Hungarian University of Agriculture and Life Sciences

Doctoral School of Economic and Regional Sciences

"THE ROLE OF GDP IN SHAPING SOCIO-ECONOMIC DEVELOPMENT IN EASTERN EUROPE: A COMPARATIVE ANALYSIS"

The Thesis of the PhD Dissertation

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1. BACKGROUND OF THE WORK AND ITS AIMS

One of the important economic indicators across countries is Gross Domestic Product (GDP), which shows the market value of all goods produced in an economy during a specific period, ideally either annually or quarterly. Although this is a number, it tells us of the economic activity and prosperity within many regions in an economy. For example, the GDP accounts for all of a country's goods and services from the manufacturing and service sectors, along with agriculture. It gives a complete view of the economy and what is going on with living standards. GDP is more than just a benchmark; it serves an important role in economic growth measurements and policymaking since the GDP figure can be compared worldwide. This makes it a standard tool for policymakers, economists, and analysts.

A growing GDP usually reflects a healthy economic situation, more jobs, and higher living standards. Conversely, a drop in GDP could mean troubled economic times, including recession, high unemployment, and disheartening consumer confidence in separate sectors. Foreign investors and financial organizations will demand Gross Domestic Product (GDP). This is because high GDP will attract Foreign Direct Investment (FDI), as investors are always looking for established and souring economies. But a contracting GDP may deter investment as it often encapsulates the aggregate economic syndrome of a nation and no less, corporations. The GDP performance is paramount for Eastern European countries like Bulgaria, Czechia, Hungary, North Macedonia, Romania, Serbia, and the Slovak Republic. These nations have undergone a transition from centrally planned economies to market-driven systems. Their robust economic growth, as evidenced by their Gross Domestic Product (GDP), has played a crucial role in attracting Foreign Direct Investment (FDI), promoting closer ties with the European Union, and propelling regional development.

There is a further relationship between GDP and the living standards of an entire country. Higher GDP generally leads to better infrastructure, healthcare, education, and overall lifestyle. This is especially true for Eastern Europe, where GDP grew and life improved significantly since the end of the Cold War. As these nations progress, tracking GDP enables governments to evaluate whether economic advancements produce concrete advantages for their citizens or whether national resources have been limited.

Finally, GDP is more than a number alone. It measures the economy, quality of life, and place on the world stage. East European countries should care about their Gross Domestic Product (GDP) the most as it is essential for FDI, shaping policies, and improving the general welfare of people living there. With these nations' endless growth and connection to the global economy, monitoring GDP will remain a major obligation. The importance of gross domestic product (GDP) can be seen in the light of Eastern European countries. In the last few centuries, economies of National have seen significant ebbs and flows. This change has led to slightly different socioeconomic options being available. But one of the biggest changes has been that GDP in every region is way up. After all, the former was increased and redefined by a tremendous boost to GDP in Eastern Europe, this transformed national policies as well as enhanced socioeconomic progress. It has given policymakers a measurable tool for driving economic stabilization and growth. Also, GDP has exerted considerable influence on higher living standards and provided investment opportunities across many sectors, leading to a better life for the populace.

It is also important to closely analyze the relationship between GDP growth and renewable energy consumption. With rapid economic growth seen in these developing countries, there is an effect on energy consumption patterns, especially the one which caters them to shift towards renewable sources so as to design proper policies targeting specific areas for effective implementation of decentralized energy projects in the future. This, too, is a need for any society that will take him out of the labor market at certain times and when work has low qualifications. Growth in the economy leads to new job creation and higher employment rates. It could possibly boost educational infrastructure and accessibility, leading to an increase in overall levels of education, which are absolutely crucial for any nation.

I have shown that these connections matter, but I need to investigate further their interplay and what this means precisely for countries in Eastern Europe. This underscores the importance of in-depth analysis that identifies these problems and also supplies concrete ideas for policymakers. Policymakers can utilize this research gap to harness their power in designing tools for accelerating GDP growth and fostering full-fledged socio-economic development, thereby ensuring them the perks of economic upsurge.

Using data from seven Eastern European countries, namely Bulgaria, Czechia, Hungary, North Macedonia, Romania, Serbia, and the Slovak Republic, the dissertation assesses how changes in

GDP influence a variety of indicators meant to capture the fragility situation. This dissertation is a well-developed analysis of these countries' economies and social transitions by taking GDP growth as an effect factor. The foremost variables are FDI, health expenditure, renewable energy utilization, employment status, and literacy rate. Furthermore, the outcomes are expected to yield valuable perspectives for policymakers who want to design interventions that foster sustainable economic growth and improve national welfare.

To address GDP-related policies to facilitate sustainable social-economic development specific economic contexts of Eastern Europe need to be considered and analyzed in more detail. It is the main concern of this study. Human capital development remains different among Eastern European countries. A higher quality workforce through education and skill enhancement will increase countries' productivity, which in turn must lead to economic advancement. The economic profiles in Eastern Europe are varied, there is real potential spawning rapidly for them as a market rich with talent and technology. Nurturing innovation can stimulate growth in GDP by generating new high-value industries and promoting greater economic competitiveness on the world stage. The Eastern European countries remain dependent on specific sectors, called locked-in industries like manufacturing, agriculture, import, export, etc., which cause these derivatives to suffer more heavily than other more developed Western economies. Decreasing reliance on a few industries and fostering new growth areas like renewable energy, IT services, and organic farming. Our findings will also help new industries with grants, funding, and infrastructure projects to encourage entrepreneurship and stimulate SME growth, leading to a GDP increase.

To investigate this influence of GDP, we collected secondary data on relevant variables from the World Bank. Then, we filtered out the data from seven Eastern European countries that we had chosen from 2010 to 2019. Then, we have to make sure that the data is stationary. If the data isn’t stationary then we have to take necessary precautions like taking differencing or log differencing. Then we need to use the unit root test to confirm stationarity. After that, we need to confirm cointegration since they are panel variables. We have considered the Pedroni test and the Kao test for the panel cointegration test. We will also check robustness using the latest Method of Moment Quantile Regression (MMQR). Lastly, I will use the OLS regression method to counter and test my hypotheses. By this, we can determine the significant influence of GDP over our selected variables.

2. MATERIALS AND METHODS

2.1 Data Source

This study uses panel data from the World Bank, including data from seven Eastern European countries dating from 2010 to 2019. We extracted GDP growth (annual %) for the GDP variable, Foreign direct investment, net inflows (% of GDP) for the FDI variable, Domestic general government health expenditure per capita (current US$) for the DGH variable, Renewable energy consumption (% of total final energy consumption) for the REC variable, Employment to population ratio, 15+, total (%) (modelled ILO estimate) for the EMP variable, Educational attainment, at least completed lower secondary, population 25+, total (%) (cumulative) for the EAS variable from the world development indicator section for each country and a panel was developed to indicate the countries that are utilized. Table 7 provides details regarding the variables that were implemented.

Table1: Descriptions of the variables

Variable	Description	Type
GDP	Per capita GDP (current US$)	Dependent
FDI	Foreign direct investment	Independent
DGH	Domestic general health expenditure	Independent
REC	Renewable energy consumption	Independent
EMP	Employment to population ratio	Independent
EAS	Educational attainment at least lower secondary	Independent

The GDP growth rate is the annual percentage increase in a country's economic output. It is the primary indicator of financial health and vitality. This variable was chosen because it significantly impacts domestic and international investment decisions. GDP growth is widely acknowledged as a critical driver of foreign direct investment (FDI), as higher growth rates usually indicate a favorable investment environment that attracts foreign capital. This makes the variable the foundation of the study. Hence, it directly affects a country's economic performance.

Foreign Direct Investment (FDI) is an important indicator as it shows how much financial investment is directed from the home country concerning its Gross Domestic Product (GDP). The

investment data is then expressed as a ratio normalized by GDP, such as FDI: GDP (Foreign Direct Investment units to Gross Domestic Product) studied perspectives. It makes the investment environment comparable across countries and is consistent with the scale of the economy. Foreign Direct Investment (FDI) is crucial as it expounds on international investments according to domestic economic conditions, such as GDP growth.

Health expenditures are critical to a country's human capital development and are closely linked to economic productivity and growth. By selecting this variable, the study acknowledges the importance of government investment in health as a determinant of long-term economic stability and growth. Higher health expenditures can enhance labor productivity, reduce economic vulnerabilities, and create a more conducive environment for sustained GDP growth.

Including renewable energy consumption as a variable signifies the growing importance of sustainable energy practices in contemporary economies. This variable was chosen to measure the degree to which a country is shifting towards renewable energy, which has consequences for long-term economic viability and expansion. The transition to renewable energy is frequently linked with innovation, enhanced energy security, and decreased environmental hazards, all of which can favor GDP development and attract foreign direct investment (FDI). So, it has shown an interchangeable impact.

Human capital assets are vital to economic development and growth, impossible without education. To gauge the educational achievement of a region's workforce, this study looks at what share of its population ages 25 and over has completed at least lower secondary education. Education is associated with higher productivity, innovation, and economic diversity, which boost the Gross Domestic Product (GDP) growth rate and hence affect foreign direct investment (FDI).

Table 1 shows comprehensive information about the variables and their respective data-driven outlines. They offer a well-organized and easily understandable summary of the aspects addressed in this analysis. By combining these variables, the analysis seeks a wider understanding of the relationship between GDP growth and other critical economic indicators. Ultimately, it hopes to provide significant insights into the elements contributing to economic success in Eastern European countries.

Figure 1 (A)

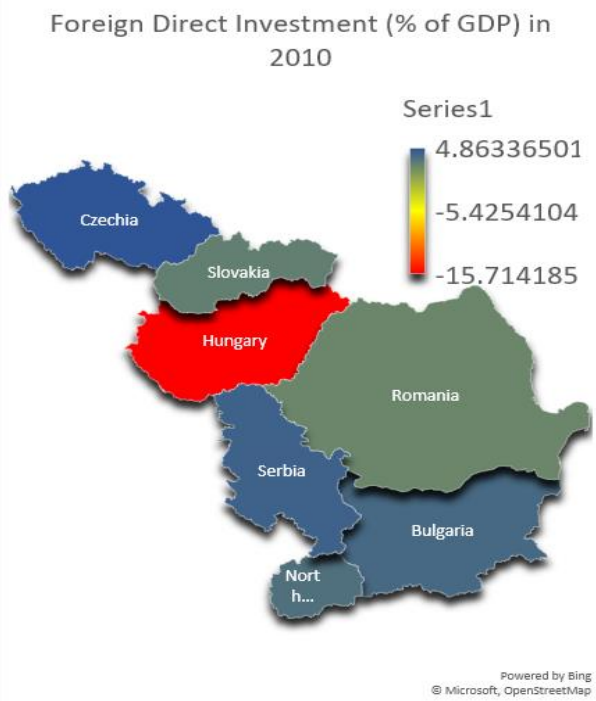
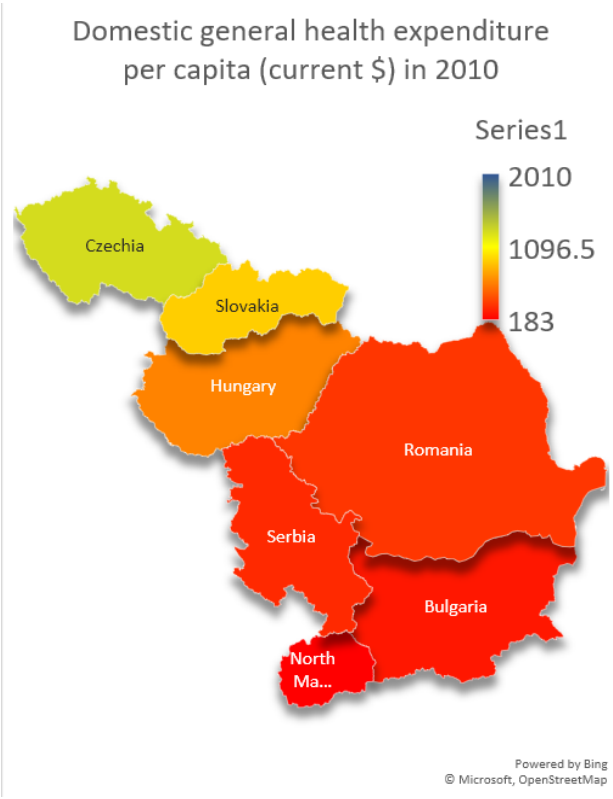


Figure 1 (B)



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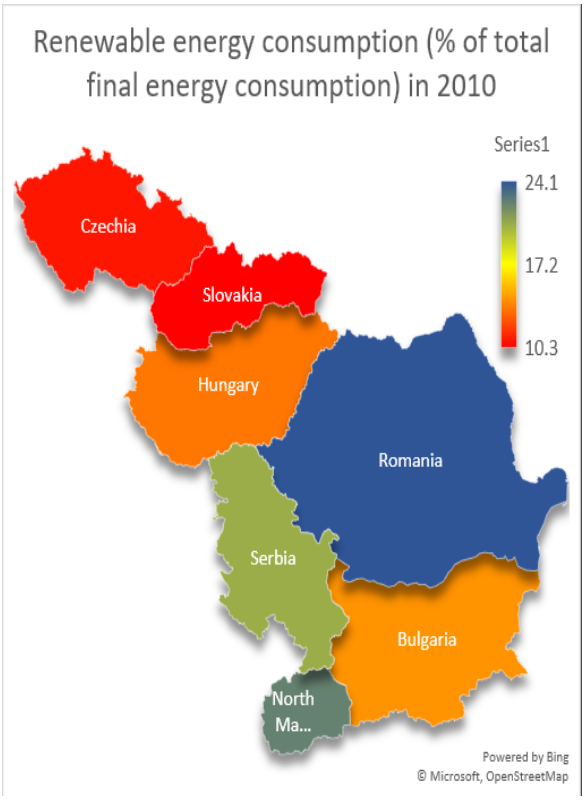

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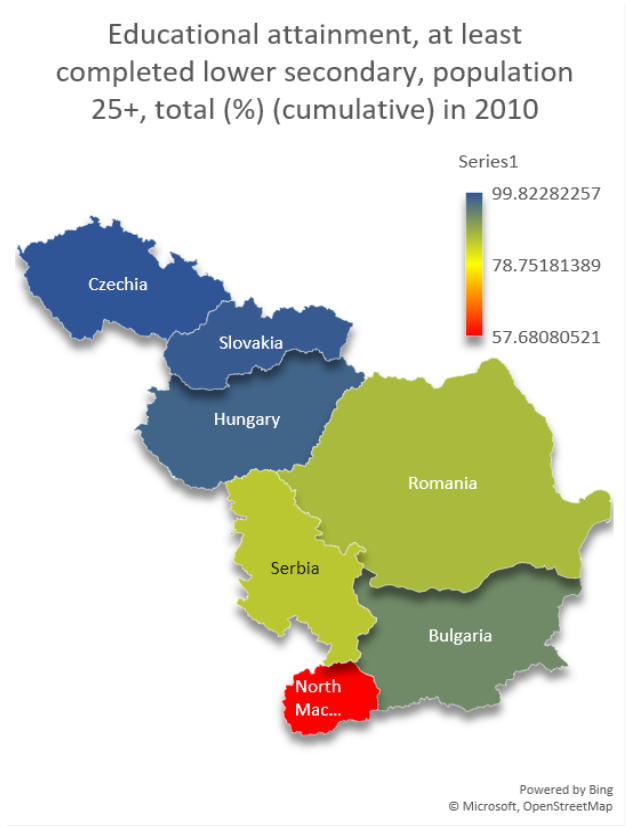

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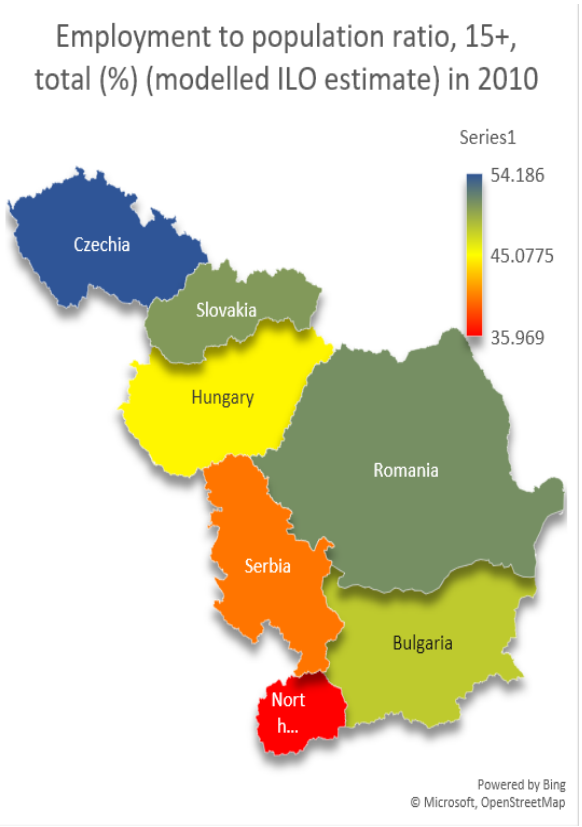

Figure 1 (F)

Figure 1: A) GDP Growth, B) Foreign Direct Investment, C) Domestic general health expenditure, D) Renewable energy consumption, E) Educational attainment, F) Employment Ratio of seven Eastern European countries in 2010.

A demographic map was also generated based on data obtained from the World Bank. The graphic illustrates notable disparities in multiple characteristics among the seven countries. We will observe substantial variations among the countries as we collect data from 2010 to 2019.

2.2 Panel Analysis Technique

These data are panel data in nature and provide units over time. The advantage of panel data is the larger number of countries in the sample, multiple observations on each country, and the inclusion of a fixed effect to provide additional control for other time-specific country-level factors or assume a common relationship across all countries (Glied and Smith, 2013).

In addition, panel data considers any unobserved differences and consists of an assessment of diverse causal effects (Chen, Clarke, and Roy, 2014). Several empirical studies have been conducted to study the long-term cointegration connection between health expenditure, educational attainment, and GDP, employing diverse statistical assumptions and approaches (Hall, Swamy, and Tavlas, 2012; Tamakoshi and Hamori, 2016). The following model has been developed to examine the Foreign direct investments, Domestic general health expenditure, Renewable energy consumption, Employment to population ratio, and educational attainment of GDP influence:

$$GDP = f(FDI, DGH, REC, EMP, EAS) \quad (1)$$

To assess the relationship between GDP and the variables mentioned earlier, unit root, cointegration, and method of moment quantile regression tests were employed.

2.3 Unit root test

The cross-sectional augmented IPS (CIPS) unit root test, which Pesaran (2007) introduced, is useful for dynamic panels with serial correlation and cross-sectional dependence along with Im–Pesaran–Shin (IPS) (Im, Pesaran and Shin, 2003) unit root tests. Unlike other tests that fail to recognize cross-section dependence, the CIPS unit root test yields reliable conclusions (Baltagi and Moscone, 2010). To ascertain stationarity, which refers to the property of selected variables remaining constant throughout time, it is necessary to investigate the presence or absence of a unit root in the given panel data.

Table 2: CIPS, CADF unit root test result

Panel unit root test: Summary		
Null Hypothesis: Unit root (individual unit root process)		
Test	Statistic	Prob.
Levin, Lin & Chu t*	-10.0153	0
ADF - Fisher Chi-square	48.9027	0
Im, Pesaran and Shin W-stat	-4.37240	0
ADF - Choi Z-stat	-4.68096	0

The result of the unit root test provided the p-values of the given test, i.e., Levin, Lin & Chu t, ADF—Fisher Chi-square, ADF—Fisher Chi-square, are all results of zero-determining stationarity. The presence of unit roots can exploit many statistical analyses. Checking for unit roots before conducting a cointegration test is important when dealing with panel data. Many econometric models, such as Ordinary Least Squares (OLS), assume that the time series data are stationary.

Therefore, panel data analysis combines the implementation of both CIPS and IPS tests simultaneously with understanding multiple testing methodologies, providing a comprehensive empirical research methodology using rich datasets to discriminate financial innovations better. Methodological triangulation is a widely utilized strategy and serves several important functions in econometric analysis.

Furthermore, this multi-test technique allows a detailed evaluation of the results' sensitivity to different model specifications and underlying assumptions. The CIPS test explicitly considers cross-sectional dependence, although the IPS test provides other methods for addressing this problem when used with the demean option. By comparing outcomes from these tests, researchers can assess the influence of cross-sectional dependence on their findings and the reliability of their conclusions under various modeling assumptions.

Moreover, this all-encompassing methodology is especially beneficial in practical econometric studies, where the intricacy of real-life occurrences frequently conceals the underlying mechanism

that produces the data. Economic and financial time series sometimes display traits that depart from statistical assumptions, such as non-normality, heteroscedasticity, or complicated forms of cross-sectional and temporal dependency. When dealing with these situations, depending solely on one testing method can result in accurate conclusions or more complex explanations of the findings.

2.4 Panel Cointegration Test

Pedroni (2001) introduced seven test statistics which has been used to test the null hypothesis of finding cointegration in nonstationary panels. The seven Pedroni tests can be classified into two different main groups: four-panel statistics and three-group statistics. The panel statistics are calculated by aggregating the residuals within each dimension of the panel, whereas the group statistics are obtained by aggregating across the dimensions. This dual methodology offers researchers a comprehensive and detailed understanding of the cointegration linkages present in the panel. In addition to these tests, we have also performed the Kao (1999) test, specifically designed to analyze cointegration in panel data. The Kao test provides an alternative viewpoint on panel cointegration, though it is less adaptable regarding heterogeneity assumptions. These eight tests, consisting of seven Pedroni tests and one Kao test, comprehensively analyze potential cointegrating correlations in panel data.

To mitigate this uncertainty, researchers often have to rely on additional testing methodologies. The best tool in this case is the Kao Residual Cointegration Test. It was devised by Kao and Chen (1995b) based on a wider range of assumptions under which it is considered to be valid compared with the Pedroni tests. The Kao residual cointegration test assumes that the cointegrating vectors are identical across panel units, which can have some appealing features, especially in applied empirical work.

The Kao test depends on the Engle-Granger two-step process for time series data, which has been extended to estimate panel cointegration. Another approach uses residuals. This procedure involves estimating the presumed cointegrating relationship and testing whether my residuals display stationarity. The test statistic follows a normal distribution asymptotically under the null hypothesis of no cointegration.

However, bivalent results can rarely be obtained using these tests; e.g., in the symmetric conclusion reported here, four p-values are below 05 and four over 05. The difference in results makes it problematic to grasp and underscores the complexity of panel cointegration analysis. Importantly, these results highlight the importance of different test methodologies and that variation in test requirements may affect the sensitivity of findings.

Table 3: Kao Residual Cointegration Test

Pedroni Residual Cointegration Test				
Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-1.58903	0.944	-2.42788	0.9924
Panel rho-Statistic	2.880148	0.998	2.727772	0.9968
Panel PP-Statistic	-7.70893	0	-8.79712	0
Panel ADF-Statistic	-2.45327	0.0071	-2.94823	0.0016

The findings of my cointegration study, as displayed in Table 3, provide detailed insights into the nature of the interactions among the variables. The modified Phillips-Perron t-statistic is particularly noteworthy since it offers robust and reliable evidence supporting the presence of cointegration. This revised metric, designed to overcome specific constraints of the conventional Phillips-Perron test, provides improved dependability in panel data analysis, especially when confronted with possible interdependence and variability within panels.

Table 4: Panel Cointegration Test using Pedroni test.

	t-Statistic	Prob.
ADF	-2.88365	0.002
Residual variance	5.192757	
HAC variance	4.089919	

Expanding on this basis, I develop an alternative hypothesis to question the null hypothesis of no cointegration. My alternate hypothesis suggests a consistent and long-lasting connection between the variables based on the cointegration of all panels in the dataset. This hypothesis is based on

economic theory, which indicates the possibility of stable correlations among the variables being studied in the long term.

To thoroughly investigate the possible existence of cross-sectional dependence among the variables in our dataset, which has panel variables. I also utilize the Augmented Dickey-Fuller (ADF) test. Conducting this initial stage is very important in panel data analysis since the existence of cross-sectional dependence can significantly impact the accuracy of later econometric estimations and inferences.

Table 5: ADF test for cointegration

Ho: No cointegration Ha: All panels are cointegrated.		
	Statistic	p-value
Modified Phillips-Perron t	4.1382	0
Phillips-Perron t	-5.9667	0
Augmented Dickey-Fuller t	-5.1626	0

In contrast to this new statistic, the standard Phillips-Perron t-statistic and ADF-t-statistics indicate statistically significant support for cointegration. The robust consistency in these test data, taken from such different testing environments, suggests good reliability of our observations.

It is essential to mention that these tests run based on slightly distinct assumptions and procedures, which adds to the strength of their collective agreement. Both the Phillips-Perron test and the enhanced Dickey-Fuller test confirm the presence of cointegrating relationships by providing a minimal p-value of less than 0.05. The Phillips-Perron test uses a non-parametric method to adjust for serial correlation. In contrast, the Augmented Dickey-Fuller test considers higher-order autoregressive processes parametrically. The consistency observed across different approaches enhances our trust in the validity of the outcomes.

When analyzing these results, it is crucial to consider their economic ramifications. Cointegration indicates that although the individual variables may display non-stationary behavior independently, there is a stationary linear combination of these variables. This statistical quality is

frequently regarded as indicative of a stable and balanced relationship over a long period between the variables. This concept holds great importance in economic theory and policy analysis.

2.5 Method of moments quantile regression outcomes

This dissertation employed the Method of Moments Quantile Regression (MMQR) (Machado and Santos Silva, 2019). This analysis of the approach is a more recent method compared to older techniques, such as Quartile regression, and it involves the application of several types of OLS.

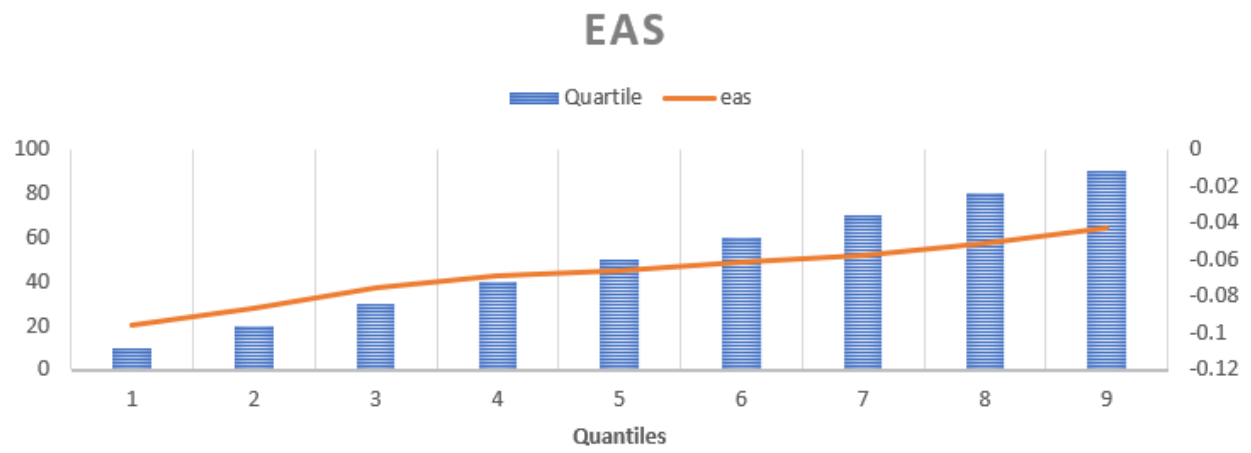

Figure 2: Graphical outcomes of MMQR

The primary identification of this is the Method of Moment Quantile Regression, which seeks to estimate either conditional median or other quantiles of response variables conditioned on some levels of exogenous variable. By contrast, regular least-squares regressions provide estimates of the conditional mean of the endogenous variable based on specific values of the exogenous variables. Quantile regressions are less sensitive to the presence of outliers during the estimate process. Furthermore, this is particularly relevant when the correlation between the average values of two variables is weak or absent (Binder and Coad, 2011).

2.6 OLS Regression Outcomes

One popular is the Ordinary Least Square (OLS) regression, a technique used to model the relationship between dependent and independent variables. It is one of the most common types of linear regression in practice and has comprehensive applications in economics, social sciences, and natural sciences.

Table 7: Summary of OLS Regression

Dep. Variable:	GDP	R-squared:	0.177
Model:	OLS	Adj. R-squared:	0.113
Method:	Least Squares	F-statistic:	2.75
No. Observations:	70	Prob (F-statistic):	0.0259

OLS regression has a major advantage in this: the model is simple and easy to interpret. The regression coefficients are much easier to interpret: they represent the anticipated change in the dependent variable for a one-unit increase in their corresponding independent variable. The R-squared statistic also helps determine how good of a quantitative representation the model is as a percentage.

A key assumption that I expounded on above is the Homoscedasticity of error terms, and OLS regression is most robust under this measure. When the underlying assumptions of linearity, homoscedasticity, normality, and independence of errors are not violated, OLS regression provides unbiased estimates for the regression coefficients. This level of flexibility makes OLS an appealing option for many modeling situations.

Although OLS regression is not completely free from shortcomings, it is, unfortunately, rather sensitive to multicollinearity. This arises from independent variables being highly correlated with each other, and exactly what we would then gather can produce unstable and unreliable coefficient estimates. Also, OLS regression assumes that the dependent variable is linearly related to the independent variables, which may not always be true for real-world scenarios.

Table 8: Outcome of OLS Regression

	Co-efficient	Standard Error	T statistic	P-value	Hypothesis	Path
const	-2.8538	2.993	0.953	0.344		
FDI	-0.007	0.021	0.337	0.737	H1	FDI → GDP
DGH	-0.0018	0.001	1.558	0.124	H2	DGH→ GDP
REC	-0.0636	0.085	0.748	0.457	H3	REC → GDP
EMP	0.2793	0.078	3.576	0.001	H4	EMP → GDP
EAS	-0.0673	0.032	-2.1	0.04	H5	EAS → GDP

Hypothesis H1 indicates that FDI has a positive influence on GDP (T = 0.337, p-value = 0.737). Thus, H1 is statistically not significant.

Hypothesis H2 indicates that DGH has a positive influence on GDP (T = 1.558, p-value = 0.124). Thus, H2 is statistically not significant.

Hypothesis H3 indicates that REC has a positive influence on GDP (T = 0.748, p-value = 0.457). Thus, H3 is statistically not significant.

Hypothesis H4 indicates that EMP has a positive influence on GDP (T = 3.576, p-value = 0.001). Thus, H4 is statistically significant.

Hypothesis H5 indicates that EAS has a positive influence on GDP (T = - 2.1, p-value = 0.04). Thus, H5 is statistically significant.

3. RESULTS AND DISCUSSION

3.1 Results interpretation

In many cases, panel data analysis is vulnerable to heterogeneity and cross-sectional dependence, resulting in inaccurate findings (McCoskey and Selden, 1998; Gengenbach *et al*., 2006). Nonetheless, most prior research did not consider these factors. Hence, this study employed suitable estimate methods to mitigate cross-section dependence and unobserved heterogeneity, yielding reliable findings about the correlation between various factors and GDP.

Table 2 presents the findings of second-generation panel unit root tests, specifically the cross-sectionally augmented IPS (CIPS) test proposed by Pesaran (2007) and the cross-sectionally augmented Dickey-Fuller (CADF) test. The Levin, Lin, and Chu t statistic produced a result of -10.0153, accompanied by a p-value of 0. This analysis provides significant evidence against the null hypothesis of a unit root, suggesting that the panel data series are stationary under the assumption of a common unit root process throughout the cross-sections. The CIPS result shows a statistic of -4.37240, with a p-value of 0. The ADF - Fisher Chi-square test also yielded a statistic of 48.9027 and a p-value of 0. Similar to the other tests, this outcome refutes the null hypothesis of a unit root, suggesting that the panel data series exhibits stationarity.

The Pedroni Residual Cointegration Test result, shown in Table 3, thoroughly analyses the possible cointegration relationships in a panel data set. The alternate hypothesis of this test suggests that there are common autoregressive coefficients (AR coefficients) among the different dimensions of the panel. It indicates a situation in which there may be long-term equilibrium relationships among the variables in the panel, even if they differ in the short term. The Pedroni Residual Cointegration test provides four statistics, their corresponding p-values, and an additional set of four weighted statistics and their respective p-values. The Panel v-Statistic is reported as -1.58903 with a probability value (Prob.) of 0.944 for the unweighted statistic and -2.42788 with a probability value of 0.9924 for the weighted statistic. The findings suggest that the null hypothesis of no cointegration for the panel variables cannot be rejected based on the v-statistic criterion. The Panel rho-Statistic follows the same principle. The unweighted statistic is presented with a value of 2.880148, with a probability of 0.998.

On the other hand, the weighted statistic has a value of 2.727772, with a probability of 0.9968. The rho-statistic values, like the v-statistic, indicate a significant inclination to support the null hypothesis without cointegration. The Panel ADF-Statistic provides more evidence of cointegration, as indicated by the values of -2.45327 (Prob. 0.0071) and -2.94823 (Prob. 0.0016) for the unweighted and weighted statistics, respectively. The presence of negative and low probability values indicates a rejection of the null hypothesis, therefore implying the existence of cointegration. The Panel PP-Statistic presents a contrasting perspective to the previous statistics, displaying values of -7.70893 (Prob. 0) and -8.79712 (Prob. 0) for the unweighted and weighted statistics. These substantial negative values and their corresponding probability values of zero provide a strong argument against the null hypothesis that there is no cointegration. Hence, the PP-statistic presents compelling evidence of cointegration among the panel variables.

In general, the Pedroni Residual Cointegration Test provides us with inconclusive findings. Although the v-statistic and rho-statistic do not offer evidence of cointegration, the PP-statistic and ADF-statistic strongly suggest the existence of cointegration relationships in the panel data. This distinction implies that the proof of cointegration is more robust according to specific statistical criteria, emphasizing the significance of examining numerous statistics in panel cointegration testing. To provide a more comprehensive answer, the outcome of the Kao Residual Cointegration Test can be found in Table 3. In contrast to the Pedroni test, the Kao test specifically examines residuals derived from estimated long-run relationships. The ADF t-statistic is reported as -2.88365, with a probability value of 0.002. This highly negative result signifies a robust rejection of the null hypothesis that no cointegration exists. The low probability value provides additional evidence for cointegration, indicating that the panel variables have a shared long-term equilibrium relationship. The residual variance is reported as 5.192757, while the heteroskedasticity and autocorrelation-consistent (HAC) variance is calculated as 4.089919. These values offer supplementary details regarding the residuals' dispersion and the cointegration relationship's long-term sustainability. Compared to the residual variance, the reduced HAC variance suggests that incorporating adjustments for heteroskedasticity and autocorrelation results in a more reliable assessment of the variance. In sum, the Kao Residual Cointegration Test provides robust evidence of strong cointegration in panel data (as supported by the Pedroni test). The results of ADF t-statistic and variance measures indicate that the panel variables are cointegrated. It suggests that there are stable long-term correlations between the variables, even though there may be

fluctuations in the short term. Based on the findings of both the Pedroni and Kao Residual Cointegration Tests, there is strong evidence of cointegration among the panel variables.

An Augmented Dickey-Fuller (ADF) test was also carried out to confirm the variables were co-integrated, further which was used as well. Table 6 provides the last evidence of cointegration. The cointegration test was performed using the Augmented Dickey-Fuller (ADF) test, in addition to the Modified Phillips-Perron (PP) and Phillips-Perron (PP) tests, to assure reliable and robust outcomes. The null hypothesis (Ho) claims no cointegration among the panel variables, while the alternative hypothesis (Ha) proposes that all panels are cointegrated. The Modified Phillips-Perron t-test statistic of 4.1382 shows a p-value of 0 that corresponds to the rejection of the null hypothesis as it suggests evidence against the unit root cause and concludes in favor of stationarity (regression). This provides substantial evidence that the null hypothesis of no cointegration in panels can be rejected. Furthermore, the Phillips-Perron t-test reports a test statistic of -5.9667 and a 0 p-value, confirming further evidence against this null hypothesis. This also confirms that the panel variables are cointegrated. Furthermore, the ADF test `statistic of -5.1626, coupled with a p-value of 0, provides strong evidence to support the rejection of the null hypothesis of no cointegration. The negative ADF test statistic indicates a consistent long-term association between the panel variables.

Again, the multiple quantile regression (MMQR) analysis provides an insightful look into the effects of various independent variables on the influence of GDP across several different quantiles (0.1–0.9). Table 6 and Figure 2 help us understand how these relationships may vary as we move across the distribution of influence of GDP. From Table 6, The coefficients for FDI show an increasing trend with GDP across different quantiles (0.1–0.9). Hence, it is certain that Foreign Direct Investment directly affects the countries' GDP. Moreover, the effect of Domestic general health expenditure (DGH) on GDP is positive across all quantiles (0.1–0.9), as shown in Table 6 and Figure 2, with an uplifting positive trend as we move into the higher quantiles. It indicates that municipal waste generation can actively affect the influence of GDP we are concerned about. However, the Employment ratio (EMP) has shown a negative trend in countries' GDPs, which indicates that the Employment of the population is unrelated to the countries' GDPs. Surely, it requires skill to be employed. Nevertheless, GDP growth can create more job opportunities for the

people. Lastly, Educational attainment (EAS) indicates a positive trend in Table 6 and Figure 2 coefficients across different quantiles (0.1–0.9).

Finally, Table 7 represents the summary of the OLS result. I can say that the R-squared is 0.177, meaning that with these independent variables, I can collectively account for an estimated 17.7% of the variance in GDP. This does indicate some explanatory power, but the low value indicates that a substantial portion of GDP variance is affected by other factors not included in this model. The F-stat of 2.750 with p=0.0259 suggests that the model is significant at 5%, i.e., collectively, all independent variables are good enough to predict GDP, say it has shown a relation. Table 8 represents that the p-value of FDI, DGH, REC, and EAS is greater than 0.05, suggesting rejecting the null hypothesis. It indicates that they have a positive effect on GDP. The coefficient of the EMP is 0.2793, which has a positive sign, and a P value less than 0.01 indicates that this variable is also significant at level p<1%. The p-value suggests that employment rates do not affect GDP per capita. EAS has a coefficient of -0.0673 and p-value = 0.040, suggesting that higher educational attainment (at least lower secondary) is related to a lower GDP per capita in this dataset. Perhaps it can be said that it doesn't affect GDP at all.

3.2 Discussion

Based on the thorough analysis given above, some factors can influence GDP. Many studies (Tai, Chao and Hu, 2015; Vu, 2019; Jakovljevic, Timofeyev, *et al.*, 2020) have previously forecast the existence or upcoming possible factors that affect a nation's economic growth. Tai, Chao and Hu, (2015); Jakovljevic, Timofeyev, *et al.*, (2020) have also mentioned that health issues can play an important role in influencing GDP. According to Islam (2015), allocating more funds to healthcare can cause social safety, security, and tranquility growth, which will also impact employment. That is why I included the hypothesis based on health expenditure. The concept of foreign investment is ancient. Over the years, the concept has evolved and contributed to many sectors worldwide. Consistent evolution has increased upper and middle-class citizens' market size and human capital (Lederman *et al.*, 2013; Cleeve *et al.*, 2015). Hence, it is crucial to analyze the influence of foreign direct investment on GDP. I have selected our first and foremost hypothesis based on this concept. As mentioned earlier, my first hypothesis is:

H1: Gross Domestic Product (GDP) is influenced by Foreign Direct Investment (FDI)

The core analysis of this hypothesis, which is the OLS regression's outcome, supported this claim. The resulting p-value of this hypothesis is 0.737, which indicates the acceptance of our selected null hypothesis. The robustness of this claim, which I analyzed using MMQR, also supports this claim. The same happens for our second variable chosen, Domestic General Government Health Expenditure (DGH), where my null hypothesis says:

H2: Gross Domestic Product (GDP) is influenced by Domestic general health expenditure (DGH)

I got my result of a p-value of 0.124, which indicates the acceptance of the selected null hypothesis. More budget should be allocated to this sector to increase public health security as it is increasing substantially, raising concerns with GDP (Mladenović *et al.*, 2016).

Enormous studies (Stern, 2011; Inglesi-Lotz and Dogan, 2018; Vasylieva *et al.*, 2019; Chica-Olmo, Salaheddine and Moya-Fernández, 2020; Emirmahmutoglu *et al.,* 2021) have assumed and proven the relationship between GDP and renewable energy. The whole economy stands on energy. However, not all the energy sources are renewable. Non-renewable energy sources are gradually decreasing and often harming the environment. Nevertheless, renewable energy has a more sustainable future and is accessible to all. Anyone can produce renewable energy and consume it with the right equipment. This advantage has a significant impact on GDP and the overall expenditure of a nation. It is also seen in my analysis too. The resulting p-value of our core analysis, OLS, is 0.457, supporting the selected null hypothesis:

H3: Gross Domestic Product (GDP) is influenced by Renewable Energy Consumption (REC)

The resulting p-value has declared there exists an influence as accepting the null hypothesis. Further robustness analysis (MMQR) also supports this claim in different quantiles.

The relationship between employment and GDP is a noticeable attraction. However, human and natural disasters have always occurred, so this relationship is inconsistent. Klinger and Weber (2020) mentioned the linkage between employment and GDP during and after the German Great Recession. They noted that during the Great Recession, the productivity rate dropped and hardly

recovered during these years. However, it is noticeable that despite the tight GDP, employment kept on rising. So, there is no relationship between these two variables. If there, it would be very weak. Gallipoli and Makridis (2022) draw attention to the COVID-19 scenario. They used employment and GDP-related public data of Canada, but they found less extreme GDP responses towards unemployment. They also forecast a shrink in the GDP budget. But this shrink will not affect employment. The layoffs will be controlled totally by the government or private firms not to be affected by GDP. The same scenario has been witnessed in our data, too. The data was taken before COVID-19 and during the Great German Recession, but the relationship between GDP and employment does not exist. Results from Table 22 also support this statement. We see the resulting p-value of OLS regression for EMP (employment ratio) is 0.001, which is greater than the 5% level of significance, indicating the rejection of my selected fourth null hypothesis, which is:

H4: Gross Domestic Product (GDP) is influenced by Employment to population ratio (EMP)

These led me to conclude that employment does not influence GDP growth (Brancaccio *et al.*, 2018). While examining the relationship between educational attainment and various factors, Kirkcaldy, Furnham, and Siefen (2004) found that GDP is weakly related to educational performance. However, they found a relationship between happiness and health-related variables. Again, Makkonen and Inkinen (2013) examine the relationship between educational attainment and economic development among the countries of the European Union. However, they found conflicted results about educational attainment, innovative capacity, and economic growth. They found that increased educational attainment leads to increased innovative capacity and economic development, but the results are bidirectional and conflicted with various variations of degrees. This type of relation highly occurs with the most innovative countries and regions but not too much witnessed in lower innovative countries. So, I can say that some conditions need to relate GDP with educational attainment. I have selected my last hypothesis as:

H5: Gross Domestic Product (GDP) is influenced by Educational Attainment at least lower secondary (EAS)

However, the resulting p-value of my OLS analysis rejects this hypothesis. The OLS result was 0.04, which is less than the threshold value for acceptance. So, a relationship between GDP and educational attainment does not exist.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Our overview of trends in seven Eastern European countries, calculated as part of their Gross Domestic Product growth and the influence they have, leads to a complicated image that goes far beyond the economic domain. While the gross domestic product (GDP) is still an overall measure of economic performance, this broad study reveals that its impact stretches to employment, education levels achieved by children's parents, international direct investment, and health spending use; it also incorporates renewable energy utilized.

The Czech Republic and Hungary witness the highest GDP growth. These countries also exhibit favorable patterns in employment and investments in renewable energy production. Given this association, economic stability is essential in supporting sustainable development. The growth you see here proves the trickle-down economics that can occur when economies are doing well, especially regarding job markets and green energy initiatives.

In Romania and North Macedonia highlight the difficulties encountered by transforming economies. These countries' GDP growth variations highlight the complex dynamics of economic advancement and the importance of successfully employing focused tactics to navigate the transitional stages. The findings indicate that although GDP growth can catalyze developments in various socio-economic sectors, policymakers must adopt holistic methods that consider the wider consequences of economic development.

However, in order to ensure continued progress and improve the quality of life for their citizens, Eastern European governments should be instructed to maximize their economic potential by creating a conducive & sustainable environment. It is necessary to formulate policies that stimulate financial expansion and guarantee that the potential advantages are divided fairly. These countries can establish a robust structure capable of supporting continual improvement in both the economic and social domains if they take this course of action.

4.2 Recommendations

This dissertation shows the impact of factors such as Foreign Direct Investment (FDI), Domestic General Government Health Expenditure (DGH), Renewable Energy Consumption (REC), Employment to Population Ratio (EMP), and Educational Attainment (EAS) on GDP growth. This has essential practical implications for Eastern European countries' policymakers, economists, and regional development agencies. Gaining insight into the relationship between these characteristics and GDP growth lays the groundwork for devising specific policies to uphold financial development and improve overall welfare in these countries.

The research underlines the importance of a favorable FDI environment as it is discovered that there exists a significant correlation between GDP growth and FDI. Policymakers working to boost foreign direct investment (FDI) inflow in Eastern Europe can capitalize on this understanding. Among the measures that might find their way to a list of investor-friendly policies are those intended to reduce red tape for company operations, provide tax holidays, and offer stable political-economic environments. It illustrates how the homogeneity of DGH emphasizes the critical importance of sufficient public health spending in producing an efficient workforce. While improved allocation of resources in the health sector can lead to better health outcomes and fewer absences, lower labor productivity growth may occur through reduced worker/working hours due to illness or premature death, which encourages economic development.

The integration of REC as a variable reflects the potential of renewable energy consumption to drive economic growth on a sustainable basis. Eastern European nations, several of which are shifting away from conventional energy sources, can use these discoveries to justify augmenting their investments in renewable energy infrastructure. This transition decreases reliance on imported non-renewable energy sources. It establishes these nations as pioneers in sustainable progress, drawing in environmentally friendly investments and generating employment opportunities in the growing renewable energy industry.

The positive influence of EAS on GDP expansion indicates that endeavors to enhance educational achievement are crucial for economic advancement. Policymakers should prioritize job creation measures, explicitly target the working-age population, and allocate resources towards enhancing education systems to guarantee that individuals obtain the necessary expertise. In addition, improving vocational training and providing lifelong learning opportunities can contribute to

sustaining high levels of employment and enabling the workforce to respond to the evolving needs of the economy effectively.

The research upholds that regional cooperation pays off based on collective characteristics: all Eastern European countries have similar economic structures and developmental problems. Together, these nations could be more economically resilient and robust, sharing strategies that work for obtaining foreign direct investment (FDI), encouraging renewable energy generation, or improving public health and education. Properly functioning regional groupings and alliances can signify encouragement and facilitation of cooperation, thus paving the way for better health and effective economic development.

Finally, this researc's findings might serve as a foundation for prolonged economic growth in Eastern Europe. By comprehending the primary factors influencing GDP growth, governments may develop strategic plans prioritizing spending in crucial sectors such as healthcare, education, and renewable energy. This planned approach guarantees that economic expansion is solid but equitable and enduring, benefiting all sectors of society.

4.3 Limitations and Future Research

This dissertation has found some exciting results regarding the impact of factors such as war, government size, and FDI on GDP growth in seven East European countries. However, this dissertation should also be taken cautiously when generalizing or policy conclusions. These limitations also provide possibilities for future work to improve and extend the results presented in this thesis.

This dissertation focuses on a distinct group of independent variables: Foreign Direct Investment (FDI), Domestic General Government Health Expenditure (DGH), Renewable Energy Consumption (REC), employment-to-population ratio (EMP), and Educational Attainment (EAS). While they are important for growth, these variables cannot encapsulate the complexity of factors contributing to GDP. Scientific advancements, infrastructure development, political stability, and the quality of institutions can significantly influence financial growth. However, it is crucial to note that these factors should have been considered in the present analysis. Subsequent studies

could integrate these additional factors to offer a more exhaustive comprehension of the factors influencing GDP growth.

The research included only seven Eastern European countries characterized by certain historical, economic, and political factors. Consequently, the conclusions may not be directly relevant to other areas with distinct economic frameworks or levels of advancement. For instance, the influence of foreign direct investment (FDI) or regional economic cooperation (REC) on the growth of gross domestic product (GDP) may vary in emerging markets in Asia or Africa due to substantial differences in economic conditions compared to Eastern Europe. A subsequent study has the potential to broaden the scope of this analysis to encompass additional geographical areas, allowing comparative investigations into the variations in the connections between these factors and the rise of Gross Domestic Product (GDP) in different economic environments.

There is a potential endogeneity issue between this study's dependent and independent variables. FDI is commonly regarded as an independent variable that influences GDP growth. However, it is logical that more excellent GDP growth rates can attract more FDI, resulting in a reciprocal connection. Likewise, improved health outcomes and increased employment rates can be both a contributing factor and a result of economic expansion. While the current study addresses these concerns, future research should utilize more advanced econometric methods. Additionally, it is crucial to consider that this study period may only partially encompass the long-term patterns or the influence of current geopolitical events on the chosen nations' economies. For example, events like the COVID-19 pandemic, the Russia-Ukraine conflict, or changes in the European Union's economic policy could have substantial consequences on GDP growth, FDI, and other factors that may not be accounted for in the present approach. Subsequent investigations could enhance the analysis by using more current data and examining the impact of exceptional occurrences on the examined correlations in this dissertation.

5. NEW SCIENTIFIC RESULTS

This dissertation emphasizes the crucial significance of Gross Domestic Product (GDP), a comprehensive concern of economic performance indicators and its diverse influence on different variables in Eastern European countries. The study examines seven countries, including Bulgaria, Czechia, Hungary, North Macedonia, Romania, Serbia, and the Slovak Republic, that have experienced substantial economic transformations from centrally optimal planned to market-oriented economies.

1. *I have investigated seven Eastern European countries that have not been explored. This study is exclusively based on seven emerging countries. These countries are neither overdeveloped nor underdeveloped, which is perfect for conducting studies. These countries share similar historical backgrounds, such as post-communism, and the same economic structures. These countries also shared a mix of EU and non-EU members. That is why different types of GDP within the same region will give us a comprehensive overview.*

Many studies have accumulated in 161 countries (Rana *et al*., 2020) or 154 countries (Demirgüç-Kunt, Lokshin and Torre, 2024) for their investigation. Concentrating on fewer countries allows for a more comprehensive discussion of each country's development outcomes, institutional structures, and economic policies.

2. *I have used MMQR (method of moment quantile regression) to search for robustness after using OLS regression, which can be the latest touch in research. One of the limitations of OLS regression is that it assumes that errors are normally distributed and that relationships between variables are constant across all levels of the dependent variable. This assumption can be a critical violation of real-world data, mainly when applied in socio-economic studies where outliers and skewed distributions are common.*

A unit root test was conducted to determine stationarity in the selected dataset. The p-values of the given tests, Levin, Lin & Chu t, ADF—Fisher Chi-square, and ADF—Fisher Chi-square, all result in zero stationarity. Expanding on this basis, I develop an alternative hypothesis to question the null hypothesis of no cointegration.

These hypotheses are based on economic theory, which indicates the possibility of stable correlations among the variables that are being studied in the long term. Both the Phillips-Perron test and the enhanced Dickey-Fuller test confirm the presence of cointegrating relationships by providing a minimal p-value of less than 0.05.

Finally, the MMQR analysis provides an insightful look into the effects of various independent variables on the influence of GDP across different quantiles (0.1–0.9). Besides employment, all the variables like Foreign direct investment, Domestic healthcare expenditure, Renewable Energy Consumption, Employment Ratio, and Educational Attainment positively affect GDP.

Identifying robustness in different quantiles can reveal significant heterogeneities that OLS might miss during the process. It can also create opportunities to explore other variables' socio-economic development and provide more effective policy recommendations to policymakers. Aside from OLS, MMQR is not influenced by outliers because it focuses on different quantiles and provides robust results.

The selected countries have unique economic development and policies. So, it is not enough to limit them to some hypothesis; they also need different layers of methodologies. In that case, MMQR is suitable for checking robustness as it analyzes different quantiles.

3. *I have seen a positive relationship between foreign development investment and GDP. This dissertation revealed some more exciting sectors and factors that might help everyone. As can be seen in the analysis, I also found the necessity of adopting renewable energy. As they are developed countries, it is necessary to invest in sustainable energy. The relationship between healthcare expenditure and GDP has also been found to indicate the importance of healthcare systems in increasing socio-economic development that improves health outcomes and reduces the economic burden of illness on families and the state. However, the relationship between education attainment and GDP has not been found for now, but further investigation is needed. Similarly, the relationship between employment and GDP has not been seen as expected.*

Investing in sustainable energy can lower energy costs for households and businesses, reduce environmental degradation, and improve public health by minimizing carbon footprint. Fostering economic growth can also create new industries and jobs. This sustainable growth from adopting

clean energy can attract both domestic and foreign investments. It also leads to technological advancements and increased energy security for a better future.

The relationship between healthcare expenditures and GDP is an important finding. Good-quality healthcare services are critical for reducing health-related problems. Adequate policy coverage can ensure that all citizens' health-related issues lessen the economic burden of illness on families.

However, I did not find the relationship between education attainment and GDP. Education is essential for economic growth, permitting individuals to obtain the knowledge and skills required to participate in a modern economy. In the selected Eastern European countries, assisting educational institutions (from primary schools to universities) will encourage innovation, improve workforce productivity, and contribute to economic growth. Excellent education drives social mobility so that people from every background can participate in a rising tide.

It is crucial to support the education of science, technology, engineering, and mathematics (STEM) institutions in a knowledge-based economy. Gaining talents in these fields will help Eastern European countries become more competitive with global development, attract high-tech industries, and drive technological progress. Workers need to engage in lifelong learning and vocational training that can teach them how to switch careers as economic conditions change so they, too, can benefit from the expansion of GDP.

The negative relationship between GDP and employment clearly shows this. Toward this end, targeted job creation programs would be helpful to support broad-based socio-economic development. Eastern Europe can reduce unemployment (especially in areas devastated by economic transitions) and work to decrease underemployment; the EU should be more active here by promoting entrepreneurship and helping small and medium-sized enterprises work hand-in-hand in labor-intensive industries.

Targeted employment programs for vulnerable groups, such as youth, women, and rural areas, can help ensure that economic development benefits everyone. Public work programs, vocational training, or incentives for employing socially marginalized groups are one way of reducing poverty and social inequality and integrating these people into the work process. Therefore, the key to a more cohesive, prosperous society in Eastern European countries lies in the responsible application

of viable employment policies and ensuring that they reflect this broader objective: a higher GDP-aligned growth-focused strategy.

Indeed, I have found that FDI and GDP positively relate to developments. It is invested in capital technology and expert people, so it is highly sought for economic growth. Through strategies to facilitate FDI flow, the countries can hasten their industrialization processes, develop infrastructure, and amplify global trade competitiveness. But, fundamentally, the FDI matches with national development goals, and several society sectors have an advantage of this instead of just a few.

The capital accounts policy and the use of foreign exchange reserves are inextricably linked to adequate supervision so that FDI can effectively promote sustainable development; FDI standards in terms of labor and suitable environments are a vital way to ensure that foreign investors adhere to local laws so there is little or no harmful spill over from FDI into society. Similarly, by promoting joint ventures and public-private partnerships between foreign firms and their local counterparts, we can enhance knowledge and development capacity in recipient countries so that the broader parts of the economy would push toward sustainable growth.

These five sectors are sustainable energy, health care, education, employment, and foreign investment - all vital domains where policymakers can leverage GDP growth to bring about more holistic economic development. If the selected Eastern European countries carefully invest in these domains, economic growth will become more inclusive and sustainable. It is one way to become economically resilient and promote social equity and environmental sustainability, supporting the overall well-being of where you live. By implementing the right kind of policies, Eastern Europe can leverage GDP growth as an effective means to facilitate inclusive and sustainable development across the region.

6. PUBLICATIONS OF THE AUTHOR

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