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RESEARCH ARTICLE

Investigating relationships between economic freedom, growth, and development in CEE countries

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Abstract
Over the last three decades, Central and Eastern European Countries (CEEC) have undergone profound institutional reforms to transition from centrally planned to market economies. Full EU membership began two decades ago, marking another significant milestone. The paper seeks to examine how the regulations and other institutions, as measured by the economic freedom indicator and its components, shape the economic growth and development of CEEC. Two research questions are posed. Data spanning from 1996 to 2021 for 11 countries are examined. We employ hierarchical clustering to identify homogeneous groups of countries and utilize panel cointegration tests and the AutoRegressive Distributed Lags model to find long- and short-term relationships. The study identifies four groups of countries according to the EF indicator. Two long-run statistical relationships are identified between GDP per capita and economic freedom and between the Human Development Index (HDI) and economic freedom. Granger causality test shows that in the short-run, GDP per capita and HDI preceded economic freedom, except for business freedom, which was a precursor to GDP per capita, and property rights, which preceded HDI. That underscores the role of institutional order in creating an environment conducive to growth and development.

Keywords: economic freedom; growth and development; institutional change; panel ARDL; post-socialist countries

Introduction

The impact of institutions on economic growth is a subject of theoretical and empirical analyses. The idea that institutions create the basis for economic growth is a critical economic concept, and various economists and scholars have articulated it over the years. North (1990) argued that well-functioning institutions, such as secure property rights, a stable legal system, and effective governance, are essential for economic growth and emphasized that these institutions provide the necessary framework for markets to operate efficiently and for individuals and businesses to make investments and engage in economic activities with confidence (North et al., 2009).

Institutions are considered a fundamental factor in the long-term economic development of nations, and this concept has been widely studied and discussed in economics. Acemoglu et al. (2005) and Acemoglu and Robinson (2012) explore the role of institutions in shaping nations' economic and political outcomes. They emphasize how inclusive institutions are conducive to economic growth and prosperity. Rodrik (2000) discusses the importance of institutions for high-quality economic growth and development. He explores the various dimensions of institutions and how they can be acquired and strengthened. Easterly (2001) also examines the challenges of achieving economic growth

in developing countries and emphasizes the role of institutions in this process. It provides insights into the complexities of economic development. In the paper by Besley and Persson (2009), the authors explore the relationship between property rights, taxation, and state capacity, highlighting how institutions influence economic outcomes. Kacprzyk (2014) emphasizes the importance of institutions in the economic growth models. Boehlke (2019) explains that various institutional designs make economic policies differ across countries.

The institutions mentioned in the last paper are measured in the economic freedom indicator published by the Heritage Foundation (https://www.heritage.org/index), one of the most influential measures of institutions' quality. In the paper, we focus on the relationships between economic growth and development on one side and economic freedom on the other. The subjects of our interest are countries from Central and Eastern Europe which, in the 1990s, started their transformation from centrally planned economies to market ones.

In the empirical literature, we can find many studies referring to the relationship between economic growth and freedom in different panels of countries, with various conclusions that motivate further research. Dawson and Seater (2013) found that federal regulations have statistically and economically significant effects on aggregate output and the factors that produce it – total factor productivity (TFP), physical capital, and labor in the US. Erdem and Tugcu (2012) examined the OECD countries in 1995–2009 and found no significant relationship between economic freedom and total factor productivity. On the other hand, cointegration analysis revealed that economic freedom matters for economic growth in OECD countries in the long run, and estimation results showed that the direction of the impact is negative. Kacprzyk (2016) assessed the effect of the components of economic freedom in the world (EFW) aggregate indicator on economic growth in the EU-28. Positive relationships from four (of the five) aspects of economic freedom, i.e., security of property rights, quality of monetary policy, freedom to trade, and regulatory policies on economic growth – have been confirmed. Cervello-Royo et al. (2023) found that combining high levels of business freedom, labor freedom, and government integrity triggers high economic growth levels and lowers the Eurozone's unemployment rate.

We aim to determine the impact of economic freedom, measuring such institutional dimensions as, among others, property rights, government integrity, and business freedom and other components on economic growth, measured by the per capita GDP and development, measured by the Human Development Index (HDI) in Central and East European countries, which joined the European Union after 2004, i.e., Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Using the data from 1996 to 2021, we catch the regularities using the panel econometric models. The distinction between GDP p.c. and HDI stems from the historical decisions made by countries in selecting their transformation models, which resulted in varying growth and development rates. Consequently, as reflected in GDP and HDI indicators, the outcomes differed.

Our paper contributes to the existing literature fourfold. Firstly, through deep analysis of Central and Eastern European countries since the period closing of the turbulent period of political and economic transformation from 1996 to 2021, it gives a broad picture of processes when economic reforms, economic growth, and development were introduced at the same time stimulating and opposing to each other. Secondly, classifying countries according to economic freedom indicators and their components helps uncover the institutional spheres where essential reforms were primarily influential and those that remained underdeveloped. Thirdly, employing cointegration analysis, including cross-sectional dependence, we can uncover the relationship between development measured by GDP pc, HDI, and economic freedom indicator and its components. Then, we model the relationships using the ARDL construction, which enables the estimation of long-run and short-run equations in the presence of common correlated effects. Finally, thanks to causality analysis in Granger's sense, we uncovered the direction of the relationships in interest in the short run.

The paper is organized as follows. The second section provides substantial information on political and economic transformation in Central and Eastern Europe and a literature review followed by definitions of research questions. Section three presented a brief overview of the economic freedom

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indicator in countries of interest. Section four provides the data characteristics, and section five describes the methodological issues. The results are presented in section six, while we conclude in section seven.

Economic transformation in CEEC – facts and literature review

Essential facts on economic transformation in CEEC

The transformation processes in Central and Eastern European countries started in Poland in 1989 and were followed by sequent countries while communism fell. This issue was the subject of several analyses provided by Sachs (1993), de Melo et al. (1996), Gros and Steinherr (2002), Csaba (2005), Nölke and Vliegenthart (2009), Rapacki (2019) and Gomułka (2023) to mention only a few.

In the mentioned literature, the following stages of transformation from planned to market economies are recalled: the collapse of centrally planned economies, economic recession, transformation, and restructurization. The last two stages refer mainly to activities directed at macroeconomic stabilization, structural changes, and microeconomic and sectoral allocation. The authors also emphasize the role of the International Monetary Fund in shaping the reforms. In CEEC, the following facts can be summarized.

1. Political and Economic Transformation: The fall of communism in 1989 and subsequent political and economic transformation in CEE countries led to the establishment of democratic governments and the transition from centrally planned to market-based economies.
2. Privatization: Privatizing state-owned enterprises and founding new private companies helped increase the economy's competition, efficiency, and productivity.
3. Liberalization: Trade and investment liberalization enabled CEE countries to integrate into the global economy, access new markets and technologies, and attract foreign investment.
4. Macroeconomic Stability: Establishing macroeconomic stability, including fiscal and monetary discipline, price stability, and sound monetary policy, reduced inflation, stabilized exchange rates, and increased investor confidence.
5. Joining NATO and EU Accession: Getting independence from Russia and the accession to the European Union helped to increase trade and investment and provide access to EU structural funds.
6. Economic Growth: Strong economic growth in many CEE countries, particularly in the transition's early years, helped increase living standards and reduce poverty.
7. Financial Crisis and Structural Challenges: After 2008, the growth path stopped, and structural challenges occurred. They include the need for further institutional and legal reforms, improvements in infrastructure, and addressing regional disparities within countries.

Literature review

It is essential to recognize that the economic transformation of Central and Eastern European Countries (CEEC) could not have begun without the attainment of political freedom, which created the conditions necessary to initiate discussions about critical reforms. While a comprehensive exploration is beyond the scope of this study, the Eucken-Hayek-Friedman hypothesis – suggesting that societies with high levels of political freedom must also exhibit high levels of economic freedom (Lawson and Clark, 2010) – is highly pertinent in this context. Although empirical evidence offers conflicting conclusions regarding this claim, it remains logically evident that economic freedom is a necessary, albeit insufficient, condition for political freedom (Kondratowicz, 2013, p. 249). Empirical research by Dethier et al. (1997) demonstrated that democracy facilitated economic liberalization within CEE countries. More recently, Piątek et al. (2013) investigated the interplay between economic and political freedom and their effects on economic growth across 25 post-socialist countries between 1990 and

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2008. The results indicated that while economic freedom positively influenced economic growth in transition economies, political freedom appeared neutral in its direct impact on economic growth. However, shifts in the degree of political freedom were shown to be influenced by economic growth.

The literature on the economic transformation of CEE countries can be divided into theoretical and empirical streams. While no unified theory exists, two primary approaches emerged at the start of the transition. The liberal approach, championed by neoclassical economics and exemplified by Sachs (1993), advocated for rapid 'shock therapy' reforms. In contrast, the evolutionary institutional approach, highlighted by Kornai (1980, 2000), emphasized gradual change and the potential for diverse capitalist models.

De Melo et al. (1996) identified several factors driving economic growth after liberalization and stabilization in CEE countries, including increased external finance, investment recovery, employment growth, and economic restructuring – the most impactful factor. Poland exemplified 'shock therapy' through the 1990 Balcerowicz Plan, rapidly liberalizing prices and cutting subsidies while gradually privatizing certain state-owned enterprises. Although many CEE countries initially pursued a neoclassical 'shock therapy' approach, most shifted to gradualist strategies during their transition from socialism to market economies in the late 1980s and 1990s (World Development Report, 1996). Hungary began market-oriented reforms in the 1960s and later prioritized gradual privatization and stabilization. The Czech Republic implemented incremental reforms, avoiding rapid privatization, while Slovakia phased in changes more slowly. Slovenia focused on developing small and medium-sized enterprises (SMEs), and Bulgaria prioritized macroeconomic stabilization before structural reforms. Though gradualism was the prevailing strategy, the pace, and policies varied, reflecting different economic and political contexts with varying levels of success. The balance between shock therapy and gradualism evolved as nations adapted to changing circumstances.

Gardawski and Rapacki (2021) coined the term 'patchwork capitalism' to describe the reform models adopted by CEE countries. This model, characterized by diverse reform paths, yielded faster economic growth rates and strong convergence tendencies than other capitalist systems (Maszczyk et al., 2024). However, this system also displayed structural weaknesses, including an underdeveloped framework of formal institutions, weak state and legal systems, and a lack of socio-structural and cultural embeddedness. At the start of the transformation, these economies were marked by an absence of a capitalist class, incoherence, and mismatches among inherited components from previous regimes, elements transplanted from Western capitalist models, and new reforms initiated by local elites.

During their transition, a key feature of CEEC economies was the lack of domestic capital and expertise. Gomułka (2016) used the Technological Frontier Area (TFA) concept to illustrate the global economic duality in the 20th century, placing CEE countries outside the TFA at the start of their transformation. Following Washington Consensus recommendations, these countries prioritized attracting foreign direct investment (FDI), which became a cornerstone of economic growth and the development of capitalist institutions (Maszczyk et al., 2024). Nölke and Vliegenthart (2009) characterized this model as a 'dependent market economy,' emphasizing FDI's central role in the region's transformation. Gomułka (2016) further noted that successful innovation diffusion from TFA countries required improved institutional and economic policy quality, a process facilitated by the CEECs' transformation.

Among many empirical studies, some journal articles are particularly worth mentioning, such as the pioneering studies of de Haan and Stur (2000), Gwartney and Lawson (2003), and Dawson (2003). De Haan and Stur (2000) recognized that greater economic freedom fosters economic growth, while the level of economic freedom is not related to growth. The authors relied on two economic freedom indicators, i.e., the Fraser Institute and the Heritage Foundation. They applied the data from 1975 to 1990 for 80 countries, excluding the Central and European Countries that remained in this period under the communist regime. Gwartney and Lawson (2003) used the broadest period data available then. Dawson (2003) demonstrated that the overall level of economic freedom appeared to cause growth, while changes in freedom were jointly related to growth. He also found that among the underlying areas of economic freedom, levels of freedom relating to the use of markets and property

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rights appear to be driving the causal relationship between economic freedom and growth. The panel data used in the study referred to the period 1970–2000.

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Doucouliagos and Ulubasoglu (2006) conducted a meta-analysis comparing studies on the impact of economic freedom on growth. Analyzing cross-sectional and panel data from 82 countries (1970–1999), they found a direct positive link between economic freedom and growth and an indirect effect through physical capital stimulation. Most studies measured economic growth using GDP and employed the aggregate economic freedom index as an explanatory variable.

Hall and Lawson (2013) provided a comprehensive literature review on the Fraser Institute's economic freedom indicator and its relationship with various economic outcomes, including growth, living standards, happiness, and inequality. Their findings confirmed economic freedom's association with a range of positive outcomes with minimal negative trade-offs. Lawson et al. (2024) further expanded and updated this research.

Several studies have highlighted a positive correlation between economic freedom (EF) and economic growth (EG) in CEE countries. Gwartney and Lawson (2002) found that international trade freedom positively influenced economic growth in the region. Expanding on this, Gwartney et al. (2016) analyzed data from 1995 to 2010, confirming the role of property rights and trade freedom in driving growth. However, Piątkowski (2018) emphasized the importance of carefully selecting countries for such analyses, as institutional factors significantly shaped CEE countries' political and economic transformation processes.

Gurgul and Lach (2011) explored the causal relationships between changes in economic freedom and GDP per capita in new EU member states during the transition period of 2000–2009. They identified significant causality from monetary and fiscal policies, trade openness, credit, labor and business regulations, legal structures, and property rights security to GDP per capita shifts. In contrast, evidence for reverse causality was weaker. Uzelac et al. (2020) further highlighted the role of the legal framework, political stability, and economic freedom in shaping the economic reality of 19 CEE countries.

Economic development is often linked to structural change, encompassing social and political transformations, as seen in the CEE countries. Economic growth and development are complementary, each enhancing the other's success (Flammang, 1979). In light of criticisms of growth measures by Stiglitz et al. (2009) and discussions by Tsai (2011), attention shifts to the Human Development Index (HDI), comprising life expectancy, expected and mean years of schooling, and GNI per capita (PPP USD). While education levels are relatively uniform across CEE countries, life expectancy and income vary significantly. Graafland (2020) explored the link between HDI and economic freedom in 29 OECD countries, finding that generalized trust positively moderates this relationship. Similarly, Nikolaev (2014), studying 34 OECD countries, confirmed that improvements in economic freedom strongly correlate with higher human development and quality of life.

Research questions

Based on the literature review, the paper identifies three gaps. One generalizes the processes of growth and development in the CEE countries as a whole group; the second refers to the HDI indicator, which is rarely considered in such studies; and the third allows for comparing growth and development

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determinants over the long and short-run based on the relatively long time series data, encouraging application of modern econometric techniques.

Following the literature review, particularly the findings related to theoretical aspects of the relationship between economic freedom and growth (Gardawski and Rapacki, 2021), the hypothesis was formulated that economic freedom, by creating an institutional base and despite its patchwork characteristics, positively impacted economic growth and development in the CEE countries in the long run.

To ask the research questions, we took various viewpoints in the literature. Having in mind the crucial role of economic freedom (Balcerowicz, 1995; Kondratowicz, 2013), the focus on macroeconomic stability in transformation (Balcerowicz, 1995), and the composition of the Economic Freedom Index (https://www.heritage.org/index), the first research question is related to the importance of the economic freedom components in CEEC.

RQ1: Which economic freedom overall indicator component primarily impacts CEE economies' growth and developmental processes?

It comes from the new institutional economics (Acemoglu et al., 2005; Rodrik, 2000) that legal, social, economic, and cultural institutional order creates a basis for economic growth and development. From a long- and short-run perspective, it is unclear how it acted in CEE countries, having controlled for standard growth factors like employment, human capital, and gross capital formation (Asghar et al., 2015). Therefore, the second research question takes the following form.

RQ2: Was economic freedom necessary for growth and development formation in the long run, or instead, was it acting in the short term, while economic growth factors were dominant in the long period?

Referring to the 11 CEE countries under investigation, we may also ask whether the adjustment speed to the identified long-run path differs across countries and why (RQ3).

Economic freedom in CEEC

Starting from the beginning of the economic transformation, the CEE countries struggled to improve their GDP and foreign trade openness and encourage private entrepreneurship. The improvement of the Economic Freedom Index became one of the main targets. In the paper, we consider The Economic Freedom Index, published by the Heritage Foundation and The Wall Street Journal.

Another critical indicator, Economic Freedom in the World (EFW), published by the Fraser Institute (https://www.fraserinstitute.org), is also very popular in the literature (Doucouliagos and Ulubasoglu, 2006). However, the annual data before 2000 are unavailable for the countries in interest. A discussion of the advantages and disadvantages of both measures can be found on the website https://mises.org/mises-wire/economic-freedom-indexes-fraser-vs-heritage, among others. Kondratowicz (2013), after an intense presentation and discussion, concludes that the indicator published by the Fraser Institute is more objective than that proposed by the Heritage Foundation. However, it is more similar to the indicators measuring political freedom than the macroeconomic indicators. In a comparison of constructs composing the indices made by De Haan and Stur (2000), both the Fraser Institute and Heritage Foundation indicators look very similar.

The Heritage Foundation data for CEE countries has been available since 1995 and consists of 12 sub-indicators clustered into four groups, i.e., rule of law, government size, regulatory efficiency, and market openness (heritage.org; accessed, Aug. 29, 2023). Among all CEE countries, which are EU member states, the highest position belongs to Estonia, the regional leader, keeping the sixth position globally in 2023. It is worth mentioning that all considered countries are above the world average in 2023 equal to 59.3, ranking as follows: Bulgaria (69.3; pos. 32), Croatia (66.4; pos. 46), Czech Republic (71.9; pos. 21), Hungary (64.1; pos. 54), Latvia (72.8; pos. 17), Lithuania (72.2; pos. 20), Poland (67.7; pos. 40), Romania (64.5; pos. 53), Slovakia (69.0; pos. 33) and Slovenia (68.5; pos. 37). The countries ranked from 5th to 27th are considered primarily free and between 28th and 83rd are considered moderately free.

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The series of crises since 2008 – including the financial crisis of 2008–2009, the eurozone crisis of 2010–2012, the COVID-19 pandemic, and the Russian invasion of Ukraine in 2022 – have raised concerns about economic freedom in CEE countries. These events increased government spending, reducing economic freedom index values across the region. Specific challenges persist in individual countries: Hungary faces criticism for government interference in the economy; Romania struggles with corruption and rule-of-law issues; and Poland has dealt with concerns about judicial independence, media restrictions, and control over state enterprises, with recent elections in October 2023 signaling potential changes. Bulgaria ranks relatively high but grapples with corruption, lack of government transparency, and weak property rights protection, while Croatia faces slow reforms, high public debt, and limited sectoral competition. These findings align with earlier observations by Gwartney and Montesinos (2017).

Data characteristics

We use economic freedom, growth, and development indicators in the study. Thirteen economic freedom indicators were sourced from the Heritage Foundation (https://www.heritage.org/index/explore), while data regarding economic growth and development came from The World Bank (https://databank.worldbank.org). All the collected data describe the economic situation in all CEE countries from 1996 to 2021. To develop the model structure, we adopted the Mankiw–Romer–Weil growth model, highlighting the importance of physical and human capital alongside investments in both (Mankiw et al., 1992). Barro (2015) presented useful theoretical and empirical extensions for modeling growth across panels of countries. In the CEE countries, while capital resources existed, they were outdated and unsuitable for modern technological demands. Technological modernization was primarily driven by imports, supplemented by FDI inflows and R&D investments (Gomułka, 2016; Rapacki, 2019). Human capital enhancement was measured through secondary and tertiary school enrollment, migration trends (especially immigration), and educational expenditures (Barro, 1991). The model treated the economic freedom indicator as a proxy for long-term regulations fostering inclusive economic institutions (Ayal and Karras, 1998; Gurgul and Lach, 2011). Output was alternately measured by GDP per capita (reflecting economic growth) and HDI (capturing broader social and economic development), as outlined in the Human Development Index methodology (https://hdr.undp.org/data-center/human-development-index#/indicies/HDI). Table 1 presents the variables used in the study with the information on panel stationarity.

The correlations between GDP per capita (or HDI) and economic freedom – an overall indicator were calculated as a first-glance measure of the relationships. The values are high, ranging from 0.71 for the Czech Republic to 0.94 for Bulgaria and Romania in terms of GDP pc and EF. Referring to the HDI and EF, the correlation values range between 0.66 for the Czech Republic and 0.95 for Bulgaria, Lithuania, and Romania. All the coefficients are statistically significant.

At the initial data analysis stage, we classified the CEE countries according to the economic freedom indicator and its components. The standard hierarchical cluster analysis was used (Köhn and Hubert, 2014). In the paper, the clusters were assigned by taking the overall period 1996–2021, as described in Lach and Malaga (2023). We found similar subgroups of countries corresponding to all components constituting EF's overall indicator, i.e., Latvia, Lithuania, and Czech Republic (group 1); Hungary, Poland, Slovak Republic, and Slovenia (group 2); Bulgaria, Romania, and Croatia (group 3). Estonia seems to behave like an outlier (group 4). The dendrogram is presented in Figure A1 in the Appendix. The number of clusters was determined using the Hubert Index (Hubert and Arabie, 1985).

Going deeper to the level of the 12 sub-indices of EF, we found that monetary freedom, property rights, and financial freedom appear most frequently in the CEE countries. On the other hand, government integrity, tax burden, and government spending appeared fewer. These subindices represented the less resolved aspects of public life. The empirical evidence is not reported but is available on request.

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Table 1. Data summary

Variable name	Variable symbol	Panel unit root test results		
		Im, Pesaran, Shin	Bai&Ng PANIC	Pesaran CIPS
Economic Freedom – Overall score	EF	I(1)	I(1)	I(0)
Business Freedom	EF_Bus_Fr	I(1)	I(1)	I(1)
Financial Freedom	EF_Fin_Fr	I(1)	I(0)	I(0)
Government Integrity	EF_Gov_Int	I(1)	I(0)	I(0)
Government spendings	EF_Gov_Spend	I(0)	I(0)	I(1)
Investment Freedom	EF_Inv_Fr	I(0)	I(1)	NA
Monetary Freedom	EF_Mon_Fr	I(0)	I(1)	I(1)
Property rights	EF_Prop_Righ	I(1)	I(1)	I(1)
Tax burden	EF_Tax	I(0)	I(1)	I(0)
Trade freedom	EF_Trade	I(0)	I(1)	I(1)
GDP pc (USD)	GDP pc	I(1)	I(1)	I(1)
Gross capital formation	GCapital	I(0)	I(1)	I(1)
FDI	FDI	I(0)	I(0)	I(1)
Government spending for education	Edu_spend	I(0)	I(1)	I(1)
Imports	Imp	I(1)	I(1)	I(1)
Exports	Exp	I(1)	I(1)	I(1)
Inflation	Inf	I(0)	I(0)	I(1)
Population	Pop	I(1)	I(0)	I(1)
Net migration	Mig	I(0)	I(1)	I(1)
Employment to population	Emp	I(1)	I(1)	I(1)
Unemployment rate	Unemp	I(0)	I(1)	I(0)
HDI	HDI	I(0)	I(0)	I(1)
R&D	R&D	I(1)	I(1)	I(1)
School enrollment (2nd)	School2	I(1)	I(1)	I(1)
School enrollment (3rd)	School3	I(0)	I(0)	I(1)

Source: Based on data from the Heritage Foundation and the World Bank.

The methodology

The methodology applied in the study consists of classification techniques, standard panel FE and RE estimators, panel unit root tests, panel cointegration and causality tests, and panel ARDL modeling.

The simplest econometric panel model is as follows:

$$y_{it} = \beta_0 + \beta' x_{it} + \varepsilon_{it} \quad i = 1, \ldots, N, \; t = 1, \ldots, T, \tag{1}$$

where y_{it} is the endogenous variable, β_0 is a constant term, x_{it} is a matrix of observed values of exogenous variables, β' is a matrix of parameter estimates, ε_{it} represents the error term, $= 1, \ldots, N$, represents the units in the panel, and $t = 1, \ldots, T$, represents the time units. Model (1) is typically inappropriate for practical use. It is a starting point for more advanced panel model construction.

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Panel unit roots testing

Testing for unit roots in the panel data is more complicated than individual time series. This is because, in panel data, we have both dimensions N for sections and T for time. The panels can be homogenous or heterogenous, depending on the unit root. Here, we can split the panel unit root tests into the first and second-generation tests. The first group of unit root tests is not flexible for cross-sectional dependence; that type of test has been proposed by the studies of Hadri (2000), Choi (2001), Levin et al. (2002), and Im et al. (2003), among others. The first group is widely known and was described in many publications (e.g., Barbieri, 2008; Breitung and Pesaran, 2005).

Variable and/or residual correlation across panel members results from common shocks (e.g., recession, standard policy rules) or spillover effects. The first group of tests assumes a cross-section independence. If neglected, cross-section dependence (CSD) can be a source of severe identification problems and lead to imprecise estimates. Therefore, the second-generation group consists of those tests that are flexible for cross-sectional dependence and incorporate Phillips and Sul (2003), Bai and Ng (2004), Moon and Perron (2004), Smith et al. (2004), Pesaran (2007), among others. In the study, we applied two of them, i.e., Bai and Ng's (2004) PANIC test and Pesaran's (2007) Cross-Sectionally Augmented IPS (CIPS). The CSD tests were described in De Hoyos and Sarafidis (2006).

To formulate a panel unit root test with cross-sectional dependence, Pesaran (2007) considers the following Cross-Sectionally Augmented Dickey–Fuller (CADF) regression, estimating the OLS method for the ith cross-section in the panel:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + c_i \overline{y}_{t-1} + d_i \Delta \overline{y}_t + \varepsilon_{it} \tag{2}$$

where $\overline{y}_{t-1} = N^{-1} \sum_{i=1}^{N} y_{i,t-1}$, $\Delta \overline{y}_t = N^{-1} \frac{1}{N} \sum_{i=1}^{N} y_{it}$, and $t_i(N, T)$ is the t-statistic of the estimate of ρ_i in the above equation used for computing the individual ADF statistics. The CIPS statistic refers to the average of individual CADF statistics, and it is provided as follows:

$$CIPS = N^{-1} \sum_{i=1}^{N} t_i(N, T) \tag{3}$$

Bai and Ng (2004) proposed a PANIC test, an abbreviation of *Panel Analysis of Nonstationarity in the Idiosyncratic and Common components*. Their approach is different than that of Pesaran. Bai and Ng assumed that each panel series $Y_{i,t}$ can be decomposed as the sum of a deterministic component, a common-stochastic component (all the common factors), and an individual component (the idiosyncratic error term). The data-generating process (DGP) is explained as follows:

$$Y_{it} = c + \beta t + \lambda_i' \mathrm{F}_t + e_{it} \tag{4}$$

where $e_{i,t}$ represents an idiosyncratic scalar error, and F_t is an $r \times 1$ vector of common factors, λ_i is providing the corresponding vector of trends; and $c + \beta t$ represents a linear deterministic trend model and can be reduced to c, which denotes the constant. Then, the $F_t$are assumed to follow an AR(1) process $F_t = F_{t-1} + f_t$ that contains $k_1 < K$ independent stochastic trends and consequently $K - k_1$ stationary components. The idiosyncratic terms e_{it} are also modeled as AR(1) processes i.e. $e_{it} = \rho_i e_{it-1} + \varepsilon_{it}$ and are allowed to be either I(0) or I(1); besides ε_{it} follows a mean zero, stationary, invertible MA process. Thus, the objective of PANIC is to determine the number of non-stationary factors k_1 and test whether $\rho_i = 1$ for each $i = 1, \ldots, N$ (Barbieri, 2008).

Panel cointegration tests

Similarly to panel unit root tests, panel cointegration tests consider cross-sectional independence and correlation. In the first group, tests such as those by Pedroni (2004), Kao (1999), and Fisher (Maddala and Wu, 1999) are widespread. The second-generation panel cointegration tests are represented by Westerlund (2007).

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Westerlund (2007) developed four new panel cointegration tests based on structural rather than residual dynamics and, therefore, did not impose any common-factor restriction. The idea is to test the null hypothesis of no cointegration by inferring whether the error-correction term in a conditional panel error-correction model equals zero. The alternative assumes two possibilities: two tests, Gt and Ga, verify whether at least one unit in the panel is cointegrated, and two other Pt and Pa, examine if the entire panel is cointegrated. The tests converge to the normal distribution (Westerlund, 2007). They include unit-specific short-run dynamics, unit-specific trend and slope parameters, and cross-sectional dependence.

Granger causality test for panel data

The Dumitrescu–Hurlin (2012) causality test is applied to test Granger causality for heterogeneous data panels Granger (1969). Utilizing the Wald test, the Dumitrescu–Hurlin test checks the null hypothesis of no causal relation for the cross-sections in the panel. The alternative hypothesis is the existence of Granger causality for some proportion of the cross-sectional data. Wbar and Zbar statistics are contained within the Dumitrescu–Hurlin test for one lag. Wbar statistics considers an average test statistic, while Zbar statistics considers a standard normal distribution Dumitrescu and Hurlin (2012). As a rule, we cannot reject the null hypothesis if the p-value exceeds 0.05.

Panel Autoregressive Distributed Lags model

Panel Autoregressive Distributed Lags model is a valuable construction for estimation relationships in panel time series data, which are either nonstationary I(1) or a combination of nonstationary I(1) and stationary I(0) series (Baltagi, 2008). Therefore, the following steps are necessary to implement while constructing the model: testing for panel unit roots, panel cointegration, and model estimation.

Pesaran and Smith (1995) and Pesaran et al. (1999) described their panel ARDL model. The panel ARDL model takes the following form:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=1}^{q} \delta'_{ij} X_{i,t-j} + \mu_i + e_{i,t} \tag{5}$$

where $i = 1, 2, \ldots\ldots, N$; $t = 1, 2, \ldots\ldots, T$; $X_{i,t}$ is a $kx1$ vector of explanatory variables; δ_{ij} is a coefficients vector; λ_{ij} are scalars and μ_i represents a group-specific effect. Additionally, time trends and other deterministic regressors are possible. If the variables are I(1) and cointegrated, it is common to re-write (5) in the error correction form:

$$\Delta y_{it} = \varphi_i \left(y_{i,t-1} - \theta'_i X_{i,t} \right) + \sum_{j=1}^{p-1} \lambda^*_{ij} \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \delta'^*_{ij} \Delta X_{i,t-j} + \mu_i + e_{i,t} \tag{6}$$

where φ_i is the error correction speed of the adjustment coefficient; θ_i – represents a vector of the long-run coefficients. If $\varphi_i = 0$, then a long-run relationship is not supported. This parameter is expected to be significantly negative to ensure the adjustment in the long run. Pesaran et al. (1999) proposed a Pooled Mean Group (PMG) estimator for estimating equation (6). It combines both pooling and averaging. The PMG estimator allows the intercept, short-run coefficients, and error variances to differ across the groups. In contrast, the long-run coefficients are set to be equal across groups. Chudik and Pesaran (2015) introduced a Common Correlated Effects (CCE) estimator, being consistent in the cross-sectional dependency case, and Chudik et al. (2016) extended it to the long-run coefficients.

The results

The econometric analysis starts with data analysis. The original data shows that the economic freedom indicators and HDI are bounded in values from 0 to 100; therefore, it is reasonable to transform all data

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into logs. Regarding the panel unit roots tests, the question of cross-sectional dependence arises. In the case of CEE countries, this assumption is straightforward as all considered countries followed a similar path of economic transformation. Using the Pesaran CD test for all variables, i.e., EF, GDP pc, and HDI, we found strong evidence supporting the cross-dependence of considered countries (Pesaran, 2015). The results are available on request.

Therefore, the second-generation panel integration tests were applied, including Bai and Ng's (2004) PANIC and Pesaran's (2007) CIPS tests. The results of the panel integration tests are pretty homogenous, as at least one test indicates that the analyzed panel data are integrated in order one. The results are presented in Table 1.

The deeper insight allows for the cointegration between panel data to be considered. Then, the corresponding cointegration test, including cross-sectional correlation, proposed by Westerlund (2007) was applied.

Considering the primary relationship between GDP pc (in USD, constant 2015) and economic freedom overall indicator (EF), we tested for cointegration in three versions, i.e., no deterministic component, constant, and constant and trend. The long-run relationship was modeled as follows (log symbol is omitted, although all variables have been transformed into logarithms)

$$GDPpc_{it} = deterministic + \beta_{1i}EF_{it} + \beta_{2i}X_{it} + u_{it} \tag{7}$$

where $GDPpc_{it}$ denotes GDP per capita observed in a given country over time, EF_{it} denotes economic freedom indicator, X_{it} denotes a variable that might be included in the long-run relation (a list of variables is presented in Table 1) and u_{it} denotes an error term. Deterministic means such components as constant and time trend.

Alternatively, we asked another question about the existence of a long-run relationship between economic development measured by the Human Development Index (HDI) and economic freedom (EF).

The long-run relation was then as follows

$$HDI_{it} = deterministic + \beta_{1i}EF_{it} + \beta_{2i}X_{it} + u_{it} \tag{8}$$

where HDI_{it} denotes the corresponding human development index values, and the remained symbols are the same as in (7).

As written in (7) and (8), we examined the cointegration between GDP pc (or HDI) and the overall economic freedom indicator in pairs and in the presence of any other economic variables. We present the Westerlund test results for panel cointegration. The results are shown in Table 2.

In the Westerlund test, the alternative hypothesis assumes some cointegrating relations exist between some units of the panel (G_t and G_a) and the entire panel (P_t and P_a). It can be noticed that GDP pc shows fewer panel cointegration relations than HDI indicators. Overall, the results suggest a potential long-run statistical association between GDP per capita and EF and between HDI and EF.

We further explored potential long-run associations between GDP pc or HDI and the components of the overall economic freedom indicator to address the first research question. The results suggest statistically significant long-term relationships between HDI and most EF components, except for trade freedom. In contrast, GDP per capita shows a long-term association with monetary freedom at the 0.05 significance level, and this relationship extends to business freedom when the significance threshold is relaxed to 0.1. The results are shown in Table A1 in the Appendix.

Considering the above results, we estimated panel-ARDL models corresponding to the confirmed long-term relations. The results are estimated using the Common Correlation Effect for dynamic models described in Chudik and Pesaran (2015) and Chudik et al. (2016). As shown in the first row of Table 3, the models are presented separately for $\Delta GDP\ pc_t$ and ΔHDI_t. The results exhibit high stability while controlling the long-run and short-run relationships. The $COINTEG_{t-1}$ remains negative and statistically significant. Two long-run relations were considered for both dependent variables; the first one consisted of GDPpc and EF (Models 1–3) and HDI and EF (Models 6-7), while in the second one, imports were added (Models 4–5 and 8–9, respectively). The information criteria IC1 and IC2

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Table 2. Westerlund test results H0: GDP pc/HDI, EF, and other variables are not cointegrated (*p*-values for the test statistics are presented)

Variable name	EF	EF – Emp	EF – GCapital	EF – Imp	EF – Exp	EF – Edu_spend	EF – School3	EF – School2	EF – R&D	EF – FDI	EF – Mig	EF – Unemp
GDP pc												
G_t	0.208	0.043	0.908	0.028	0.198	0.944	0.001	0.357	0.264	0.071	0.229	0.178
G_a	0.578	0.914	0.987	0.697	0.979	0.972	0.986	0.925	0.657	0.818	0.764	0.989
P_t	0.052	0.129	0.417	0.035	0.701	0.691	0.017	0.437	0.259	0.046	0.063	0.078
P_a	0.016	0.377	0.730	0.028	0.961	0.660	0.875	0.412	0.146	0.201	0.194	0.389
HDI												
G_t	0.000	0.000	0.000	0.002	0.018	0.000	0.000	0.000	0.057	0.000	0.000	0.000
G_a	0.033	0.003	0.784	0.225	0.189	0.441	0.140	0.403	0.887	0.535	0.764	0.737
P_t	0.000	0.000	0.000	0.000	0.006	0.000	0.003	0.001	0.032	0.000	0.001	0.001
P_a	0.000	0.000	0.081	0.002	0.000	0.134	0.060	0.015	0.224	0.040	0.230	0.072

Note: Significant results at a 0.05 significance level are shown in shadowed cells.
Source: Own calculations.

(Margarita and Westerlund, 2023) are used for model comparisons. The CD Stat (Pesaran, 2015) refers to the weak cross-section dependence, i.e., H_0 assumes weak dependence, and H_1 refers to strong dependence. As Ditzen (2018) mentioned, the test tends to over-reject the null.

Comparing the models describing economic growth ($\Delta GDPpc_t$), one can notice that the overall economic freedom indicator appears significant in the long-run equations; while imports are not far from the acceptable significance level of 0.1, they exceed the level. In the short run, the standard growth factors, such as changes in employment and gross capital, are significant in all model's specifications. When controlled for other variables, the changes in FDI, school enrollment at the secondary level, and the unemployment rate were significant while included individually. The changes in FDIs have a negative impact overall, but looking at the individual country coefficients (available on request), six are negative, while five are positive. The negative country error correction effects vary from -0.11 in Bulgaria to -0.006 in Latvia. Romania was the only exception with a positive sign of the adjustment coefficient, which means it did not adjust to the estimated long-run equation, valid for 11. CEE countries. Referring to the models describing ΔHDI_t, stability must be emphasized concerning the economic freedom indicator in the long-run relation. Imports were more sensitive to the presence of other variables. In the case of ΔHDI_t, the best model includes changes in secondary school enrollment with a positive impact on social and economic development. The analysis of idiosyncratic effects revealed positive effects across countries apart from Lithuania, for which changes in secondary school enrolment were negative. The negative country error correction effects, similarly to $\Delta GDPpc$, vary from −0.05 in Slovenia and Slovakia to -0.006 in Latvia, and Romania remained the only exception with a positive sign. It is worth noting that the dynamic structure of the estimated models is not extended, which comes from two important characteristics. The time series observations are still quite short in fully uncovering the dynamics of the processes observed annually. Besides, the reforms in the transformed economies were not introduced sequentially. Therefore, many changes occurred in the same year, justifying simultaneous relations.

What should be emphasized is the decrease in population in CEE countries. They all gained higher levels of GDP pc, which were partly achieved by adverse demographic processes (lower fertility rate, lower natural increase) and migrations. In particular, the populations of Bulgaria and Romania decreased respectively by 14% and 12% between 1997 and 2015, mainly due to emigration (Grela et al., 2017). However, net migrations were insignificant in our models.

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Table 3. Empirical ARDL models

Endogenous variable	$\Delta GDP\ pc_t$					ΔHDI_t			
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Long-run (pooled) eq									
EF_t	0.084 [0.092]	**0.080 [0.044]**	0.084 [0.000]	0.077 [0.044]	0.084 [0.087]	0.021 [0.001]	**0.016 [0.046]**	0.020 [0.000]	0.017 [0.109]
Imp_t				0.033 [0.137]	0.032 [0.176]			0.005 [0.000]	0.002 [0.343]
Short-run (mean-group) eq									
$COINTEQ_{t-1}$	−0.037 [0.000]	**−0.037 [0.000]**	−0.035 [0.000]	−0.052 [0.000]	−0.057 [0.000]	−0.032 [0.010]	**−0.035 [0.013]**	−0.043 [0.000]	−0.057 [0.004]
ΔEMP_t	0.233 [0.001]	**0.241 [0.002]**	0.234 [0.001]	0.178 [0.000]	0.160 [0.000]		**0.026 [0.052]**		
$\Delta GCapital_t$	0.095 [0.000]	**0.099 [0.000]**	0.093 [0.000]	0.083 [0.000]	0.085 [0.000]				
ΔFDI_t		**−0.004 [0.096]**							
$\Delta SCHOOL2_t$			0.0741 [0.093]				**0.045 [0.001]**		
$Unemp_t$					−0.001 [0.009]				
Pop_t									−0.050 [0.089]
IC1	−7.47	**−7.70**	−7.43	−7.68	−7.71	−11 .2	**−11.3**	−11.2	−11.4
IC2	−7.21	**−7.66**	−7.29	−7.63	−7.66	−11 .1	**−11.2**	−11.1	−11.3
CD Stat	−1.30	**−0.94**	−1.27	−0.47	−0.85	−3.11	**−1.74**	−2.86	−2.49
p-value	[0.19]	**[0.34]**	[0.21]	[0.63]	[0.39]	[0.00]	**[0.08]**	[0.00]	[0.01]

Note: *p*-values are given in brackets. Best models are bolded.
Source: Own calculations.

Table 4. Granger causality test results

Granger causality: Dumitrescu & Hurlin									
V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
ΔGDP pc->ΔEF									
yes	no	yes	yes	no	no	yes	yes	Yes	no
ΔEF->ΔGDP pc									
no	no	no	no	no	yes	no	no	no	no
ΔHDI ->ΔEF									
yes	no	yes	yes	no	yes	yes	yes	Yes	no
ΔEF-> ΔHDI									
no	yes	no	no	no	no	no	no	no	no

Where: V1 – Economic Freedom Overall score, V2 – Property rights, V3 – Government Integrity, V4 – Tax burden, V5 – Government spendings, V6 – Business freedom, V7 – Monetary freedom, V8 – Trade freedom, V9 – Investment freedom, V10 – Financial freedom.
Source: Own calculations.

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The Granger causality between GDPpc (or HDI) and EF and its components was examined using the Dumitrescu and Hurlin panel causality test. The results, presented in Table 4, univocally confirmed that the direction of causality was from GDP pc (or HDI) to various components of economic freedom. This shows that a specific economic growth and development level needed to be achieved quickly, just when legal and organizational reforms were introduced. In the long horizon, these processes intermingled.

Conversely, the results suggest that changes in business freedom were associated with subsequent changes in GDP per capita and that increases followed improvements in property rights in HDI. These two exceptions support the viewpoint that institutional order is essential for forming growth and development processes.

Discussion and Conclusions

This paper investigates the relationships between economic freedom, growth, and development in Central and Eastern European (CEE) economies between 1996 and 2021.

We formulated one hypothesis and three research questions to guide our inquiry. To address the first research question, we conducted multivariate statistical analyses to identify clusters of similar countries and determine the most influential areas of economic freedom. Additionally, we applied the Granger causality test to examine short-term relationships. Our analysis of economic freedom revealed distinct clusters of countries over the studied period. Estonia stood out as the leader, while the Czech Republic, Latvia, and Lithuania formed a second group. Hungary, Poland, Slovakia, and Slovenia composed a third group, followed by Bulgaria, Croatia, and Romania in the fourth. Among the components of economic freedom, monetary freedom, property rights, and financial freedom emerged as the most influential, while government integrity, tax burden, and government spending were relatively less significant.

The Granger causality analysis between GDP per capita or the Human Development Index (HDI) and economic freedom (EF) components yielded noteworthy results. GDP per capita and HDI generally preceded economic freedom in the short run. However, business freedom was found to precede GDP per capita, and property rights were observed to precede HDI. These findings suggest that while the development of institutions supporting economic freedom evolves alongside economic transformation over the long run, GDP per capita and HDI may lead to regulatory processes in the short term.

Our results resonate with earlier findings by Gurgul and Lach (2011), who also clustered CEE countries into leaders, followers, and others, closely aligning with our four EF-based groups. The Heritage Foundation's classification supports our observation that Estonia is in a league of its own, significantly outperforming other CEE countries in economic freedom. Furthermore, Gurgul and Lach explored the causal relationships between changes in economic freedom and GDP per capita in 2000–2009, highlighting causality from policy changes – such as fiscal and monetary policies, trade openness, and regulatory reforms – to GDP growth. However, their evidence for causality in the opposite direction was weaker than in our findings. These differences may stem from our more extended dataset (1996–2021) and the application of a more recent panel causality test.

In the long run, our findings confirm a robust relationship between economic freedom on the one hand and GDP per capita (as a measure of economic growth) and HDI (as an indicator of socio-economic development) on the other hand. Using the Westerlund test and panel ARDL models, we estimated long-run elasticities of approximately 0.08 for the EF-GDP per capita relationship and 0.02 for the EF-HDI relationship, indicating a more substantial impact of EF on economic growth than socio-economic development. Notably, while all CEE countries adjusted to the long-run equilibrium, Romania was an outlier, likely due to specific initial conditions following the fall of communism, including the absence of an entrepreneurial class, slower reform progress, and significant impacts from the 2008 financial crisis (Daianu and Murgescu, 2013). Romania's lower economic freedom ranking further supports this divergence.

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To address the second research question, we controlled for additional factors influencing growth and development. The panel ARDL models revealed that, in the long run, imports had the most substantial impact on GDP per capita, underscoring the role of technology transfer through fixed capital, FDI, materials, semi-finished products, technology lines, and know-how. In the short run, gross capital formation and the employment-to-population ratio significantly strengthened GDP growth across all models. Asghar et al. (2015) confirmed this relation in Asian countries. Secondary school enrollment, FDI, and unemployment rates also appeared in the short-run equations, reflecting the region's transitional challenges. For HDI, long-term influences mirrored those observed for GDP per capita, while short-term effects emphasized the employment-to-population ratio, secondary school enrollment, and population size.

From a methodological standpoint, the panel ARDL model proved suitable for our relatively large dataset, comprising 11 countries over 26 years, despite its inherent limitations. These limitations, such as data availability, interpolation, and structural breaks, are common in macroeconomic research. Our study accounted for critical assumptions, including cross-sectional correlation within the panel, enhancing the robustness of the results.

Our findings align with broader literature on economic freedom and growth. For instance, Dawson (2003) demonstrated Granger causality from economic freedom to GDP per capita, though components like government size exhibited reverse causality. Similarly, Lawson et al. (2024) found that property rights, sound money, and limited regulation positively influenced growth and income levels, while larger government size and trade protectionism had adverse effects. Erdem and Tugcu (2012) also identified a long-run relationship between economic freedom and GDP in OECD countries, albeit over a shorter timeframe. Our study builds on these findings by focusing on CEE countries' unique historical and institutional contexts.

Finally, we acknowledge several limitations. Data availability posed challenges, with some series requiring interpolation to ensure completeness. This issue refers to comparing two economic freedom indicators, i.e., the Heritage Foundation's EF and Fraser Institute's EFW. Moreover, the economic freedom indicators primarily capture formal institutions, leaving informal institutions and environmental considerations for future exploration. A more detailed analysis of sectoral economic structures across individual countries remains a promising avenue for further research.

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Appendix

Table A1. The results of the Westerlund test for cointegration between GDP pc/HDI and components of the economic freedom – overall indicator

Variable name	V2	V3	V4	V5	V6	V7	V8	V9	V10
GDP pc									
G_t	0.997	0.851	0.607	0.957	0.379	0.001	0.998	0.989	0.230
G_a	0.994	0.989	0.930	0.992	0.833	0.375	0.996	0.994	0.954
P_t	0.873	0.228	0.402	0.809	0.093	0.052	0.713	0.854	0.111
P_a	0.854	0.490	0.647	0.879	0.746	0.238	0.654	0.877	0.421
HDI									
G_t	0.000	0.000	0.000	0.000	0.000	0.000	0.112	0.000	0.000
G_a	0.013	0.042	0.050	0.047	0.608	0.005	0.448	0.578	0.587
P_t	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	0.000
P_a	0.000	0.000	0.000	0.000	0.050	0.001	0.070	0.120	0.075

Note: Significant results at a 0.05 significance level are shown in shadowed cells – all symbols like in Table A1.

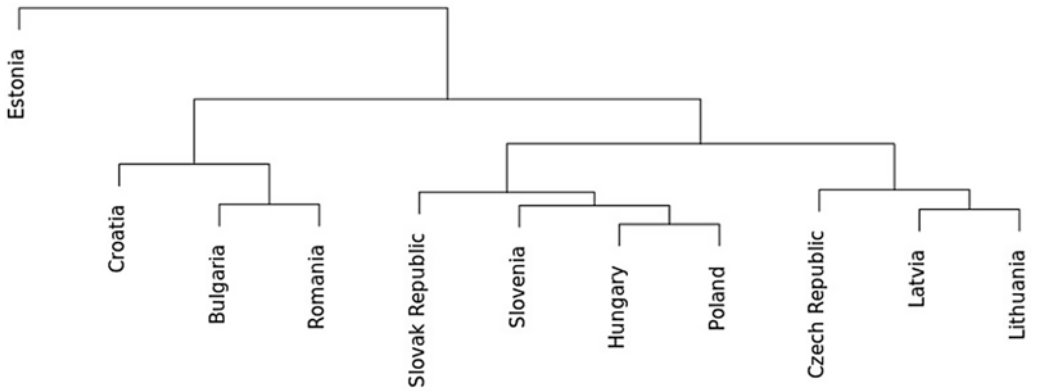

Figure A1. Economic Freedom Overall score – dendrogram.
Source: Based on data from the Heritage Foundation.

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