.01056.x

MEINEL, G. – REICHERT, S. (2004): *Flächenwirkung des deutschen Autobahnnetzes – Konzept und erste Ergebnisse einer GIS-gestützten Analyse*. Deutschen Gesellschaft für Photogrammetrie, Band 13. pp. 227-234.

MNB (2022): *Inflation Report*. Magyar Nemzeti Bank, Budapest.

MOUROUGANE, A. (2006): *Forecasting Monthly GDP for Canada*. OECD Economics Department Working Papers, No. 515.

OECD (2014): *How's Life in Your Region? Measuring Regional and Local Well-being for Policy Making.* OECD Publishing, Paris.

OECD (2022): *Economic Outlook*. (www.oecd.org/economic-outlook/november-2022)

PETERSON, J. S. (2014): *Review of Research at Virginia Tech on the Relationship between School Building Condition and Student and Teacher Performance and Attitudes*. PhD dissertation. Virginia Polytechnic Institute and State University. https://vtechworks.lib.vt.edu/bitstream/handle/10919/56836/Peterson_JS_D_2014.pdf?isAllowed=y&sequence=1 (letöltés ideje: 2022. november 10.).

POTRAFKE, N. – GRÜNDLER, K. – MOSLER, M. – DÖRR, L. (2019): *Der Zusammenhang zwischen Verschuldung, Budgetzusammensetzung und volkswirtschaftlichem Wachstum*. ifo Forschungs-Berichte, 107/2019. München.

SEDILLOT, F. – PAIN, N. (2003): *Indicator Models of Real GDP Growth in Selected OECD Countries*. OECD Economics Department Working Papers, No. 364.

SETO, K. C. – DAVIS, S. J. – MITCHELL, R. B. – STOKES, E. C. – UNRUH, G. – ÜRGE-VORSATZ, D. (2016): Carbon Lock-In: Types, Causes, and Policy Implications. *Annual Review of Environment and Resources*, 2016 41 (1), pp. 425-452.

STARFIELD, B. – BIRN, A. E. (2007): Income redistribution is not enough: income inequality, social welfare programs, and achieving equity in health. *J Epidemiol Community Health*, 61 (12), pp. 1038-1041.

TIBERIUS, V. – GOJOWY, R. – DABIC, M. (2022): Forecasting the future of robo advisory: A three-stage Delphi study on economic, technological, and societal implications. *Technological Forecasting and Social Change*. 182.

ZIMMERMANN, K. F. (2009): Prognosekriese: Warum weniger manchmal mehr ist. Wirtschaftsdienst, Nr. 2, pp. 86-90.

Annex 1. Average and standard deviation of the indicators

block	nr.	indicator	EU average (2020)	sigma EU (st. dev.) (2020)	six countries average (2020)	sigma six countries (st. dev.) (2020)
real economy block	1.	GDP/capita (USD, PPS)	44765.8	18917.3	33048.3	5102.7
	2.	trade balance (% of GDP)	85.6	10.1	126.0	31.4
	3.	investments (% of GDP)	21.9	5.2	22.1	3.8
	4.	labour productivity	88559.5	15647.1	22261.2	5172.8
	5.	patent applications per 10000 inhabitants	1.17	0.3	0.5	0.2
	6.	number of active enterprises per 1000 inhabitants	52.2	29.4	93.3	35.1
	7.	FDI inflow (% of GDP)	0.7	4.9	1.6	1.8
	8.	activity rate (%)	73.0	3.1	74.2	2.8
	9.	R&D expenditures (% of GDP)	74.7	4.7	72.3	2.2
	10.	unemployment rate (%)	7.4	3.2	4.5	1.3
	11.	income per household (USD. PPS)	22364.0	7636.1	11975.0	2500.6
	12.	dependency ratio (share of the population aged 0-14 years/ share of the active population (15-64 years) (%)	23.5	1.0	23.4	0.9
	13.	gross average wages (USD)	2793.5	649.3	1267.8	245.1
	14.	household consumption per capita (PPP. USD)	16360.0	1976.1	15640.7	1691.3
	15.	government debt (% of GDP)	436	7.4	15.4	0.4
fiscal and monetary block	16.	consumer price index (%)	90.1	43.9	51.6	17.9
	17.	budget deficit (% of GDP)	0.5	5.1	2.6	0.8
	18.	current account balance (% of GDP)	-6.9	2.6	-6.7	2.1
	19.	long-term interest rate (%)	3.0	4.4	0.1	3.0
	20.	exchange rate (%/year)	0.39	1.9	1.8	1.4
	21.	doctors per 1000 inhabitants	1	0	15.0	9.84
human infrastructure block	22.	hospital beds per 1000 inhabitants	2.2	1.7	34.4	7.0
	23.	healthcare expenditures (% of GDP)	5.2	1.3	67.7	6.0
	24.	education expenditures (% of GDP)	7.7	2.2	4.9	0.8
	25.	tertiary education students per 1000 inhabitants (head)	4.8	1.4	4.2	0.5
	26.	population growth (%)	39.3	10.7	30.4	3.7
technical infrastructure block	27.	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
	28.	built houses per 10000 inhabitants	53.2	36.3	41.5	12.5
	29.	passenger cars per 1000 inhabitants	560	110.4	478.7	102.2
	30.	length of motorway per 100000 inhabitants	30.7	12.6	10.1	4.7
	31.	gas consumption per inhabitants	806.1	469.2	740.1	219.1
	32.	price of gas (euro/100m^3)	5.1	0.74	4.2	0.95
environmental block	33.	waste generated per 1 inhabitant (kg)	505.0	102.6	392.5	70.1
	34.	greenhouse gas emissions (1990=100%)	79.3	21.3	63.9	12.4
	35.	electricity consumption per person (GWh/cap)	5.5	0.7	4.3	0.9
	36.	share of renewables in total energy consumption (%)	22.0	11.7	18.7	3.8
	37.	price of electricity (euro/kWh)	0.213	0.014	0.141	0.031

Source: own editing