

Econometric Assessment of the Degree of Economic Convergence between Member States of the European Union

Elena Mădălina OPRIȚESCU¹

¹University of Craiova
oprutescumadalina@yahoo.com

Abstract. *One of the important objectives of the European Union is to support economic growth based on economic, social and territorial cohesion between Member States. Due to the accession of relatively poor countries to the European Union, maintaining cohesion is and will remain a major challenge, with cohesion policy having to support the reduction of imbalances between the old Member States and also support the development of less developed regions. One of the main measures adopted by the European authorities emphasizes the importance of increasing the degree of economic convergence between Member States by promoting a common market along with an economic and monetary union. In addition, increasing productivity and convergence within the EU are the foundations of the Lisbon Strategy and remain an important pillar of the Europe 2020 Growth Strategy.*

Keywords: Economic growth, regional development, sigma convergence, beta convergence.

JEL classification: E01, O47, O52.

1. Introduction

Concerns about convergence arise from Solow's first economic growth theory (1956) and later in studies by Abramovitz (1986), Baumol (1986), Barro and Sala-i Martin (1992 and 1996) as a goal to highlight catch-ups in some countries, regions or areas with a low level of economic development compared to other advanced ones. In a broader sense, convergence implies, in fact, the approach to the same level of development and welfare of a group of countries or regions. The exact definition of convergence can be difficult to achieve. The most important element of the theoretical framing of convergence is the alignment of gross domestic product per capita. However, in order to increase GDP per capita, a number of other indicators, both economically and socially relevant, are needed to converge to an established benchmark. Under these circumstances, Dauderstädt (2014) defines convergence from three perspectives: i) real convergence in terms of income, standard of living, employment rate, etc; ii) policy convergence (eg fiscal policy, monetary policy, social policy, labor market, but also foreign policy) and convergence of institutions (eg central bank independence); iii) the convergence of attitudes and opinions (eg the degree of acceptance of EU membership or political, cultural or social preferences).

Given the importance of regional development and economic convergence, the analysis of the impact of cohesion policy on the economic growth of the EU Member States as well as at the level of Romania's regions, is essential.

2. Methodology

In order to add depth to the scientific study but also to support with real data the theoretical issues discussed, econometric modeling was used with the econometric

program Eviews 7.0 and the statistics program Stata 12.0. These programs will allow to draw clear conclusions on the level of convergence in the European Union Member States but also regarding the Romanian regions, by testing the Sigma and Beta convergence assumptions. As such, the *validity of convergence was tested both at the European Union level and at the level of Romania during 2007-2016*. Specifically, we started from two hypotheses:

H(a): Within the European Union, there has been economic convergence between Member States.

H(b): In Romania, there was economic convergence between the eight development regions.

The validity of the two hypotheses supports a balanced regional development with effects on the reduction of economic gaps. The rejection of the two hypotheses would indicate that the functioning of the European Union does not lead to a balanced growth but also that the structural funds have not resulted in a balanced regional development in Romania.

In order to reach the set goals, models based on the *beta and sigma convergence* hypothesis were estimated. Generally, to estimate the level of convergence, the most commonly used convergence tests are β and σ . These tests have also been applied in the present case in order to identify the level of convergence in GDP between the European Union and Romania.

Although challenged by economists such as Friedman (1992) and Quah (1993) as irrelevant to the true convergence process of economic growth, the concept of beta convergence has nevertheless been imposed in economic literature. Friedman points out that, according to the definition, beta convergence can be replaced by the change in GDP/capita, and Quah notes that the analysis of convergence is one that highlights the dynamics of income distribution.

However, the methodology used by Barro and Sala-i-Martin for measuring beta convergence involved estimating a regression equations of economic growth, namely the establishment of the increase in GDP/capita for a time T and the initial GDP per inhabitant in year t0; this issue of recovering or removing development gaps between EU Member States remains an essential topic of great relevance to the European Union's Economic and Scientific Strategy.

The concept of sigma convergence evaluates the process of reducing regional economic disparities over time, representing a breakdown of income distribution among the economies (Young, Matthew, Higgins 2008). The results obtained are similar to those provided by other specialist studies that have focused on Sigma convergence analysis among the new Member States. One of them is the one elaborated by Ingiani A. and Zdarek V. (2007), studying convergence in the new EU countries (2004, 2007), achieving clear results in reducing the dispersion of income among the economies. Moreover, Matkowski, Próchniak (2004) confirms the existence of Sigma convergence between the new EU member states.

For β convergence, we will use the following equation:

$$\ln PIB_{i,t} - \ln PIB_{i,t-1} = \alpha + \beta \ln PIB_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where:

$PIB_{i,t}$ is gross domestic product per capita within the purchasing power standard, expressed in logarithm, in country i in year t;

$PIB_{i,t-1}$ is the gross domestic product per capita within the purchasing power standard in country i in year t-1;

$\varepsilon_{i,t}$ is the error.

There is β convergence if the associated β coefficient is negative. β convergence implies that countries with a lower level of efficiency have higher growth rates than those with higher efficiency.

Equation (1) is based on a dynamic analysis, taking into account developments in each year. However, there is a more static approach to beta convergence, where the analysis is made taking into account two reference years: the base year and a year considered relevant for the estimation of convergence. To give robustness to estimates and the model, this approach has also been used. We considered 2007 as the base year, and 2016 as the final year, for which the assumptions of convergence were tested. In this context, equation (1) becomes:

$$\ln PIB_{i,2016} - \ln PIB_{i,2007} = \alpha + \beta \ln PIB_{i,2007} + \varepsilon_{i,t} \quad (2)$$

D. T. Quah (1996) considers that estimation of β convergence does not provide information on the evolution of time dispersion. To remove this disadvantage, the σ convergence, which captures the evolution of the dispersion of a sample, was estimated. Thus, convergence will result if the level of dispersion decreases in the analyzed period. The two convergence measures are complementary but not excluded: β convergence is a necessary but not sufficient condition for σ convergence. For the σ convergence, the following equations were used:

$$\Delta W_{i,t} = \alpha + \beta W_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

$$W_{i,t} = \ln PIB_{i,t} - \ln MPiB_{i,t} \quad (4)$$

where $\ln MPiB_{i,t}$ is the average $\ln PIB_{i,t}$ for each t period.

σ convergence will exist under the condition that the associated coefficient β is negative. Below are some aspects of the data included in the estimates. First, to study convergence in EU Member States, gross domestic product per capita was used in the purchasing power standard. Data were extracted from the database of the World Bank for the period 2007 - 2016. Second, to test the hypothesis convergence regions of Romania we used GDP per capita in purchasing power standards. Data were extracted from the Eurostat data during the period 2007 - 2015. We elected this period pd time given the fact that 2007 was the year of Romania's accession to the European Union, which will allow assessment of the impact of this process on development. Finally, it should be noted that in order to ensure the stability of the data series and in line with the literature studies, the data series were logarithmized.

3. Interpretation of indicators

(a). *Regional development in the European Union*

The analysis begins with the presentation of the results obtained by estimating equation (2), which tests the existence of beta convergence, because this model will allow for a wider interpretation of the results. For the European Union, the results obtained are presented in figure 1, the regression equation being included in the figure.

In figure 1, the horizontal axis is the value in the logarithm of GDP at PPC in 2007, while on the vertical axis is the GDP growth average of the PPP in the period 2007-2016, calculated as the logarithm difference between the values in the years 2016 and 2007. The results show some relevant issues. In principle, a certain degree of real convergence can be observed in the analyzed sample. This fact is also indicated by the results of the linear regression and the fact that the model represents quite well the analyzed data ($R^2 = 0.28$). The negative value of the independent variable (-0,18) indicates a negative relationship between the initial GDP values at the PPP and the

growth rates for the period 2007-2016. This indicates that countries with the lowest GDP per capita had much higher growth rates than countries with high GDP. This finding is not confirmed, however, for all countries in the sample. Thus, interpretation is valid, especially for the Central and Eastern European countries, given that Romania, Bulgaria, Latvia, Lithuania, Estonia, Poland, Slovakia, Hungary, the Czech Republic, Croatia, the countries with the lowest level of GDP in PPP in 2007, had the largest increases in GDP in the PPP during the analyzed period. These results are somewhat intuitive. Central and Eastern European countries (CEE) form a group of countries that have undergone similar development phases: moving from a planned, socialist economy to a market economy, restructuring of the public sector, the reforming process, the liberalization process etc. In addition, high GDP growth over the period under review can also be explained by the low base effect. More specifically, any increase is more significant if we relate to a low initial GDP, such as the CEE countries, compared to a higher initial GDP.

Luxembourg has a special case due to the nature of the financial system in this country and will not be subject to any interpretation. If we look at the Eurozone countries that adopted the single currency in 1999 and 2000, the convergence process is no longer so obvious. Moreover, the results indicate rather a GDP per capita divergence in PPP. Thus, Greece, Italy, Spain, Portugal, low-GDP countries in 2007 had some of the lowest growth rates in the analyzed period, which kept the development gap (Italy, Portugal and Spain) or significant increase in the gap (Greece). Also, with the exception of Greece, the weakest performance in terms of growth can be seen in Spain, one of the countries with a high per capita GDP in PPP in 2007. Similarly, low growth rates are also observed in the case of France. For the countries that originally formed the Eurozone, we see the best performances in the case of Ireland, Germany and Austria, which had the highest GDP growth in the analyzed period. The results obtained are consistent with other literature studies (Dobrinisky and Havlik, 2014, ECB, 2015) indicating that there is beta convergence at EU level, but the rate of convergence in the analyzed period is very low, reaching 1.86%. In some regions of the EU (the euro area, for example), the data seem to indicate a certain divergence.

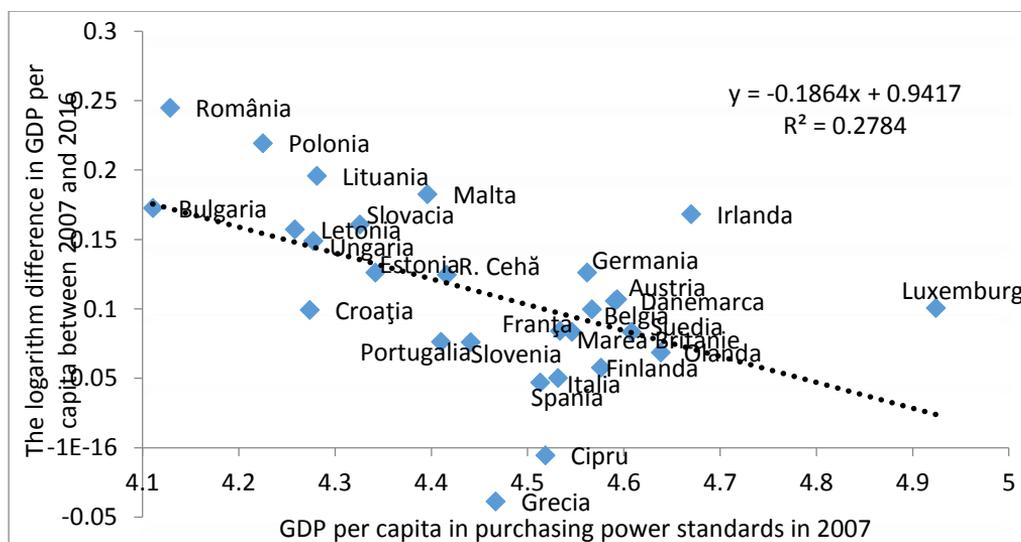


Figure no. 1 – Beta convergence in the European Union, based on GDP per capita (2007-2016)

Source: own estimates, information obtained with the help of the Eviews 7.0 application

As such, previous results support the beta convergence hypothesis. However, β convergence does not provide information on the dispersion evolution in time. To overcome this disadvantage, in figure no. 2, we estimate the σ convergence, which captures the evolution of the dispersion of a sample, namely, the σ convergence indicates how fast the GDP per capita in each country tends towards the sample's average.

As can be seen, in the period 2007-2016, the dispersion of gross domestic product per capita in the purchasing power standard has been reduced in the European Union. In dynamics, we notice that dispersion has been steadily reduced over most years of analysis. This implies acceptance of the sigma convergence hypothesis. It should also be mentioned that, starting in 2012, GDP dispersion has not fallen to the same pace as up to that time. In this respect, the decline in dispersion by 2012 is correlated with the negative effects of the crisis, which have generated declines in GDP in most countries.

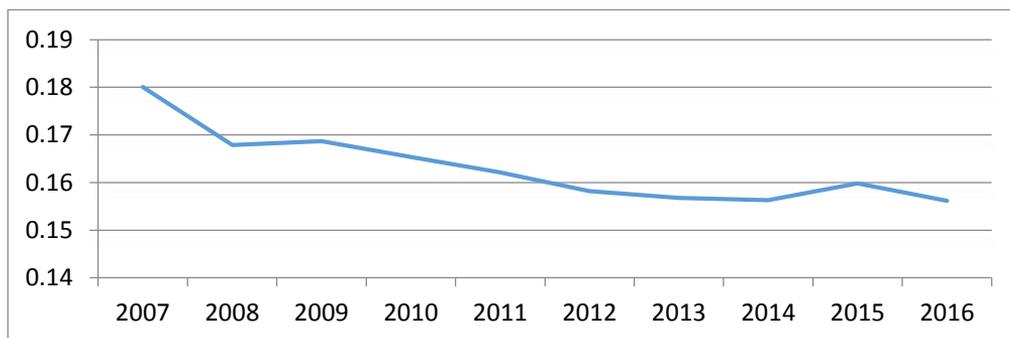


Figure no. 2 – Sigma convergence (dispersion of GDP per capita) in the European Union (2007-2016)

Source: own estimates, information obtained with the help of the Eviews 7.0 application

Further, in order to obtain more consistent results, convergence β and σ were estimated also by equations (1), (2) and (3). Table 1 shows the results for the Member States of the European Union. Intuitively, given the previously obtained results, the estimates support the hypothesis of convergence between EU Member States.

The obtained results indicate the existence of the β convergence for the EU Member States, the β coefficient being negative (-0.0207) and significant (significance threshold of 5%). Under these circumstances, it is clear that countries with the highest GDP per capita in purchasing power standards in 2007 had a lower growth compared to the countries with the lowest GDP per capita in the standard of power purchase in 2007. A similar result can be seen in the case of σ convergence. In this case, the estimated coefficient is negative (-0.0248) and significant (significance threshold of 1%). Thus, the dispersion of average per capita GDP in purchasing power standards in EU Member States decreased during the period under review. The results obtained are similar to those presented in Figures 1 and 2, which gives reliability and robustness to estimates.

Table no. 1 – Estimation of beta and sigma convergence in the European Union

Dependent Variable: $\ln PIB_{i,t} - \ln PIB_{i,t-1}$	
Convergence β	
$\ln PIB_{i,t-1}$	-0.0207**
	(0.0082)
Constant	0.106***
	(0.0372)
Adj. R ²	0.0327

Convergence σ	
$\ln W_{i,t-1}$	-0.0248***
	(0.0086)
Constant	-0.0008
	(0.0012)
Adj. R ²	0.0513
Number of observations	252
Number of countries	28

Note: *, **, *** denotes a significance level of 10%, 5% and 1%, respectively. Robust standard errors (in brackets) are used for all models.

Source: estimates using application Stata 12.0, based on equations (1), (2) and (3).

Finally, based on the estimates made, it is clear that in the European Union there was a convergence of gross domestic product per capita in the purchasing power standard. However, the results must be viewed with some reluctance, because in some regions of the European Union an economic divergence can be observed. For example, in the euro area, peripheral countries - Italy, Greece, Spain, Portugal - have declined compared to the euro hard core - Germany, Austria, Belgium.

(b). Regional development in Romania

The models used in the Member States of the European Union have also been applied to the eight regions of Romania. It can be noticed (Figure no. 3) that beta convergence is not identified between the eight development regions. More specifically, the coefficient associated with beta convergence is positive (0.0181), indicating that richer regions had GDP per capita increases in purchasing power standards higher than poorer regions. The most relevant example in this respect is Bucharest-Ilfov, which had a much higher than average growth, while poorer regions - North-East, South-West Oltenia - had rises below average.

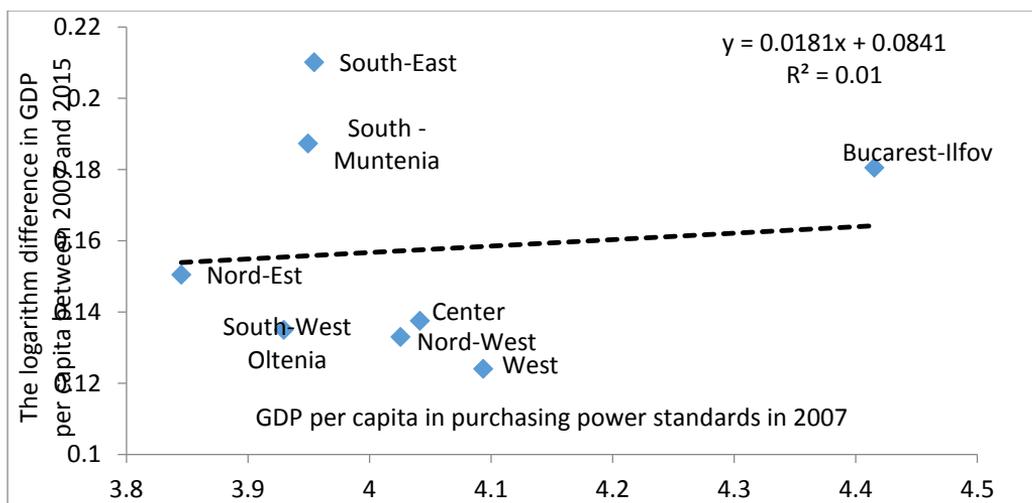


Figure no.3 Estimation of beta convergence in Romania, based on GDP per capita 2007-2015)

Source: own estimates, information obtained in Eviews 7.0

Figure 4 shows σ convergence, which captures the evolution of the dispersion of a sample. And in this case, between 2007 and 2015, the dispersion of gross domestic product per capita in the purchasing power standard increased in the regions of Romania. Moreover, the dynamics of this indicator is very volatile, with graphs showing

years where dispersion increased more significantly - 2008 and 2011, more precisely. After these periods, there is a downward trend, but the reduction is not consistent over time. On the whole, the dynamics over the entire interval indicates an increase in the development gaps between the eight regions in Romania. Under these circumstances, in 2015, the GDP per capita dispersion in purchasing power standards is higher than in 2007.

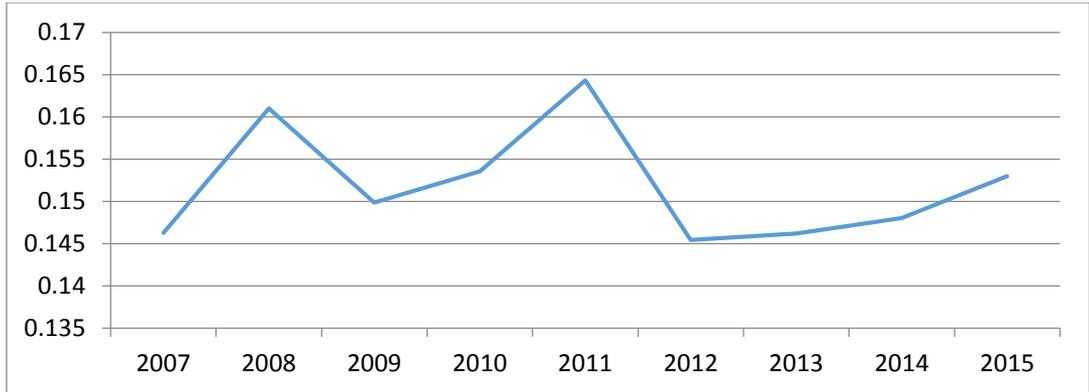


Figure no. 4 Sigma convergence (GDP dispersion per capita) in Romania (2007-2015)

Source: own estimates, information obtained with the help of the Eviews 7.0 application

Furthermore, in this case also, in order to obtain more consistent results β and σ convergence were estimated through equations (1), (2) and (3). In table no. 2, the results for the development regions in Romania are presented. In this case as well, the results indicate a rejection of the convergence hypothesis between regions.

The results obtained do not indicate the existence of the β convergence for the regions of Romania, the β coefficient being negative (-0.0101), but insignificant statistically. Under these circumstances, a relationship between the initial GDP per capita and the growth rates cannot be established. A similar result is also observed in the case of σ convergence. Also in this case, the estimated coefficient is negative (-0.0007) and insignificant. Thus, it cannot be stated with certainty that the dispersion of the GDP per capita in the purchasing power standard between the regions of Romania decreased during the analyzed period. The results obtained indicate the rejection of the convergence hypothesis between the regions of Romania.

Table no. 2 – Estimation of beta and sigma convergence in Romania

Dependent Variable: $\ln PIB_{i,t} - \ln PIB_{i,t-1}$	
Convergence β	
$\ln PIB_{i,t-1}$	-0.0101
	(0.0087)
Constant	0.0612*
	(0.0353)
Adj. R ²	0.0466
Convergence σ	
$\ln W_{i,t-1}$	-0.0007
	(0.0048)
Constant	-0.0007
	(0.0012)
Adj. R ²	0.0578
Number of observations	64
Number of regions	8

Note: *, **, *** denotes a significance level of 10%, 5% and 1%, respectively. Robust standard errors (in brackets) are used for all models.

Source: estimates using Stata 12.0 application, based on equations (1), (2) and (3).

Taking into account the results obtained, it can be said that there was no balanced development between the Romanian regions. Moreover, there may be an increase in the gaps between regions, which implies an increase in economic and social disparities. These results have major negative implications because, over time, inequities that cannot be reduced can be created.

4. Conclusions

The following conclusions can be drawn from the analyzes of the process of economic convergence of the European Union countries, respectively of Romania to the EU average in the period 2007 - 2016:

- there are significant differences between countries in terms of economic convergence (Czech Republic is the most advanced, Romania is ranking last);
- the waves of the economic and financial crisis have interrupted the convergence of the countries towards the European average;
- lack of an economic integration strategy - divergent economic policies: Hungary - populist policies, Poland - extensive structural reforms, Romania - reforms applied under the wand of international institutions;
- the existence of populist measures at a regional level;
- enhancing populist measures at regional level (including those affecting the banking sector that have an impact on potential economic growth);
- the implementation of the new European Economic Governance and the continuity of structural reforms;
- the countries of the European Union still face a series of structural challenges: real economic convergence; continuity of structural reforms; increasing the degree of economic and financial integration.

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