AKADÉMIAI KIADÓ

Is the European Union still a convergence machine?

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ABSTRACT

We investigate whether the European Union can be considered as a convergence machine after the 2008/2009 financial crisis. To do so, we econometrically test the relationship between the per capita GDP growth rate and macroeconomic variables in the period of 2004–2018, further subdivided into three periods: 2004–2008, 2009–2013 and 2014–2018. We hypothesize that the 2008/2009 financial crisis had a negative effect on the σ and β-convergence process. Our results support the convergence hypothesis, namely that the poor countries tend to grow faster than the rich countries. The convergence rates ranged between 1.71% and 4.51%. The negative effects of the crisis on convergence have been identified only for the absolute convergence. Our findings demonstrate that economic openness, inflation and government integrity have a positive impact on growth. The effects of unemployment have not been identified.

1. INTRODUCTION

In this paper, we analyze the real economic convergence process in the 28 countries of the European Union (EU-28). The analyzed period is 2004–2018; therefore, the United Kingdom is

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included in the convergence analysis. The research is focused on σ and β-convergence during the analyzed period and three sub-periods, i.e., 2004–2008, 2009–2013 and 2014–2018.

Convergence has been in focus of the European Union (EU) since the Treaty of Rome and its importance has not diminished over time. On the contrary, it has become especially relevant with the accession of the former socialist countries in 2004 and the international financial crisis that hit the world economy in 2008.

According to the World Bank report (2018), the EU has become the modern world's greatest "convergence machine". Convergence is defined as a tendency of poor countries to grow faster than rich countries in per capita terms (Barro – Sala-i-Martin 1992). Throughout its history, the EU has taken measures to help the less developed countries catch up with more developed ones. In the Treaty of Rome, common policies to promote "harmonious economic development and balanced expansions" were adopted. Following the accession of Ireland (1973), Greece (1981), Portugal and Spain (1986), which lagged behind the EU average, the European Regional Development Fund (ERDF) was created in 1975. The main objective of this Fund was to assist the underdeveloped regions in the catching-up process.

Perhaps the EU's greatest challenge was the accession of the 8 Central and Eastern European (CEE) countries in 2004. These were the transition countries that needed to transform from a centrally planned economy to a market economy. The transition process went relatively smoothly with the help of the EU. In 1993, the EU established a set of criteria (the Copenhagen criteria) that every former socialist country had to fulfill in order to become a Member State (MS) and to be able to cope with the pressures of the EU membership. The criteria pertain to economic, political, and institutional issues and they still apply for all potential new MSs. In this process, each potential MS receives financial help from the EU through the pre-accession funds. Once a country joins the Union, it has access to the European Structural and Investment Funds (ESIF). The transition process in the CEE countries was successful and in the first years after the enlargement, their economies performed better than expected, which resulted in more trade and foreign direct investment (FDI), and decrease in unemployment. Between 2007 and 2015, 5 CEE countries adopted the euro as their currency. In order to do so, they had to fulfill the Maastricht or convergence criteria, which required them to stabilize prices, currencies, interest rates, the government debt and deficits. The former socialist countries achieved a certain degree of macroeconomic stability during the first years of their membership (Csaba 2004, 2018).

Accordingly, from the EU's perspective, the notion of convergence cannot be considered as purely a quantitative category. It is also a qualitative category, because it focuses on the development and assimilation of countries. The EU has delivered to its citizens some of the highest living standards and the lowest level of income inequality in the world (Ridao-Cano – Bodewig 2018: 18).

Sigma and beta convergence in the EU have been analyzed since the very start of the transition process of the CEE countries. Analyses of sigma convergence have shown that the CEE countries catching-up with the EU-15 MSs was successful (Kaitila 2013; Mihuţ – Luţas 2013; Micallef 2020; Bisciari et al. 2020). Yet while the dispersion in per capita GDP has decreased between the periphery and the core of the EU, the EU-15 states have exhibited signs of divergence, especially after the 2008 crisis (Micallef 2020).

Most studies have found that the EU countries converge. The CEE countries, which are poorer economies in the analyzed group, converged towards the old MSs even during their transition period (Kulhánek 2014; Colak 2015; Grela et al. 2017; Stanišić et al. 2018). However,

the convergence process in the EU is not homogeneous (Cavenaile – Dubois 2010; Grzelak – Kujaczyńska 2013; Endrődi-Kovács 2013), as countries form clusters, such as the new and the old MSs (Benczes – Szent-Ivanyi 2015).

Recently, a number of studies have analyzed convergence during the financial crisis (Merler 2016; Marelli et al. 2019; Stoica et al. 2019; Díaz Dapena et al. 2019; Rapacki – Próchniak 2019; Bisciari et al. 2020), and all confirm that the crisis had a negative effect on the process.

The EU was negatively affected by the 2008/2009 financial crisis and almost all MSs went into a recession. Most EU countries started recovering after 2013; therefore, we consider the period 2009–2013 as the crisis period. We test not only if the countries converged during the crisis period, but what the effects of the crisis on the post-crisis period were, i.e., did the countries start recovering and were the convergence rates similar to the rates in the pre-crisis period. The aim of this research is to investigate what the effects of the financial crisis are on the EU convergence process and can the EU still be considered as a "convergence machine" in the post-crisis period. Our hypotheses are the following: 1) The dispersion in per capita GDP has decreased in the EU between 2004 and 2018; 2) The absolute convergence rate was lower during the crisis period, as compared to the pre-crisis and post-crisis periods; 3) The conditional convergence rate was lower during the crisis period, as compared to the pre-crisis and post-crisis periods.

This paper analyses the effects of the 2008/2009 crisis on the convergence process in the EU on the basis of three periods: pre-crisis, crisis and post-crisis. This subdivision is one of the novelties of our research. While plenty of studies exist on the effects of the crisis on convergence in the same group of countries, these papers typically consider the period after 2009 as the crisis or post-crisis period, even though most EU economies started recovering only after 2013. To our knowledge, a comparative analysis of the crisis and post-crisis periods does not exist, nor there is any analysis based on three periods of equal length (i.e., 5 years).

The discussion on economic convergence is far from being over. The world economy has faced many challenges in the past 30 years, from the fall of the Berlin Wall in 1989 and the beginning of the transition process to a number of economic crises. The economic effects of the latest, Covid-19 crisis threatened to be even more severe than the financial crisis of 2008.

A further analysis of convergence is more than welcome, as it can show the impact of deeper integration (single market vs. monetary union) or financial crises on the process, and what the main drivers of economic growth are. The literature on economic growth and transition has identified trade, investment, unemployment, government debt and inflation as the main factors that influence economic growth. However, the effect of institutions must not be neglected, as institutions are the fundamental cause of economic growth (Acemoglu et al. 2005: 1).

The paper is organized as follows: *Section 2* presents the methodology and data. *Section 3* discusses the empirical findings on σ-convergence and on absolute and conditional β-convergence. *Section 4* concludes the paper.

2. METHODOLOGY

The methodology for convergence analysis is based on the Solow growth model (1956). Barro – Sala-i-Martin (1992) pioneered the analysis on convergence. Their research focused on the constituting states of the USA between 1840 and 1988. The results, which are considered as a

benchmark for the convergence analysis, showed that the states converged at the rate of 2% per year, regardless of the time period.

The Solow growth model is a model in which there are diminishing returns to scale to each factor of production individually, but constant returns to scale when the factors of production are taken jointly. Solow introduced technology to the growth equation. Technological progress became the residual factor in explaining long-term growth and its level was assumed to be determined exogenously, i.e., independently of all other factors in the model. Therefore, the Solow growth model is also referred to as an exogenous growth model. This model assumes convergence, i.e., that poor countries will grow faster than rich countries and, at some point, they will reach a steady-state or long-term equilibrium.

Economic divergence, a tendency of rich countries to grow faster than poor ones, is also supported by the endogenous growth theory. In the Romer (1986) model technological spill-overs are present. The assumption of the model is that the growth processes derive from the firm or industry level. Each industry produces individually with constant returns to scale. Technical progress is considered endogenous; it is dependent on policy initiatives designed to boost investment in education, training, research and development, economic openness and an increase in foreign trade. There might be a constant or increasing, not diminishing, return on investment as the capital stock increases.

The economic literature on convergence distinguishes two types of real economic convergence, σ and β-convergence. The former is a simple measure of convergence. If the dispersion of real per capita GDP in a group of countries decreases over time, it means that the countries are converging in the sense of σ-convergence (Sala-i-Martin 1996). The measure of σ-convergence can be the standard deviation or the coefficient of variation. However, a problem with using the standard deviation is that it tends to rise as real per capita GDP rises. The coefficient of variation is the standard deviation divided by the mean. If real per capita GDP increases, unlike the standard deviation, the coefficient of variation would remain unchanged. In this research, we use the coefficient of variation as a measure of σ-convergence. If the coefficient of variation decreases, it indicates decreased dispersion and σ-convergence. If the coefficient increases, it indicates σ-divergence.

A necessary condition for the existence of σ-convergence is the existence of β-convergence. The existence of β-convergence tends to generate σ-convergence (Sala-i-Martin 1996: 1021). If there is a negative relationship between the per capita GDP growth rate and per capita GDP in the initial year of the analyzed period, then β-convergence occurs. β-convergence can be absolute and conditional. If countries of one group are converging towards the same steady-state, convergence is absolute. The β coefficient, which captures the speed of convergence during one year, is obtained using a simple linear regression analysis and it has to be negative. If it is positive, divergence occurs. The absolute convergence model (Equation 1) includes one dependent variable (the average real per capita GDP growth rate in the analyzed period) and one independent variable (the initial real per capita GDP of the analyzed period expressed in purchasing power terms (PPP) and computed in natural logarithm). In order to test absolute convergence, we estimate the following linear-log model:

$$\Upsilon_{i,0,T} = \alpha_i + \beta \log(Y_{i,0}) + \varepsilon_i \qquad (1)$$

where β is the convergence coefficient; $\Upsilon_{i,0,T}$ is the average annual growth rate of per capita GDP for country i; $Y_{i,0}$ is per capita GDP at PPP for country i at the beginning of the analyzed period 0; α_i is a constant; ε_i is the stochastic error of the equation; and T is the end of the time interval.

The β coefficient can be used to calculate the half life of convergence, the number of years that it takes for the per capita GDP gap to be cut in half (Ben-David 1996: 286) by using the following formula (Rapacki – Próchniak 2019: 8):

$$t^* = -\frac{\log 0.5}{\beta} = -\frac{0.6931}{\beta} \qquad (2)$$

If countries are homogenous, i.e., if they do not have different political systems, economic structures or institutions, they will converge towards the same steady state, and convergence will be absolute. However, if countries are heterogeneous, they will converge towards a different steady-state and convergence will be conditional. The convergence coefficient is obtained through multiple regression analysis. The conditional convergence model represents an augmented absolute convergence model. The dependent variable, the real per capita GDP growth rate, remains constant; while there are a number of independent variables next to the initial per capita GDP (these variables can be economic, political, institutional or social nature). In this paper, we include four economic and institutional variables; the economic openness rate (EO), the inflation rate (Inf), the unemployment rate (Unemp), and the Government Integrity (GI) index as a proxy for corruption (Equation 3). This analysis follows the classical approach to the convergence analysis presented by Sala-i-Martin (1996). The absolute and conditional convergence process is analyzed through ordinary least square (OLS) regression based on cross-sectional data, using the average values for the analyzed periods.

$$Y_{i,0,T} = \alpha_i + \beta_1 \log(Y_{i,0}) + \beta_2 \text{EO}_{i,0,T} + \beta_3 \text{Inf}_{i,0,T} + \beta_4 \text{Unemp}_{i,0,T} + \beta_2 \text{GI}_{i,0,T} + \varepsilon_i \qquad (3)$$

Economic openness is calculated as a sum of export and import divided by the GDP. Economic openness has a positive impact on convergence, because theoretically, the countries that are more open and trade more should have higher growth rates. We use the average annual change of the Harmonized Indices of Consumer Prices (HICPs) as a measure of inflation. Little inflation is always desirable, but high inflation rates cause uncertainty that hampers economic growth. The unemployment rate is the ratio of unemployed people to the total labor force. High unemployment has a negative impact on GDP growth. Inflation and unemployment are indicators of macroeconomic stability. Government integrity is an institutional variable and a proxy for corruption. The index is derived from the Heriatage Foundation dataset and has values from zero to 100. The lower the value index, the lower government integrity is, i.e., the country is more corrupt. Government integrity has a positive impact on economic growth.

The analyzed period is 2004–2018, with three sub-periods: the pre-crisis sub-period of 2004–2008, the crisis period of 2009–2013, and the post-crisis period of 2014–2018. The sub-periods are included in the analysis to test the effects of the 2008/2009 financial crisis on the convergence process in the EU. According to Islam (1995), five-year periods should be used, because the short-term disturbances may appear at shorter intervals. Even though Bulgaria and Romania joined the EU in 2007, followed by Croatia in 2013, the three countries are included in the analysis since 2004, i.e., in every analyzed period.

In order to investigate the relevant model diagnostics, two tests were conducted with the absolute convergence models and three tests with the conditional convergence models. The

Table 1. Descriptive statistics

Variable	Description	Mean	Standard deviation	Minimum	Maximum
Per capita GDP growth	Annual percentage growth rate of GDP per capita based on constant local currency	1.96	1.56	–0.66	4.84
Log (initial per capita GDP)	Natural logarithm of per capita GDP at the beginning of the analyzed period	10.03	0.47	9.10	11.07
Economic openness	A sum of exports and imports divided by GDP	120.70	66.35	53.92	345.42
Inflation rate	Measured by the Harmonized Index of Consumer Prices	2.15	0.92	1.12	4.65
Unemployment rate	The number of unemployed people as a percentage of labor force	8.74	3.13	4.94	17.13
Government Integrity Index	Measures the level of corruption	0.62	0.18	0.36	0.93

Source: Authors' calculations based on World Bank, Eurostat and Heritage Foundation data.

Breusch-Pagan test, which tests the null hypothesis that the variance of residuals is constant, and the Ramsey RESET test, which tests the null hypothesis that a model has no omitted variables, are used in both types of models, while the test for multicollinearity is used in the conditional convergence models because it tests the correlation among the independent variables. We test for multicollinearity using the variance inflation factor (VIF).

This research is based on annual data. Table 1 presents the descriptive statistics of the variables used in the estimation of the convergence models in the period of 2004–2018. The data set includes twenty-eight countries.

Data for this research come from three sources. Data for the per capita GDP growth rate and per capita GDP (in PPP) for the years 2004, 2009 and 2014, and economic openness have been obtained from the World Bank database. The data for the inflation rate and the unemployment rate have been obtained from Eurostat. The data for the Government Integrity Index originates from the Heritage Foundation web site.

3. RESULTS AND DISCUSSION

This paper analyzes the σ and β-convergence process among the EU MSs in the period of 2004–2018.

3.1. Sigma convergence

Sigma convergence measures the dispersion of per capita GDP among the analyzed countries. Figure 1 shows σ-convergence and divergence in the EU-27[1] MSs between 2004 and 2018. The measure of σ-convergence is the coefficient of variation. The less developed countries have mostly caught up with the more developed ones in the analyzed period. The average per capita GDP of the CEE countries increased from 47.3% of the EU-14 average in 2004 to 64.9% in 2018. The results indicate that the EU membership has been beneficial for the CEE countries, as income disparities among the EU countries decreased between 2004, when most of the countries joined the EU, and 2018. Other studies confirm sigma convergence during different periods (Vojinović et al. 2009; Kaitila 2013; Mihuţ – Luţas 2013; Dvoroková 2014; Blaško 2016; Micallef 2020; Bisciari et al. 2020).

There are only three years of divergence, 2009, 2015 and 2018, which indicates that the countries were catching up during the 2008/2009 financial crisis. The results do not provide sufficient evidence to reject the first research hypothesis, and we can conclude that the catching up of the CEE countries with the EU-14 MSs was successful.

After 2008, σ-convergence was relatively stable in the analyzed group. The process of catching up of the CEE countries with Western Europe (EU-15) accelerated after their EU accession, but it was adversely affected by the financial crisis (Rapacki – Próchniak 2019: 37). The region grew on average at a rate of 7.1% between 2004 and 2007, while the EU-15 growth rate was 2.5% in the same period. After the start of the financial crisis, all countries, except Poland, went into a recession. The highest average drop of per capita GDP growth rate in the CEE region was 7.2% in 2009. Even though the countries started to recover the next year, they never reached the pre-crisis growth rates. The highest average rate in 2017 was 4.9%. The EU-15 countries started to recover after 2013. In the period of 2014–2018, their average per capita GDP growth rate was 2%, which was slightly lower than the rate during the pre-crisis period.

3.2. Beta-convergence

Beta-convergence occurs when there is a negative relationship between the per capita GDP growth rate and per capita GDP at the beginning of the analyzed period; i.e., when poor
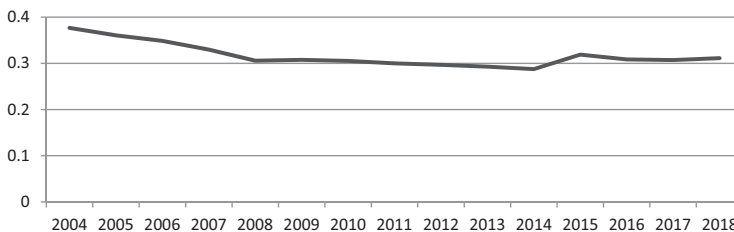
Fig. 1. σ-convergence in the EU-27, 2004–2018
Source: Authors' calculations based on World Bank data.

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[1]As an outlier, Luxembourg was excluded from the analysis. In 2018, the country's average GDP was 2.8 times higher than the CEE average.

countries have higher per capita growth rates than rich countries. In this analysis, the focus is on the absolute and conditional β-convergences.

We tested the hypotheses that the convergence rates during the crisis period (2009–2013) were lower as compared to the pre-crisis (2004–2008) and post-crisis (2014–2018) periods. Eight convergence models, i.e., four absolute convergence models (Models 1–4) and four conditional convergence models (Models 5–8), were estimated.

Table 2 presents the regression results for absolute convergence in the analyzed periods.

The empirical analysis shows that the EU MSs converged in every analyzed period, except in the period of crisis. The β coefficient for the period 2004–2018 is negative, at –2.43, and highly significant at the P-value = 0.0000. The countries converge towards the same steady-state at a rate of 2.4% per year, which is higher than the rate of 2% from the Barro and Sala-i-Martin (1992) findings. We use the β coefficient to calculate the half-life of convergence and conclude that it takes 29 years for the income gap to be cut in half in the EU. The convergence rate in the pre-crisis period is the highest, at 4.51%. The EU accession accelerated the growth of the CEE countries. The average per capita growth reached 7.6% in 2007, compared to the average rate of 3.24% in the period of 1999–2003, and dropped to 0.2% during the crisis. In the crisis period, the β coefficient was negative, but not statistically significant. The convergence rate decreased to 1.71% during 2014–2018. In the post-crisis period, the CEE countries had a positive average growth rate (3.8%), but this was lower than the pre-crisis rate. The EU-15 group recorded a growth rate of 2.02%, which was 0.22 percentage points higher than the rate during the period of 2004–2008.

Considering the fact that the countries did not converge during the crisis period, but they converged in every other analyzed period, it can be concluded that the 2008/2009 financial crisis had a negative effect on convergence, which is also confirmed by Stoica et al. (2019) and Novac –

Table 2. Absolute convergence among the EU-28 member states

	Model 1 2004–2018 β (t)	Model 2 2004–2008 B (t)	Model 3 2009–2013 β (t)	Model 4 2014–2018 β (t)	Model 4' 2014–2018 β (t)
Log of initial per capita GDP	–2.43*** (–5.56)	–4.51*** (–7.44)	–1.27 (–1.54)	–1.71* (–1.76)	–1.71* (–1.78)
Half-life	29	15	-	41	41
Number of observations	28	28	28	28	28
Number of panel observations	420	140	140	140	140
F statistics (P-value)	30.87 (0.0000)	55.30 (0.0000)	2.39 (0.1346)	3.10 (0.0903)	3.16 (0.0872)
R^2	0.5428	0.6802	0.8071	0.1064	0.1064
Breusch-Pagan test	0.2760	0.8668	0.8071	0.0082	

Notes: Significance codes: ***P < 0.01, **P < 0.05, P^* < 0.1.
Source: Authors' calculations based on World Bank data.

Moroianu-Dumitrescu (2020). The financial crisis brought a reduction in output per capita growth and lower income convergence across the EU (Cabral – Castellanos-Sosa 2019). Convergence appears less intense and significant during the period of 2009–2016, which was caused by the slow growth of the middle-income or low-income countries that were hurt by the sovereign debt crisis (Marelli et al. 2019). According to Merler (2016), during the crisis, the regions in the Eurozone and the old MSs stopped converging – or even started diverging. The results are confirmed for the state level (Bisciari et al. 2020). The convergence rate in the post-crisis period was lower as compared to the pre-crisis period, but the countries started to recover after the crisis. The empirical results do not provide sufficient evidence to reject the first research hypothesis.

The problem of heteroscedasticity is presented in Model 4. When regression with a heteroscedasticity robust standard error (Model 4) is estimated, the issue of heteroscedasticity is corrected and the β coefficient remains unchanged. It has to be emphasized that there is a relatively weak fit of Models 3 and 4 to data as the coefficients of determination (R-squared) have low values. Figures 2 and 3 show that there is a higher degree of heterogeneity among the EU-28 MSs in the crisis and post-crisis periods, compared to the entire analyzed period; i.e., the countries are more scattered around the regression line, which is consistent with the low R-squared values.

Figure 4 indicates absolute convergence among the EU MSs in the period of 2004–2018, it plots per capita GDP in 2004 (X-axis) against the average annual per capita GDP growth rate in the analyzed period (Y-axis).

The line of fitted values has a downward slope, therefore it shows a negative relationship between the two variables. Figure 4 also shows a high level of heterogeneity in the analyzed group. It is evident that there is a polarization between the new and the old MSs of the EU,
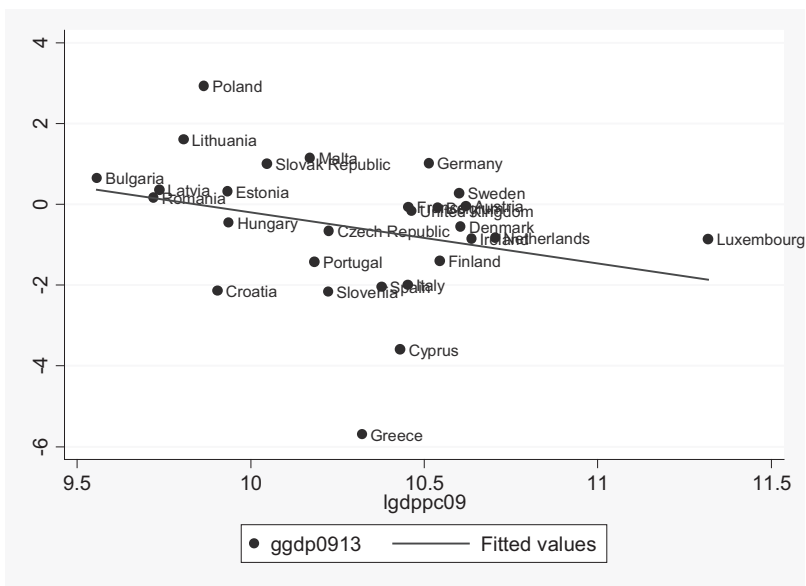

Fig. 2. Absolute convergence in the EU-28 between 2009 and 2013
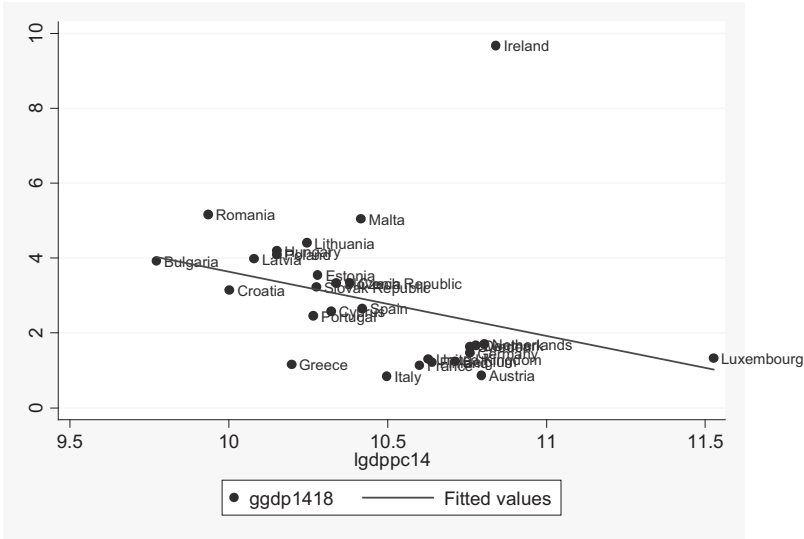*Source:* Authors' calculations based on World Bank data.

Fig. 3. Absolute convergence in the EU-28 between 2014 and 2018
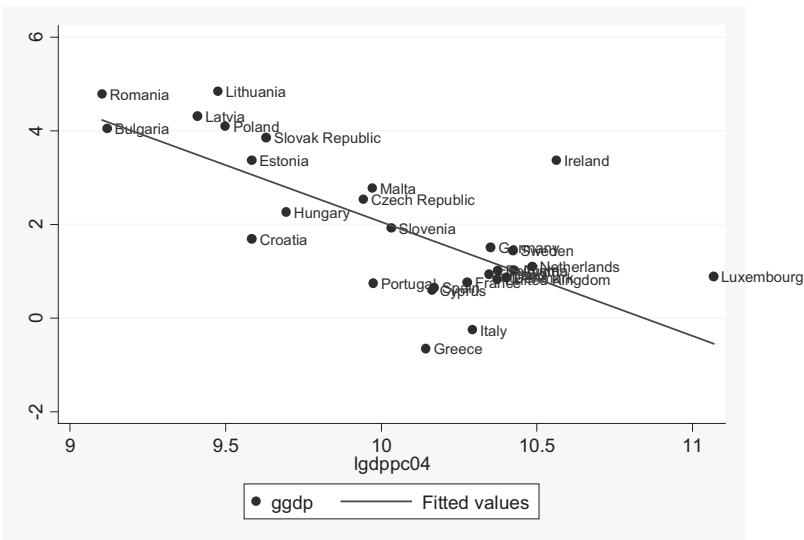*Source:* Authors' calculations based on World Bank data.

Fig. 4. Absolute convergence in the EU-28 between 2004 and 2018
Source: Authors' calculations based on World Bank data.

where the new MSs are positioned in the upper left corner, again indicating convergence. However, a few clusters emerge among the new MSs. Cyprus is the only new MS that converges with the old MSs.

The CEE countries had higher growth rates in every analyzed sub-period. Before the crisis, the countries grew at an average rate of 6.1%, while the rate in the EU-15 was 1.8%. During the crisis, almost all countries entered a recession and the average growth rate was 0.2%, as compared to –1% in the EU-15.

After the enlargement the growth of the new MSs accelerated, which can be attributed to a number of factors. The countries became more globalized, as they liberalized trade and capital flows, which led to increased trade with the old MSs and the rest of the world. Since the labor force was cheaper than in the core of the EU, the CEE countries attracted more foreign direct investment, which improved the quality of their products, and increased labor productivity and competitiveness. After a transition recession and price liberalization, the countries decreased their inflation rates and became more stable, which also attracted investors. During the transition process, the former socialist countries had to go through structural reforms and establish institutions that were nonexistent in the previous system. As a result, the level of corruption decreased, the judicial system became more effective and property rights were better protected.

The transition was faster and more successful with the EU's help. On their way towards the EU membership, the transition economies had access to the pre-accession EU funds. Once they joined the Union, the countries gained access to the European structural and investment funds. The EU structural funds, aimed to foster the development of the poorer countries and regions of the EU, had a significant role in accelerating the pace of convergence (Rapacki – Próchniak 2019: 13). Greater budget transfers from structural funds meant new resources for improving competitiveness, particularly in terms of infrastructural investments (Palánkai 2010: 12). Through the Cohesion Policy 2007–2013, EUR 346.5 billion was injected into the EU. The investments were a vital source of capital, representing 24.5% (Slovenia) to 57.1% (Hungary) of government capital investment (European Commission 2016). The Cohesion Policy had a positive effect in many areas, from job creation to a reduction of regional disparities and an increase in the GDP. In 2014–2020, the total budget of the ESIF was EUR 351.8 billion. The CEE country that benefited most from ESIF funding in this period was Estonia (EUR 3.362 per capita), while Bulgaria received the least amount (EUR 1.363 per capita). A large inflow of structural funds to the new MSs might be one of the key preconditions for a fast convergence process in the EU in the coming years (Rapacki – Próchniak 2019). The funds have a positive effect on per capita GDP growth, thus allowing the regions to reach convergence (Maynou et al. 2016; Goecke – Hüther 2016). In the next section, we will analyze the effects of some of the aforementioned variables on the convergence process in the EU.

3.3. Conditional convergence

If countries are more heterogenous, their convergence process will be conditional. Four conditional convergence models were estimated in this analysis (Models 5–8), and they all included economic and institutional variables: economic openness, the inflation rate, the unemployment rate, and the Government Integrity Index. Table 3 presents the results for the conditional convergence models.

The regression results show that the less developed countries of the EU converged in every analyzed period. The conditional convergence rates were higher than the absolute convergence rates, except in the pre-crisis period, which indicates that the countries differed in their structures. The determinants of convergence are economic openness, the inflation rate and

Table 3. Conditional convergence among the EU-28 member states

	Model 5 2004–2018 B (t)	Model 6 2004–2008 β (t)	Model 7 2009–2013 β (t)	Model 8 2014–2018 β (t)
Log of initial per capita GDP	–3.84*** (–5.04)	–3.81*** (–2.94)	–4.39*** (–3.68)	–4.14** (–2.30)
Economic openness (%)	0.01*** (3.45)	0.01 (1.60)	0.01* (1.97)	0.01*** (2.65)
Inflation rate (annual %)	–0.03 (0.10)	0.47* (2.02)	–0.07 (–0.20)	–0.64 (–0.86)
Unemployment rate (% of labor force)	–0.03 (–0.46)	0.06 (0.43)	–0.13 (–1.65)	–0.06 (–0.57)
Government integrity	3.28* (1.99)	2.07 (0.88)	5.80** (2.37)	3.34 (0.88)
Number of observations	28	28	28	28
Number of panel observations	420	140	140	140
F statistics (P-value)	14.46 (0.0000)	15.83 (0.0000)	4.10 (0.0088)	3.01 (0.0322)
R^2	0.7667	0.7825	0.4823	0.4063
Breusch-Pagan test	0.7917	0.0927	0.4749	0.1554

Notes: Significance codes: ***$P < 0.01$, **$P < 0.05$, $P^* < 0.1$.
Source: Authors' calculations based on World Bank, Eurostat and Heritage Foundation data.

government integrity. The β coefficients for the unemployment rate are not statistically significant in the analyzed periods. The problem of heteroskedasticity and multicollinearity are not detected in any of the estimated models (*Tables 3* and *4*).

The CEE countries went through a transition process – from a centrally planned to a market economy. One of the characteristics of the former system was limited trade, as the economies were closed and could trade only with specific countries. In the 1990s, the CEE countries opened their economies. After the accession, the trade of the CEE countries increased both with the EU-15 states and with the world. The CEE countries benefited from the lifting of trade barriers; their average annual growth rate of exports of goods was 9% between 2002 and 2019. The average rate in the old MSs was 3.5% (European Commission 2020c). The accession increased investment, which improved labor productivity and the quality of products, and also increased the competitiveness. This research has shown that economic openness has a positive effect on per capita growth, which is confirmed by Rapacki – Próchniak (2009), Szeles – Marinescu (2010), Stoica et al. (2019), and Popovic et al. (2020). The average economic openness rate of the CEE countries increased from 111.3% in the period of 2004–2008 to 133.9% in the period of 2014–2018. In the EU-15, economic openness increased from 100.9% to 117.9%.

The CEE countries have become more stable economies. One of the characteristics of the centrally planned system was that prices were fixed and determined by institutions, and not by the law of supply and demand. When the system collapsed, the former socialist countries faced hyperinflation, which started to stabilize in the mid-1990s. Between 2004 and 2008, the average inflation rate in the CEE countries was 5.4%, as compared to 2.4% in the EU-15. The present research indicates that inflations had a positive effect on per capita GDP growth within this period.

The positive effects of inflation on economic growth are confirmed by Hasanov (2010) and Kryeziu – Durguti (2019). The situation is explained by the Balassa-Samuelson effect (1964). The Balassa-Samuelson effect assumes that the economies, where productivity grows faster, will have higher inflation rates. However, the inflation differentials should not be a matter of concern because they are the result of an equilibrating mechanism (de Grauwe 2009: 41). The rate decreased to 0.81% in the post-crisis period and was almost equal to the rate of the EU-15 countries, at 0.78%. One of the reasons for the decrease was that five CEE countries joined the Eurozone, i.e. they adopted the euro as their currency in the period of 2007–2015. If a country wants to join the Eurozone, it has to fulfill the convergence criterion on price stability, which requires that the country's inflation rate does not exceed 1.5 percentage points of the average of the three lowest inflation rates in the EU (European Commission 2020a). The European Central Bank recommends the inflation rate of 2%. In 2018, seven of the CEE countries (some of them are Eurozone members) produced inflation rates that exceeded this value. The highest inflation rate was in Romania, at 4.7%. Theoretically, inflation has a negative effect on per capita growth, which has been confirmed by Vojinović et al. (2009) and Stoica et al. (2019). However, Szeles – Marinescu (2010), Ulaşan (2012) and Rapacki – Próchniak (2019) found that this negative relationship is not statistically significant.

Economic transition is a process of institutional change, a process of building new institutions required by a capitalist economy (Redek – Sušjan 2005: 995). A lack of institutions in the socialist system led to increased corruption in the former and current transition economies. The former socialist countries that joined the EU have benefited from a strong institutional change and performance compared to the transition countries (Aralica et al. 2018). Institutions should have a positive impact on economic growth. This has been confirmed for the new MSs of the EU, including Croatia, in the period of 1996–2012, as a higher level of institutional development was associated with higher levels of per capita GDP (Buterin et al. 2017: 1590). The Government Integrity Index values ranged between 0 and 100, and countries with the lower index were more corrupt. This research confirms that government integrity has a positive effect on the per capita growth rate. In the CEE countries, the average value of the index increased from 43.5 in the pre-crisis period to 50 in the post-crisis period. At the same time, the index decreased from 76.7 to 72.1 in the EU-15 countries. The quality of institution has a positive effect on economic growth and promoting convergence, which is confirmed by a number of studies (Borys et al. 2008; Marelli – Signorelli 2010; Masuch et al. 2017; Żuk – Savelin 2018; Stoica et al. 2019).

We find that unemployment is the only variable that does not have an impact on per capita growth. The variability of data is low, as the coefficient of variation for each period is less than one. The average unemployment rates among the two groups of countries in the EU-28 do not differ significantly (2 percentage points) and the rates are not much higher than the natural unemployment rates. However, the effects of unemployment on economic growth cannot be neglected. During socialism, unemployment was virtually nonexistent. Most enterprises were state-owned, but when the transition process started, the companies went bankrupt and they were privatized. Privatization is a slow process and workers that were employed in those companies lost their jobs. Countries that knew nothing about unemployment all of a sudden faced unemployment rates that reached double digits. However, foreign investors either privatized the companies or started new businesses and employed the labor force. The highest average unemployment rate, 11.5%, was recorded in 1995, and ranged from 4% in the Czech Republic to 19% in Latvia. By 2018, the average rate decreased to 5.3%. The highest rate, 8.4%, was in Croatia; the lowest rate was measured again in the Czech Republic, at 2.2%.

The empirical results show that even though the countries converged in every analyzed period, the convergence rates were higher in the crisis and the post-crisis periods, as compared to the pre-crisis period. The results indicate that the 2008/2009 financial crisis did not have a negative effect on the conditional convergence process. Based on the results, we reject the third research hypothesis.

4. CONCLUSION

This paper investigated the convergence process among the 28 MSs of the EU, including the United Kingdom, in the period of 2004–2018. In order to test the effects of the recent financial crisis on convergence, three sub-periods were established: 1) the pre-crisis period of 2004–2008; 2) the crisis period of 2009–2013; and 3) the post-crisis period of 2014–2018. Sigma convergence and two types of beta convergence, absolute (unconditional) and conditional, were analyzed.

The per capita GDP dispersion among countries decreased in the analyzed period, indicating σ-convergence. There are only three years of σ-divergence and the countries mostly converged during the crisis period. Based on the results, there is no sufficient evidence to reject the first research hypothesis.

The empirical results demonstrated absolute convergence among the EU MSs in the pre- and post-crisis periods, implying that the 2008/2009 financial crisis had a negative impact on the absolute convergence process. Therefore, we do not have sufficient evidence to reject the second research hypothesis.

The negative effects of the 2008/2009 financial crisis on the conditional convergence process have not been identified. According to the regression results, the conditional convergence rate reached its peak during the crisis period. In other words, the analyzed countries differ in their structure and converged towards different steady-states, since the conditional convergence rate were higher than the absolute convergence rates with the exception of the pre-crisis period. Based on the empirical results, we reject the third research hypothesis.

Among the included variables, economic openness, inflation and government integrity had a positive impact on the convergence process in at least one of the analyzed periods. The unemployment rate was the only statistically insignificant variable in the estimated models.

The 2008/2009 financial crisis had a negative effect on the absolute convergence process. The EU MSs were recovering and converged in the post-crisis period, in both absolute and conditional terms. Based on the empirical results from this research, the EU can still be considered as a convergence machine.

The investigation could have been extended to the analysis of institutional effectiveness on the convergence process. We attempted to do so, but a problem of multicollinearity occurred between the Government Integrity Index and the Property Rights Index on the one hand, and the Government Integrity Index and the Judicial Effectiveness Index on the other. Thus, we had to exclude these variables from the analysis, which is the main limitation of this study. In the next stage of our research we anticipate the inclusion of a panel data analysis.

This research can be extended to other groups of countries, such as the transition economies, as the Western Balkan and Eastern Partnership countries have special relations with the EU. Also, the effects of the recent Covid-19 crisis on convergence should be investigated in the future.

Empirical results can serve as a recommendation for countries when they are deciding on policies that should promote economic growth. Convergence is not an automatic process, and

the CEE countries did not start the catching-up process on their own. EU accession, access to the single market, reduced barriers to trade, increased investment and new job opportunities, together with structural and institutional changes, led to growth acceleration in the years following the enlargement. The countries continued to catch up with the EU-15 after the crisis, but at a lower rate. This research has shown that countries should maintain or even increase their economic openness and improve institutional effectiveness, as these factors have a positive impact on growth. Also, they should stabilize prices, because some countries, even though they are members of the Eurozone, have inflation rates higher than 2%.

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