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Effects of European funding on the convergence of central and eastern European countries

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Abstract

This study aims to analyze the effects of European funding for Central and Eastern European countries (CEE) on the degree of convergence. The model for measuring the real β-convergence and the standard regression equation when working with a general population were mainly used as part of the analysis methodology. The results confirm the tested neoclassical hypothesis that less developed countries record faster growth rates relative to stronger developed countries. The analysis finds that only in Bulgaria of the studied countries is an independent impact of EU financing on real convergence expressed in the inflation rate. When examining the unemployment rate, a relationship is found in three of the CEE countries: Lithuania, Latvia and Bulgaria. Indicators from the analysis of the relationship between EU funding and convergence through the Gini index are found only in Slovenia while the same observed relationship expressed through GDP per capita shows a negligible independent influence on real convergence in all CEE countries. The study in its entirety demonstrates the relationship between the real effects of European funding on the convergence of CEE countries through four independent variables and raises discussion questions about the approaches to measure the real effect of the budgetary resources allocated at the European level.

Keywords: Convergence, Evaluation, Impact, Integrated territorial investments, Planning, Regions.

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1. Introduction

It is a common concept in the literature that less developed countries have simpler growth rates than more developed ones [1]. Cohesion policy is the foundation of the philosophy of building the European Community. It implements investment instruments to reduce regional disparities within the European Union (EU) mainly through the European Regional Development Fund (ERDF 43%) and the Cohesion Fund (CF 13%) [2]. However, experience shows that regional disparities are not affected in the most effective way despite efforts and financial resources which for the planning period 2014-2020 amounted to 32.5% of the total community budget (351.8 billion euros) [3].

The creation of the European Structural and Investment Funds (ESIF) is committed to in Article 130a of the Single European Act of 1986 according to which reducing interregional disparities and the lagging of certain regions is a priority for the European Community. ESIF has reallocated a large financial resource (908 billion euros) with a view to social and economic cohesion between member states posing the problem of convergence as constant and relevant over the years since its establishment as a financing instrument. It has different aspects defined by the macro indicators to be assessed and leading researchers classify it as real economic, nominal, institutional and structural convergence [4, 5].

In the case of economic convergence, the β-convergence (absolute and conditional) and σ-convergence indicators are applied to establish convergence. The latter usually refers to the income per capita growth rate but could also refer to other socio-economic indicators such as income inequality, price stability, employment, interest rates, stability of public finances, etc. (the treaty provision, protocol no. 13 on criteria for convergence). β-convergence is measured when poorer economies exhibit a faster growth trend than rich ones [6] i.e. the dynamics of the given indicators in the distribution are observed. In turn, the σ-convergence establishes the "direction of spread" of the levels of development of these indicators through the reported changes based on the time of change reducing the degree of variation of the studied indicators on a regional basis [7, 8]. Each of the presented models has specific features respectively advantages and disadvantages for the confirmation of convergence. We assumed that β-convergence has higher information significance when examining a sample of countries with similar historical, anthropological and socio-economic characteristics such as the countries of CEE. Therefore, the empirical study focuses on it.

2. Literature review

The European Union as a form of unification of different countries faces a number of challenges to its homogeneous development with the disproportions between the economic and social states of developed and less developed countries being key. Researchers agree that convergence can ensure political stability as European policy in this direction is the policy for the overall development of the Union [9]. In this regard, researchers have converged on two main aspects in the study and analysis of disparities in the community in recent years. The first relates to the economic performance of member states while the second is based on the political environment driven by civil discontent stemming from widening inequality [10]. Both the analysis and assessment of financial and economic indicators such as GDP [11] and real convergence [12] as well as the variations in the effects of the EU's cohesion policy in its social dimensions [9] are of research interest.

In terms of the first group of indicators, the European Central Bank in its report indicates that for CEE countries, the degree of convergence of incomes to the community average largely depends on integration into global value chains and the transition to a market economy [13]. To some extent, the observed effects of the union's cohesion policy are also determined by the actions taken to expand the borders of the community as countries from the former socialist regime such as Bulgaria and Romania transformed their economies and others such as Lithuania, Latvia and Estonia adopted the euro as their national currency. As a result of the smooth transition process, it is found that convergence occurs to a greater extent when less developed countries improve their socio-economic conditions at a faster rate than more developed ones. However, according to research by Davide and Aleksandra [14] in the case of GDP fluctuations in the Eurozone, the amount of smoothing needs to be increased to produce significant convergence on this indicator.

Pipień and Roszkowska's research on reaching convergence among EU members demonstrates higher uniformity in the growth of CEE countries compared to the Commonwealth of Independent States Pipień and Roszkowska [15]. Alcidi [16] who also researched these issues found that for the period 2000-2015, the CEE countries with the best performance in terms of convergence indicators were Lithuania, Latvia, Estonia and Romania. In this regard, a study by Siljak and Nagy [17] reaches results that emphasize the need to open the economies of countries that want to improve their positions in terms of reaching high levels of convergence [17]. In view of the fundamental concept of the functioning of the Union in conditions of common markets, mobility and single currency, these proposals together with the opportunities to seek investment are reasonable.

In general, the concept of convergence in the EU aims to give direction and recommendations to reach a development of all member states that combines social and economic well-being. The convergence process needs to be monitored, evaluated and analyzed to establish progress in this direction. In this regard, some authors propose expanding the set of economic indicators with the addition of social ones as well [9].

Research interests also include the causes and consequences of divergence, the opposing process and the challenges of reaching convergence. Some authors identify economic shocks as one of the key reasons for the trend towards divergence [18] while others introduce the term "asymmetric behavior" [19] to describe the actions of individual countries leading to an ever-greater deepening of disparities.

3. Methodology and Data

The aim of the study is to establish the existence of convergence between CEE countries (Bulgaria, Czech Republic, Estonia, Lithuania, Latvia, Hungary, Poland, Romania, Slovenia and Slovakia) in 2007-2018 (the first year of Bulgaria's EU membership and the last year for which we have empirical data) on income, inflation, income inequality and unemployment based on the European funding cash flows to the selected countries[1]. A time period fixed until 2018 excludes the impact of external critical factors such as the COVID-19 pandemic and the war in Ukraine on the processes analyzed. The real β-convergence on the four aspects is estimated by cross-section regression where the model-dependent variables reflect the standard deviation of the natural logarithm respectively of income, inflation, income inequality and unemployment rate and the independent variables are the initial levels of the above indicators (2007). The observation period covers the period from January 2007 to December 2018 on an annual basis (Y-o-Y) and includes 10 EU member states from CEE. Table 1 presents the details and description of the dependent variables.

Table 1.
Description of dependent variables.

Variable	Abbreviation	Calculation	Source
Gross domestic product	GDPper capita	Average annual change, per capita	Eurostat
Gini index	GINI	Medium change	World bank
Unemployment rate	UNEMPL_R	Medium change	Eurostat
Inflation	INFL_R	Medium change	Eurostat

The following formal representation of the model for measuring the real β-convergence has been applied [20, 21].

$$\frac{1}{T}\ln[Yit/Yio] = \alpha_0 + \alpha_1 \ln(Yio) + \varepsilon_1 \quad \text{where}$$

T is the time period.
Yit is the value of the dependent variable of country i in period t.
Yio is the value of the independent variable of country i in the first period (2007).
α is constant.
ε is the random component.
Thus, the specific equations for the four chosen variables take the following form:

$$\frac{1}{T}\ln[\text{GDP\_percap}it/\text{GDP\_percap}io] = \alpha_0 + \alpha_1 \ln(\text{GDP\_percap}io) + \varepsilon_1 ,$$

to estimate GDP per capita growth.

$$\frac{1}{T}\ln[\text{GINI}it/\text{GINI}io] = \alpha_0 + \alpha_1 \ln(GINIio) + \varepsilon_1 .$$

to estimate the change in income inequality.

$$\frac{1}{T}\ln[\text{UNEMPL\_R}it/\text{UNEMPL\_R}io] = \alpha_0 + \alpha_1 \ln(UNEMPL\_Rio) + \varepsilon_1 ,$$

to estimate the change in unemployment on an annual basis.

$$\frac{1}{T}\ln[\text{INFL\_R}it/\text{INFL\_R}io] = \alpha_0 + \alpha_1 \ln(\text{INFL\_}Rio) + \varepsilon_1 ,$$

to estimate the change in the prices of goods and services on an annual basis.

In the second part, the presence of dependence between the above factor variables and European funding cash flows is tested based on the standard single regression equation when working with a general population [22] and has the following formal representation:

$$Yi = \alpha + \beta * Xi + \varepsilon i,$$

Where Yi represents the empirical value of the dependent variable.
Xi is the factor (independent) variable.
α and β are the point estimates of the unknown parameters in the tested model.
εi is the random component.
To minimize the values of the deviations of the empirical points Yi from the theoretical values lying on the regression line, the least squares method shall be used to determine the values of the coefficients α and β. Thus, the above equation will take the form:

$$EU\_FINit = \alpha + \beta * \text{Xi} + \varepsilon i$$

Where *EU_FINit* is the value of EU funding income as a percentage of GDP by year for each CEE country and Xi is the factor variable that will consistently represent GDP per capita, Gini index, unemployment and inflation ratios for each of the years. The successive addition of the factor variables applied to the four working equations:

(1) $\text{EU\_FINit} = \alpha + \beta * \text{GDPper capita} + \varepsilon i$

which describes the impact of EU funding income on the general income growth of the CEE countries.

(2) $EU\_FINit = \alpha + \beta * GINI + \varepsilon i,$

which describes the impact of EU funding income on the state of CEE countries income inequality.

[1] The survey includes only the CEE countries that are EU member states without the Republic of Croatia which as of 2007 is not a member of the EU.

(3) $EU\_FINit = \alpha + \beta * Unemlp\_R + \varepsilon i,$
which describes the impact of European funding income on CEE countries unemployment.
(4) $EU\_FINit = \alpha + \beta * Infl\_R + \varepsilon i,$
which describes the impact of European funding income on inflation rate of CEE countries.

4. Results and Discussion

4.1. State of Convergence on Income, Inequality, Unemployment and Inflation in the CEE Countries

The relationship between the natural logarithm of the independent variable in the initial year of the survey period (2007) and its annual average rate of change (2007-2018) is presented by means of a correlogram (see Figures 1-4). The negative slope of the curve describing the relationship between the average Y-o-Y change in GDP per capita and the base level of this indicator in the CEE countries (-0.0237) testifies to a negative relationship between the initial level of GDP per capita and their average growth and confirms the existence of convergence between CEE countries (see Figure 1). According to the Al-Samman ranking, the correlation coefficient (R^2) between the two indicators is also high (0.6357) at a 95% confidence interval [23]. In addition, the figures show that the countries that registered the lowest values of the GDP per capita indicator at the initial period are Bulgaria (4240 EUR), Romania (6110 EUR), Poland (8230 EUR), and Slovenia, the Czech Republic and Estonia whose GDP per capita exceeds 1.5 to 4 times that of the countries cited above have the best performance. The average annual rate of change of the ten countries under analysis positions Bulgaria, Lithuania and Romania with an average annual growth rate of 6, 5.9 and 5.4 percentage points. Poland lags slightly behind these countries plus Estonia with a score of 4.5% compared to 4.7% for Estonia. The cited results confirm to a significant degree, the underlying neoclassical hypothesis that countries with poorer initial performance (less developed countries) record faster growth rates relative to stronger developments. In this case, this is true for Bulgaria and Romania, as well as Slovenia and the Czech Republic positioned respectively in the upper left and lower right quadrants of correlogram 1.

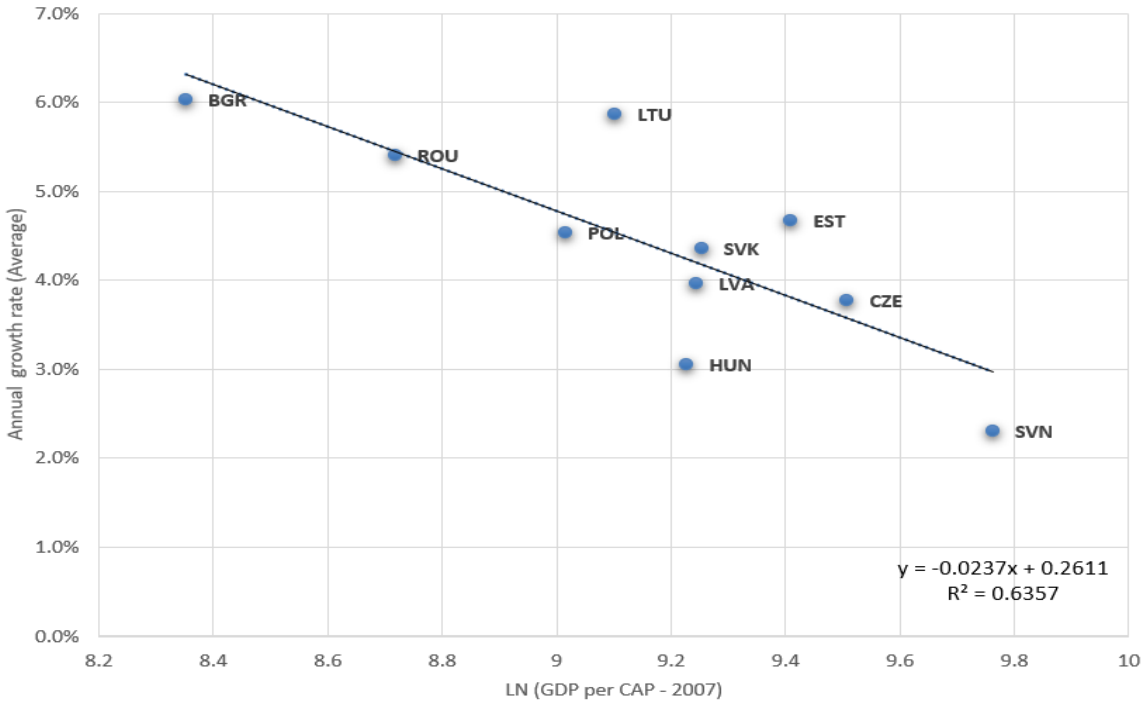

Figure 1.
Convergence between CEE countries in 2007-2018 (Measured on the basis of GDP per capita (Average Y-o-Y change in GDP per capita in Euro for the period 2007-2018) and baseline level of GDP per capita in Euro of CEE countries).

In the Gini coefficient, there is also a negative slope of the curve (-0.0048) describing the relationship between its Y-o-Y average change and the baseline level in the CEE countries (see correlogram and Figure 2). The convergence between them is confirmed on the basis of the existence of a negative relationship between income inequality in the initial study period and its average growth for the analyzed period. Empirical data determine Romania (37.5), Latvia (37.5), Bulgaria (36) and Lithuania (34.8) as the countries with the highest income inequality compared to the rest of CEE at the beginning of the study period in 2007. The lowest values of the Gini index at the same time accept the Czech Republic, Slovenia and Slovakia whose indicators mark a difference of 10-11% down from the countries cited above. The average Y-o-Y rate of change of the Gini index of the ten countries under analysis is positive for Bulgaria, Hungary, Slovenia and Slovakia while in the other countries the measured values are negative. The results presented confirm the tested neoclassical hypothesis that countries with poorer initial performance (those with higher income inequality) recorded faster growth rates than others. In this case, this is true for Bulgaria and Lithuania while at the opposite pole is the Czech Republic. However, the interpretation of the results is questioned based on the low coefficient of correlation between these two indicators (0.0153) at a confidence interval of 95% which requires further analysis for final conclusions.

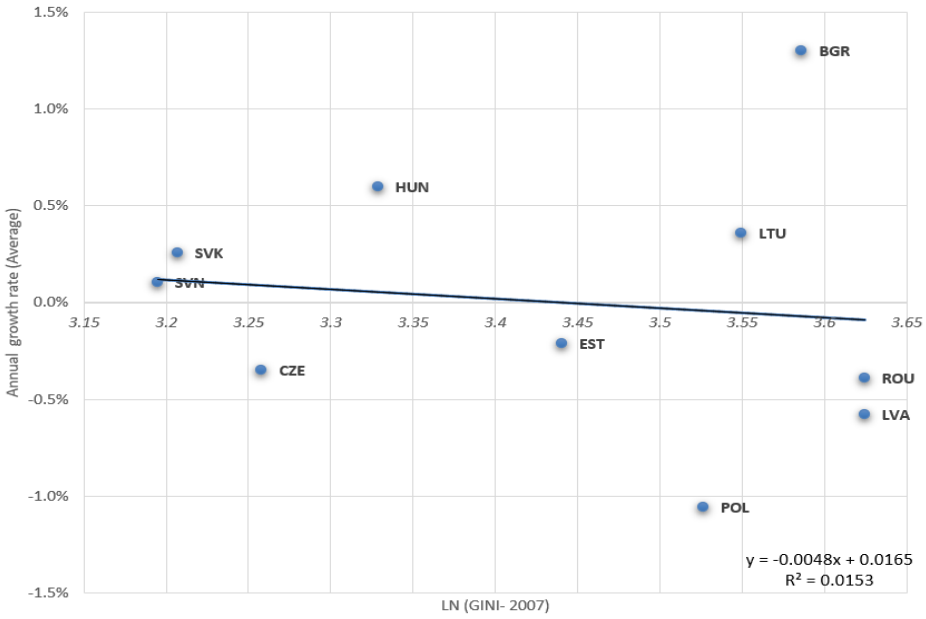

Figure 2.
Convergence between CEE countries in 2007-2018 (Measured on the basis of the average Y-o-Y change of the Gini index for the period 2007-2018 and the baseline level of the Gini index of the CEE countries).

A negative slope of the curve is also observed (-0.585) describing the relationship between the average Y-o-Y change of the indicator and its initial level in 2007 in the CEE countries with the indicator unemployment rate on an annual basis. This negative relationship confirms the existence of convergence between CEE countries regarding annual unemployment. A high correlation coefficient between the two indicators (0.506) at a confidence interval on Al-Samman allows interpretation of the empirical information to verify the tested hypothesis. Empirical data show that the countries with the lowest values of the annual unemployment rate at the initial year are Lithuania (4.3%), Estonia (4.6%) and Slovenia (4.9%) while the highest unemployment is measured among the Vise grad group except the Czech Republic. In Slovakia, Poland and Hungary, the unemployment rate exceeds 1.5 to 2.5 times that of the countries cited above. These are also the countries with the best positioning regarding the average annual rate of decrease in unemployment for the period analyzed. The opposite trend is observed in Lithuania and Slovenia which start with relatively low unemployment rates compared to the other countries but for the same period report a positive trend. Empirical values position them in the upper left quadrant of the correlogram (see Figure 3) and together with Slovakia, Poland and Hungary (positioned in the lower right quadrant of the correlogram), they differentiate the countries where the tested neoclassical hypothesis is confirmed. Countries with worse initial performance record faster growth rates relative to stronger development and vice versa. This trend is not observed for Bulgaria and Romania, the Czech Republic or Latvia.

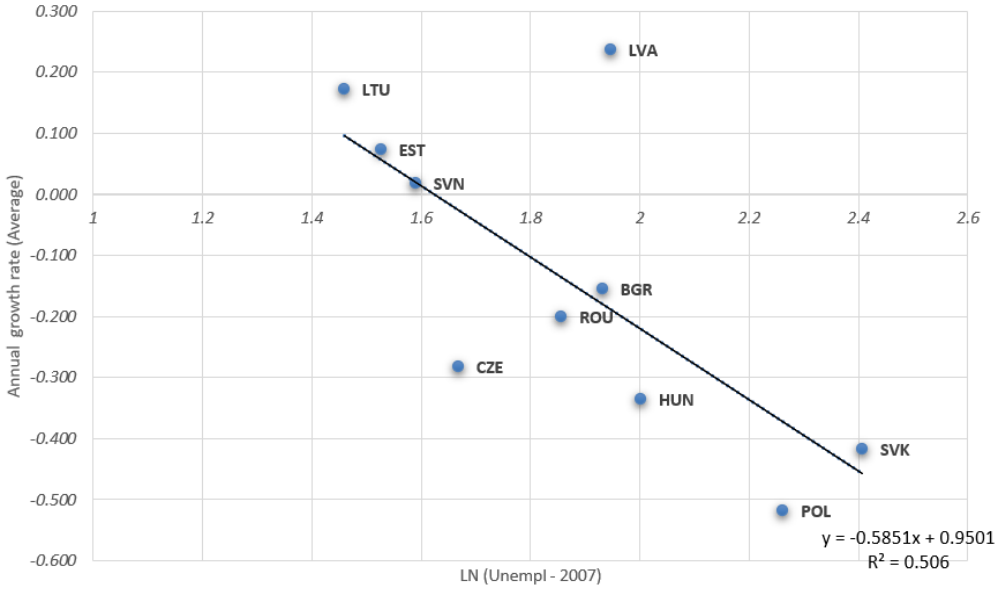

Figure 3.
The convergence between CEE countries in 2007-2018 was measured on the basis of the average Y-o-Y change in the unemployment rate for the period 2007-2018 and the baseline unemployment rate of the CEE countries.

Negative commitment is also measured in the last studied indicator: Y-o-Y inflation. The negative slope of the curve (-0,37) describing the relationship between the average Y-o-Y change in the coefficient and its initial level in 2007 in the CEE countries confirms the existence of convergence between them. We also interpret the empirical information to verify the tested hypothesis with a high measured correlation coefficient between the two indicators (0.826) at a confidence interval of 95%. Similar to the upper indicator (unemployment rate), the data positions the best three of the Vise grad group countries regarding to the baseline level of inflation. Slovakia, Poland and the Czech Republic start the survey period with respectively 1.9, 2.6 and 2.9 percent inflation compared to the previous year while at the opposite pole are Latvia, Hungary and Bulgaria where the indicator exceeds 2.6 to 3.5 times the values quoted above.

Figure 4.
The convergence between CEE countries in 2007-2018 measured on the basis of the Y-o-Y average rate of change of the inflation ratio in 2007-2018 and a baseline level of the same indicator in the CEE countries.

The tested hypothesis suggests that the last three countries (i.e. those with the worst baseline indicators) should register the highest decline in the inflation rate, and respectively Slovakia, Poland and the Czech Republic – the countries with the best baseline indicators – report the worst results. Figure 4 confirms this hypothesis: Latvia, Hungary and Bulgaria are positioned in the lower right quadrant while Slovakia, Poland and the Czech Republic are in the upper left quadrant based on empirical data. The other countries do not show such a clear tendency.

4.2. Impact of EU Funding Flows on Real Convergence Indicators in CEE Countries

The results of the model applied in the first part prove the existence of convergence in CEE in 2007-2018. It is a result of fiscal, investment, social, political and other processes taking place at the regional, national and community levels. They have an individual impact but in their entirety, they impact the convergence of national economies. As already noted, ESIF instruments are designed to overcome interregional disparities (their different dimensions youth unemployment, quality of education, development of agriculture and public administration, transport infrastructure, justifying the functioning of individual funds) and support cohesion between the different economies and regions that form them [24]. In this context, the financial resources allocated by the European budget should be seen as a factor in overcoming existing problems, and their effects can be measured. Conceptually, this can be achieved through a study based on data grouped into a time series to assess the relationship between two variables which also describes the methodology of the study. Grouped data in the regression model is a suitable approach in this case because it allows control of the input data and the representation of the temporal and structural differences of the sample of countries. The independent variable is the cash flows of EU funding, separately for each CEE country (as a percentage of GDP) and the dependent variable (results) are four: GDP per capita, Gini index, Y-o-Y unemployment and inflation rates. The authors focus on the main macro indicators determining the level of economic growth: income inequality, growth in the prices of goods and services and employment. The data used cover a 12-year period (2007-2018) and are publicly available and accumulated as a priority from the Eurostat and World Bank databases. Regarding historical payments from the EU, the open database of the European Commission is used which is processed and compiled for the purposes of our study. Table 2 presents the results of the regression analysis in testing the model with the first working equation.

Table 2.
Single- factor regression of the impact of European funding receipts on the income of the CEE countries.

BGR	**Coefficients**	**P value**	**Lower 95%**	**Upper 95%**	**HUN**	**Coefficients**	**P value**	**Lower 95%**	**Upper 95%**
Intercept	5228.996	0.000	3362.974	7095.018	Intercept	11363.351	0.000	8727.965	13998.737
X var 1	31968.202	0.398	-48647.820	112584.225	X var 1	-12766.681	0.754	-100905.831	75372.470
R square	0.269	**X**	X	X	R square	0.010	X	X	X
SF	0.398	X	X	X	SF	0.754	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
CZE	Coefficients	P value	Lower 95%	Upper 95%	POL	Coefficients	P value	Lower 95%	Upper 95%
Intercept	16216.837	0.000	12846.309	19587.365	Intercept	10829.796	0.000	7713.767	13945.825
X var 1	-18661.700	0.824	-200958.166	163634.766	X var 1	-24413.394	0.680	-152472.611	103645.823
R square	0.005	X	X	X	R square	0.018	X	X	X
SF	0.824	X	X	X	SF	0.680	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
EST	Coefficients	P value	Lower 95%	Upper 95%	ROU	Coefficients	P value	Lower 95%	Upper 95%
Intercept	16938.483	0.000	13254.801	20622.164	Intercept	6854.168	0.000	4580.682	9127.654
X var 1	-99903.706	0.107	-225713.800	25906.387	X var 1	42351.899	0.456	-79420.600	164124.397
R square	0.238	X	X	X	R square	0.057	X	X	X
SF	0.107	X	X	X	SF	0.456	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LVA	Coefficients	P value	Lower 95%	Upper 95%	SVN	Coefficients	P value	Lower 95%	Upper 95%
Intercept	14454.556	0.000	10751.497	18157.616	Intercept	19951.262	0.000	17694.393	22208.130
X var 1	-107561.982	0.083	-232218.790	17094.825	X var 1	-92589.851	0.214	-248053.506	62873.804
R square	0.270	X	X	X	R square	0.150	X	X	X
SF	0.083	X	X	X	SF	0.214	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LTU	Coefficients	P value	Lower 95%	Upper 95%	SVK	Coefficients	P value	Lower 95%	Upper 95%
Intercept	14335.519	0.000	10691.919	17979.118	Intercept	12775.792	0.000	9677.392	15874.193
X var 1	-88885.334	0.108	-201096.569	23325.900	X var 1	45860.370	0.518	-106538.858	198259.598
R square	0.238	X	X	X	R square	0.043	X	X	X
SF	0.108	X	X	X	SF	0.518	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X

We establish the contribution of the independent variable (revenues from European funding) to the income situation of the CEE countries based on the regression analysis. The values of the coefficient R^2 are positioned in the lower half of the scale determining the strength of the regression dependence on the Al-Samman scale. The dark blue color of the presentation of the CEE results marks the strengthening influence of the factor variable. In this case, this is most clearly expressed R^2 by taking values between 0.27 and 0.24. In this sense, in Latvia 27% of the changes in the empirical values of GDP per capita are explained by the change in the independent variable and in Lithuania and Estonia this percentage is 24. It is evident from the graph that the current results colour the map a lighter blue indicating that the strength of dependence in the other member states is decreasing. This also has high information significance as it proves that the factor does not affect the indicator studied. In these cases, the income situation of the country is not due (or is due to a very small extent) to the receipts of European funding. Figure 5 illustrates the above reasoning.

The results of the analysis can be interpreted for these member countries where the model adequacy test is true. Theoretically, the model is adequate for those countries where SF has a value less than 0.05 with a confidence interval of 95% [25]. In this case, the hypothesis of a relationship between the dependent variable and the revenue from European funding is accepted. In this case, the appropriateness of the model needs to be validated for all of the countries under examination and we accept the hypothesis that there is no dependency between the two indicators. The results are quite plausible when contrasted to the previously recorded low correlation coefficient. The same principle applies to the P-value for assessing the significance of the regression coefficients, the values of which are presented in Table 2. Regression coefficients are not relevant in establishing the direction of the effect of GDP per capita on the dependent variable since no country has demonstrated connection between the two variables under analysis. We shall compare this to the other three variables.

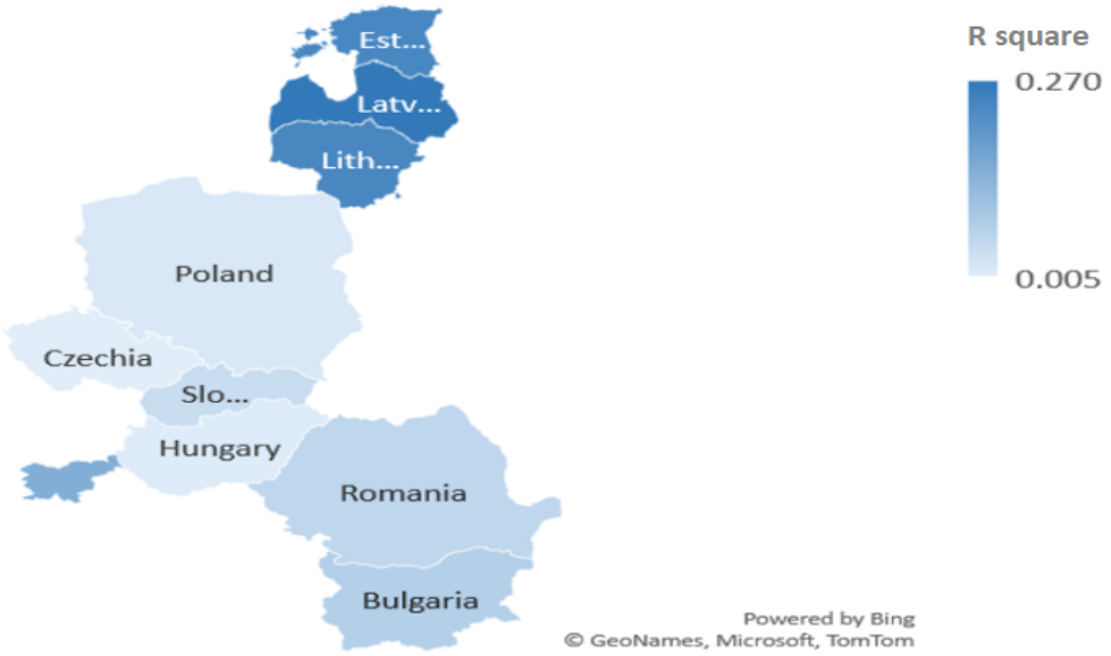

Figure 5.
R^2 values of the dependency ratio "GDP per capita-revenues from European funding/GDP" of the CEE countries.

As a result of the application of the model for the first factor variable, we find that the revenues from European funding have a negligible single impact on the real convergence in the CEE countries expressed in terms of GDP per capita.

The following table presents the results of the regression analysis in testing the model with the second working equation.

Table 3.
Single-factor regression of the impact of European funding receipts on the income inequality of the CEE countries.

BGR	**Coefficients**	**P-value**	**Lower 95%**	**Upper 95%**	**HUN**	**Coefficients**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	35.658	0.000	31.074	40.242	Intercept	27.684	0.000	25.173	30.196
X var 1	64.328	0.486	-133.716	262.372	X var 1	67.802	0.102	-16.195	151.799
R square	0.050	X	X	X	R square	0.244	X	X	X
SF	0.486	X	X	X	SF	0.102	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
CZE	Coefficients	P-value	Lower 95%	Upper 95%	POL	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	25.657	0.000	24.591	26.722	Intercept	30.910	0.000	28.075	33.746
X var 1	15.956	0.551	-41.685	73.597	X var 1	65.382	0.240	-51.147	181.910
R square	0.037	X	X	X	R square	0.135	X	X	X
SF	0.551	X	X	X	SF	0.240	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
EST	Coefficients	P-value	Lower 95%	Upper 95%	ROU	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	31.263	0.000	29.140	33.387	Intercept	36.531	0.000	35.282	37.780
X var 1	35.176	0.305	-37.346	107.697	X var 1	-29.034	0.356	-95.922	37.855
R square	0.105	X	X	X	R square	0.086	X	X	X
SF	0.305	X	X	X	SF	0.356	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LVA	Coefficients	P-value	Lower 95%	Upper 95%	SVN	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	36.004	0.000	33.848	38.160	Intercept	23.811	0.000	23.024	24.598
X var 1	-16.360	0.626	-88.940	56.220	X var 1	84.444	0.006	30.241	138.647
R Square	0.025	X	X	X	R square	0.546	X	X	X
SF	0.626	X	X	X	SF	0.006	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LTU	Coefficients	P-value	Lower 95%	Upper 95%	SVK	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	37.530	0.000	34.778	40.282	Intercept	24.676	0.000	22.420	26.932
X var 1	-54.918	0.179	-139.663	29.826	X var 1	69.406	0.194	-41.545	180.357
R square	0.173	X	X	X	R square	0.163	X	X	X
SF	0.173	X	X	X	SF	0.194	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X

Regression analysis shows the contribution of the independent variable. European financing revenues to the level of income inequality in CEE countries is determined by the Gini index. The coefficient values $R^2$are positioned in the central

and lower halves of the scale determining the strength of dependence according to Al-Samman [23] (see Figure 6). The dark blue colour of the map presenting the CEE results marks the strengthening influence of the factor variable. In this case, this is most clearly expressed in Slovenia where R^2 it takes values of 0.546, i.e. over 50% of the changes in the empirical values of the Gini index are explained by the change in the independent variable. In the other nine countries subject to analysis, the current results colour the map a lighter blue marking the decrease in strength dependence between the variables. The information significance here is reduced to the fact that the factor magnitude does not affect the indicator in Bulgaria, the Czech Republic, Estonia, Lithuania, Latvia, Hungary, Poland, Romania, and Slovakia. Income inequality is affected by EU funding receipts to a very small extent. Figure 6 illustrates the above reasoning.

Figure 6.
R^2 values of the coefficient of dependence "Gini-Revenue from European Funding/GDP" of the CEE countries.

The results of the correlation analysis can be interpreted for the member countries where the model adequacy test is true (i.e. SF < 0.05) at a confidence interval of 95%. In this case, the hypothesis of the existence of a relationship between the dependent variable and the receipt of European funding is accepted. The results correspond to already measured low correlation coefficient and, in this case, the adequacy of the model is confirmed only for Slovenia. In the other CEECs, the model is not adequate. The same principle applies to the P-value for estimating the significance of the regression coefficients, the values of which are traceable through Table 3. The intercept is significant in all analysed countries and the significance of the dependent variable is only confirmed in Slovenia.

We interpret the direction of the impact of the factor only in those countries where the existence of dependence between the two analysed variables is confirmed. The positive sign before the regression coefficient (X var 1 in Table 3) determines the positive direction of the impact of the variable receipts from European funding on GDP on the Gini index in Slovenia and vice versa. In this sense, the increase in revenues from European funding by 1% compared to the country's GDP on an annual basis should result in an increase in the Gini index as the values of this effect amount to 0.84 units under similar circumstances.

As a result of the application of the model to the second factor variable, the concurrent performance of the conditions for the adequacy of the model and the presence of high to medium correlation determine the conclusion that the proceeds from European funding have an independent impact on the real convergence expressed by the Gini index in only one of the CEE countries (Slovenia). In the other nine countries, income inequality is not tied to the EU funding factor.
Table 4 presents the results of the regression analysis in testing the model with the third working equation.

Table 4.
Single-factor regression of the impact of European funding receipts on unemployment in CEE countries.

BGR	Coefficients	P-value	Lower 95%	Upper 95%	HUN	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	0.047	0.019	0.010	0.084	Intercept	5.828	0.030	0.696	10.960
X var 1	1.942	0.022	0.341	3.543	X var 1	77.483	0.338	-94.150	249.117
R square	0.422	X	X	X	R square	0.092	X	X	X
SF	0.022	X	X	X	SF	0.338	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
CZE	Coefficients	P-value	Lower 95%	Upper 95%	POL	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	3.957	0.018	0.821	7.093	Intercept	4.169	0.032	0.433	7.905
X var 1	82.750	0.303	-86.868	252.369	X var 1	166.077	0.037	12.553	319.601
R square	0.106	X	X	X	R square	0.367	X	X	X
SF	0.303	X	X	X	SF	0.037	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
EST	Coefficients	P-value	Lower 95%	Upper 95%	ROU	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	3.300	0.086	-0.563	7.163	Intercept	5.876	0.000	4.304	7.449
X var 1	202.338	0.007	70.412	334.265	X var 1	25.692	0.512	-58.519	109.904
R square	0.539	X	X	X	R square	0.044	X	X	X
SF	0.007	X	X	X	SF	0.512	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LVA	Coefficients	P-value	Lower 95%	Upper 95%	SVN	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	1.469	0.629	-5.099	8.036	Intercept	4.720	0.002	2.151	7.289
X var 1	392.534	0.003	171.453	613.615	X var 1	197.270	0.032	20.315	374.224
R square	0.610	X	X	X	R square	0.382	X	X	X
SF	0.003	X	X	X	SF	0.032	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LTU	Coefficients	P-value	Lower 95%	Upper 95%	SVK	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	3.790	0.138	-1.451	9.032	Intercept	9.674	0.001	5.054	14.294
X var 1	217.401	0.013	55.976	378.826	X var 1	95.442	0.371	-131.801	322.684
R square	0.474	X	X	X	R square	0.081	X	X	X
SF	0.013	X	X	X	SF	0.371	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X

We determine the contribution of the independent variable the money from European funding to employment as shown by the unemployment rate in the CEE countries based on the regression analysis results. The values of the coefficient R^2 are positioned in the central and lower halves of the scale determining the strength of the dependence on Al-Samman [23] (see Figure 7). The dark blue colour of the map presenting the CEE results marks the strengthening influence of the factor variable. In this case, this is most clearly expressed in Lithuania where R^2 takes values of 0.688, i.e. over 68% of the changes in the empirical values of the unemployment Y-o-Y rate are explained by the change in the independent variable. A trend is also observed in the other two Baltic countries Latvia and Estonia whose R^2 was 0.610 and 0.538, respectively. Strong to medium dependence is also reported in Bulgaria (0.422) while in other countries, the correlation coefficient is 40 percent or below. There, the current results colour the map in lighter blue marking the decreasing dependence between the variables. In this sense, the independent variable does not significantly affect the indicator studied in the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia where employment is tied to the proceeds of European funding to a comparatively lesser extent. Figure 7 illustrates the reasoning above.

Figure 7.
R^2 values of the dependency ratio "unemployment rate-revenues from European funding/GDP" of the CEE countries.

The next step is to assess the adequacy of the model relative to the current factor. The results of the correlation analysis are interpreted for the member countries where SF does not exceed 0.05 with a confidence interval of 95%. Then we accept the hypothesis of the existence of a relationship between the dependent variable (the unemployment rate) and the proceeds from European funding. Thus, we find that the model is adequate in half of the countries: Bulgaria, Lithuania, Latvia, Poland and Slovenia. In the other CEECs, the model is not adequate.

The p-value shown in Table 4 is also used to assess the significance of the regression coefficients. It relies on the same concept. Both variables allow interpretation (i.e. a p-value < 0.05) in Bulgaria, Estonia, Poland and Slovenia but given the established adequacy of the model, the direction of the impact of the factor will be interpreted only in Bulgaria, Poland and Slovenia. The positive sign before the regression coefficient (X var 1 in Table 4) determines the positive direction of the impact of the variable receipts from European funding on GDP on the unemployment rate in these three countries. In this sense, the increase in revenues from European funding relative to the GDP of the country on an annual basis should have a negative economic impact expressed as an increase in the unemployment rate.

As a result of the application of the model to the third factor variable, the concurrent performance of the conditions for the adequacy of the model and the presence of a high to medium correlation determine the conclusion that the proceeds from European funding have an independent impact on the real convergence as expressed by the unemployment rate in three of the CEE countries: Lithuania, Latvia and Bulgaria. In the other seven countries, unemployment is linked to the EU funding factor to a lesser extent.

Finally, we present the results of the regression analysis in testing the model with the fourth working equation.

Table 5.
Single-factor regression of the impact of European funding receipts on inflation in CEE countries.

BGR	**Coefficients**	**P-value**	**Lower 95%**	**Upper 95%**	**HUN**	**Coefficients**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	0.088	0.003	0.039	0.138	Intercept	6.792	0.006	2.492	11.093
X var 1	-2.921	0.012	-5.060	-0.781	X var 1	-123.837	0.084	-267.653	19.978
R square	0.481	X	X	X	R square	0.269	X	X	X
SF	0.012	X	X	X	SF	0.084	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
CZE	Coefficients	P-value	Lower 95%	Upper 95%	POL	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	4.023	0.012	1.084	6.962	Intercept	1.090	0.540	-2.737	4.917
X var 1	-117.652	0.130	-276.603	41.299	X var 1	38.558	0.597	-118.705	195.820
R square	0.214	X	X	X	R square	0.029	X	X	X
SF	0.130	X	X	X	SF	0.597	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
EST	Coefficients	P-value	Lower 95%	Upper 95%	ROU	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	4.159	0.069	-0.399	8.717	Intercept	7.809	0.000	4.440	11.178
X var 1	-27.745	0.700	-183.417	127.927	X var 1	-251.434	0.011	-431.877	-70.991
R square	0.016	X	X	X	R square	0.491	X	X	X
SF	0.700	X	X	X	SF	0.011	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LVA	Coefficients	P-value	Lower 95%	Upper 95%	SVN	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	8.064	0.097	-1.751	17.878	Intercept	2.454	0.084	-0.392	5.301
X var 1	-165.961	0.289	-496.346	164.425	X var 1	-47.364	0.602	-243.417	148.689
R square	0.111	X	X	X	R square	0.028	X	X	X
SF	0.289	X	X	X	SF	0.602	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X
LTU	Coefficients	P-value	Lower 95%	Upper 95%	SVK	Coefficients	P-value	Lower 95%	Upper 95%
Intercept	2.739	0.284	-2.654	8.133	Intercept	2.414	0.101	-0.561	5.389
X var 1	12.098	0.874	-154.009	178.204	X var 1	-40.762	0.549	-187.101	105.578
R square	0.003	X	X	X	R square	0.037	X	X	X
SF	0.874	X	X	X	SF	0.549	X	X	X
Obs.	12.000	X	X	X	Obs.	12.000	X	X	X

We estimate the contribution of independent variable revenues from European funding to the change in the prices of goods and services measured by Y-o-Y inflation rate in the CEE countries based on the regression analysis. The values of the coefficient R^2 are positioned in the central and lower halves of the scale determining the strength of the dependence Al-Samman [23] (see Figure 8). The dark blue colour of the map presenting the CEE results marks the strengthening influence of the factor variable. With the current pair of variables, this is most clearly expressed in Romania and Bulgaria where R^2 values of 0.49 and 0.48 respectively, i.e. above 48-49% of the changes in the empirical values of the inflation coefficient on an annual basis are explained by the change in the factor variable. Among the other countries, the dependency is average or below with Lithuania approaching zero. Thus, the current results colour the map a lighter blue marking the decreasing dependence between the variables. In this sense, we can say that the independent variable significantly affects the indicator in Bulgaria and Romania and among the others inflation is linked to the proceeds from European funding to a relatively lesser extent in other independent circumstances. Figure 8 illustrates the reasoning above.

Figure 8.
R^2 values of the coefficient of dependence "Inflation rate: Revenues from European funding/GDP" of the CEE countries.

The assessment of the adequacy of the model is achieved by tracing the values of the SF indicator. The existence of a relationship between the dependent variable (in this case the inflation rate) and the proceeds from European funding is confirmed in cases where SF < 0.05 (with a confidence interval of 95%). Thus, we find that the model is adequate in six of the countries studied: Bulgaria, Estonia, Lithuania, Latvia, Poland and Slovenia. The p-value shown in Table 5 is another measure of the regression coefficients' significance that follows the same concept. Both variables allow interpretation (i.e. p-value < 0.05) with a view to establishing the direction of the impact of the factor in Bulgaria, Poland and Slovenia for which the adequacy of the model was confirmed above. The positive sign before the regression coefficient (by X var 1 in Table 5) determines the positive direction of the impact of variable receipts from European funding on GDP on the inflation rate in all three countries. In this sense, the increase in EU funding revenues to GDP on an annual basis should have an economic impact on an increase in the consumer price index.

The application of the model for the final factor variable leads to the concurrent performance of the model's adequacy conditions and the presence of a high to medium correlation which in turn leads to the conclusion that only in Bulgaria among the Member States under analysis do the proceeds from European financing have an independent impact on real convergence as expressed by the inflation rate.

In the other nine countries, the change in the prices of goods and services is linked to the EU financing factor to a lesser extent.

5. Conclusion

We can conclude that significant progress has been achieved in terms of convergence between CEE countries in 2007-2018 based on the calculations and analysis made. The results confirm the tested neoclassical hypothesis that countries with worse initial performance (less developed countries) mark faster growth rates compared to stronger development and vice versa in three of the studied indicators (without the Gini index) for certain Member States but not in all. In Bulgaria and the Czech Republic in particular, convergence is measured in terms of income growth measured by GDP per capita and changes in consumer prices in Hungary, Poland and Slovakia, unemployment and inflation in Slovenia, income growth as measured by GDP per capita and unemployment in Lithuania in the change in employed and unemployed persons and in Latvia in the change in consumer prices. In two of the countries studied (Estonia and Romania), the data do not confirm hypothesis above but this does not exclude them from the overall picture of achieved convergence at the regional level such as CEE. It is also found that cash inflows from operational programmes have an independent impact on economic convergence indicators in only some of the CEE countries. In a negative aspect, the results in terms of unemployment and inflation are interpreted in Bulgaria where an average positive relationship between independent and dependent variables is found as well as in Slovenia for income inequality. It should also be noted that in the indicator of income growth (GDP per capita), none of the countries registers a commitment to funding under operational programs. The results raise discussion questions about the approaches to measuring the real effect of the budget resource allocated at the European level considering the fact that the second half of the study period is characterized as relatively stable compared to its first half which are marked by the global economic crisis.

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