# TETING SIGMA CONVERGENCE ACROSS NEW EU MEMBERS

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***Abstract***

*Even though the issue of convergence between the member states of European Union is an extremely debated subject nowadays, the existing disparities continue to persist and even accentuate. Furthermore the economists and researchers in the field are interested to analyze whether the rich economies will continue to develop and at what speed on one side, and whether the poor countries will remain at the same level or will try to reduce their gap on the other side . The main objective of this study is to investigate sigma convergence across new member states of European Union using a deterministic methodology and analyze whether the states that adopted until now the euro converge faster that the other ones.*

***Keywords:*** *convergence, divergence, economic growth, European Union.*

## 1. Introduction

Even though the issue regarding the convergence between different economies has always been a central point of interest for theoreticians and economists that concentrate their works upon the development of economic growth models, only at the end of the 80"s the major debates concerning this process were starting to arise; Sala-i-Martin (1995). All studies that were concentrating upon this subject were based on a common objective and namely finding the answer to the following question:" *Which is the role of integration and economic convergence in the process of economic growth?*" This question may determine the development of future discussion upon the

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factors that determine economies to converge one another or by contrary to diverge. Nowadays the modern econometric instruments used in order to test all these hypotheses allow the development of some pertinent conclusions regarding the economic convergence of different countries and the elaboration of some following direction in order for this process to be achieved in a more advantageous manner. At regional level the interest for testing convergence is even more controversial. Maybe the most interesting and debated subject related to the process of convergence is the one regarding Central and Eastern European economies. A series of authors concluded the fact that economic integration of Europe represents a continuous support towards a sustainable economic growth. What determines the high interest of macroeconomists and econometricians towards these economies may have different causes. First off all these economies register important differences starting from their monetary policies and continuing with political orientations, social behavior, institutional structures and even religious orientations. Also the evaluation from a theoretic and also empiric point of view of the elimination of the barriers concerning trade and production, capital, service and population factors had a defining impact upon the development in a conceptual and methodological framework regarding economic convergence. Nevertheless, achieving a sustainable convergence between poor and rich economies from euro zone may only be anticipated in a period of 10-20 years at least; Zdarek Vaclav (2009). This statement rely on the fact that some economies that have joined earlier the European Union did not managed to achieve the average level of development required by the union not even now, by contrary registering during some periods of time even divergent tendencies.[3]

This paper analysis the process of convergence namely, the reduction of the dispersion of income levels between new member states (sigma convergence) both in the pre-accession period but also in the post accession one. The measurement of the convergence between economies is very complex and we have to admit the fact that there are no measurement instruments that capture all the aspects of convergence. Therefore in order to formulate objective conclusions it is important to assess the advantages and disadvantages of each measuring instrument and also the limits it imply.

[3] See the case of Germany in achieving a rapid (Rotter, Suppel 2003).

## 2. Literature Review

Accordingly to the neoclassical economic growth models economic integration of Europe should generate an increase in what concerns the long-term growth rates. These models forecasted a positive impact of the membership to the EU upon both the new and the old members due to the more integrated economies. Despite all that, more recent studies obtained contradictory result. Vanhoudt t (1999) analyzing a group of 23 OECD countries founds no clear evidence of any significant impact of joining EU upon long term growth rates. On the other hand a series of studies like the one developed by Henrekson, M., and Torstensson (1998) indentify strongly positive effects generated by the integration upon a group of 115 countries.

A series of recent empirical studies had as starting point in their research the convergence testing between different economies using as a landmark the real convergence that deals with the level of GDP/capita in order to assess the standard of living or the work productivity. The most relevant studies regarding this topic are the ones that concentrate upon sigma and beta convergence, the first one being a measure of the dispersion of the revenues/worker or of the productivity/worker between different economies that can be tested at regional or national level, and the second one being an estimator of the inverse relationship between the growth of the revenues/worker or of the productivity/worker and the initial level. The utility in testing sigma convergence denotes from the fact that it offers a clear image upon the convergence or divergence periods between different economies over a certain period of time. With all that, there are some others indicators used in order to test sigma convergence developed by Cowell (1980) namely: the coefficient of variation[4], the Gini coefficient[5], Atkinson index[6], Theil index [7] or the Mean Logarithmic Deviation[8].(See table 1). Although many of the studies in this field concentrated their work in testing beta convergence,

[4] The coefficient of variation is used in order to compare two or more frequency distributions from the point of view of their variation.

[5] The Gini coefficient is used to test the inequality in what concerns the revenue distribution or the welfare distribution. It varies between 0 and 1. Values close to zero indicate a more balanced distribution of revenues while the values close to 1 indicate a more unequal distribution. The coefficient is used to compare revenues distribution between different countries or regions.

[6] Atkinson index represents another instrument used in measuring income distribution. It has the ability to detect some specific changes in what concerns the distribution of different segments.

[7] Theil index answers to the sum of inequality of the average between some sub-groups of countries, property known as"decomposition".

[8] Mean logarithmic deviation is used in order to test inequality between a group or between different groups.

economists draw the conclusion that this is not a sufficient condition for achieving sigma convergence. Supporting this idea Quah (1993) and Friedman (1992) states the fact that sigma convergence is of greatest interest because it brought into attention the issue of revenues uniformity between economies. The authors pointed out the fact that the methodology used in order to test beta convergence may produce bias estimates of $\beta$ convergence due to the Galton error; Young, Andrew; Higgins, Matthew, Levy, Daniel (2007). In response to this problem Friedman proposed an indicator to test convergence among states namely the coefficient of variation that provides unbiased estimates of beta convergence.

Whit all these the study of Beta convergence remains an extremely complex issue regarding the convergence aspect also due to the fact that represent a necessary, but not sufficient condition to test sigma convergence.

Also the literature shows evidence of some indicators that combine both sigma and beta convergence. One of these is known as Kendall index of rank concordance developed by Boyle and McCarthy (1997, 1999) that besides testing sigma and beta convergence has the ability to offer a clear image about the changes in what concerns the ranking of the economies taking into consideration the distribution of GDP/capita.

**Table 1: Different approaches towards sigma convergence**

| | **Measure** | **Range** | **Main characteristics** |
|---|---|---|---|
| **Sigma convergence** | Coefficient of variation | 0-1 | Sensitive to average changes, especially when the average value is close to zero. |
| | Gini coefficient | 0-1 | Sensitive to changes regarding the inequality around the average. |
| | Atkinson Index | 0-1 | The share of the existing differences between the upper level and the lower level of the distribution is parameterized as the ”aversion towards inequality”. |
| | Theil Index | 0-∞ | Gives equal hares around the distribution. Not has a clear interpretation. |

Source: Adaption after Monfort Philippe (2008),”Convergence of EU regions. Measures and evolution.”Working papers, European Union, Regional Policy, pg. 19.

## 3. Data and methodology

The studies developed previously that were concentrating upon testing the convergence hypothesis between different economies included in their estimation a series of indicators that would allow the validation of convergence or divergence hypothesis between different economies. Many authors admitted the fact that while studying convergence, especially sigma convergence one may use different indicators that have as a main role to highlight the differences towards the average or regarding the manner in which the reduction of the differences between different chronological series takes place; Iancu Aurel (2009):

$$\lim_{t\to\infty}(x-y)=a$$

When talking about sigma convergence, the most common indicator is the coefficient of variation of the GDP/capita, coefficient that will be marked with $\sigma$ and determined using the following formula:

$$\sigma_t=\frac{\sqrt{(\sum_{i=1}^{N}(y_{it}-\overline{y_t})^2/(N-1)}}{\bar{y}_t}$$

where:

- $\sqrt{(\sum_{i=1}^{N}(y_{it}-\overline{y_t})^2/(N-1)}$ represents the standard deviation, namely a measure of the dispersion where N is an indicator of the number of observations within the sample.
- $\bar{y}_t$ represents the average of that certain series.

The first utilization of this indicator in testing the degree of convergence between different economies was developed by Sala-i-Martin (1995) who defined this concept as follows:" *a group of countries converge in the sense of sigma convergence if the dispersion in what concerns the GDP/capita decreases over time.*" This may be systemized as follows:

$$\sigma_{t+T}<\sigma_t$$

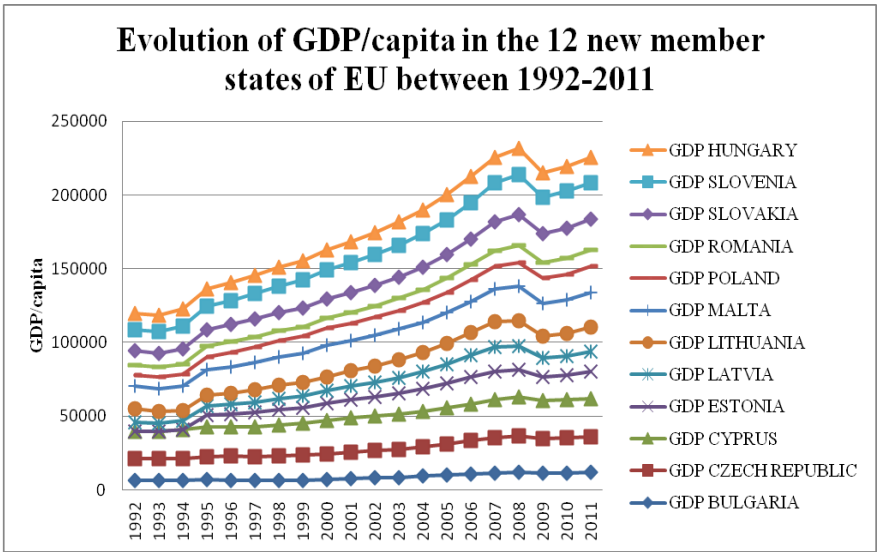
The formula used by the author in order to test sigma convergence is:

$$\sigma=\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\log\frac{y_i}{y^*}\right]^2}\text{ where }\log y^*=\frac{1}{n}\sum_{i-1}^{n}\log y_i$$

**4. The evolution of sigma convergence estimated through the coefficient of variation.**

In our study for testing the degree of real convergence between different emerging economies, we used sigma indicator for the EU member states, devising it into three main categories namely: EU 12 (the countries that joined EU in 2004 and 2007), EU 5 (the countries that joined EU in 2004 or 2007 and adopted euro so far) and EU 7 (the countries that joined EU in 2004 or 2007 and are in the process of adopting euro). The chronological series is based upon the estimated data for this indicator for a period, between 1992-2001, annual data. This indicator used to analyze sigma convergence was estimated upon the GDP/capita in constant prices. The source of the data is World Bank.

**Figure 1- Evolution of GDP/capita in the 12 new member states of EU between 1992-2011**




Source: Authors calculation based on World Bank data

In what concerns the evolution of GDP/capita within the 12 new members of European Union the general tendencies is of increasing within the analyzed period of time. In the majority of the cases the peaks of this indicator were registered in 2007-2008 when were achieved high growth rates at the

level of EU and implicit to the member states. The highest levels of GDP/capita were registered in Cyprus with approximately 18918,77 euro/capita in 1992 and 26045 euro/capita in 2011, Malta with 14912 euro/capita in 1992 and 23007 in 2011. At the opposite pole is Romania along with Bulgaria with levels ranging between 6300 euro/capita in 1992 and 10900 euro/ capita in 2011. The important differences between these values are also a determinant factor of a degree of convergence and also of the speed needed to achieve convergence. Being an indicator of real convergence, the level of GDP/capita embodies a series of data regarding the gap between different economies. Possible reasons for these disparities could be the economic and political instability that characterize these economies, the lack of efficient monetary policies and also the adoption of some unrealistic measures by the entitled authorities.

After we made a short analysis of the general patterns of GDP/capita within the group of selected countries the next step is to test sigma convergence using the described methodology. The obtained results and their evolution are presented in the table below.

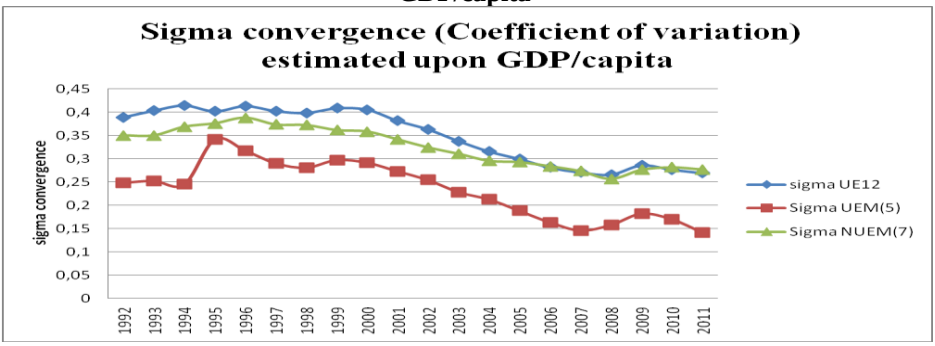
**Table no 2: Numerical evolution of sigma convergence for EU12, EU 5 and EU 7**

| **Numerical evolution of sigma convergence for EU12, EU 5 and EU** 7 | | | |
|---|---|---|---|
| **Year** | sigma EU12 | Sigma EMU(5) | Sigma NEMU(7) |
| **1992** | 0,389363042 | 0,248562415 | 0,350249087 |
| **1993** | 0,403595742 | 0,252699968 | 0,350249087 |
| **1994** | 0,414620624 | 0,245307454 | 0,368816944 |
| **1995** | 0,402074134 | 0,341852182 | 0,375999634 |
| **1996** | 0,41340459 | 0,317832322 | 0,388060236 |
| **1997** | 0,402702498 | 0,290425676 | 0,373450592 |
| **1998** | 0,398721365 | 0,281139211 | 0,37217748 |
| **1999** | 0,408711629 | 0,297431378 | 0,361532262 |
| **2000** | 0,405744155 | 0,291651568 | 0,358459955 |
| **2001** | 0,381787439 | 0,273102005 | 0,341634245 |

| | | | |
|---|---|---|---|
| **2002** | 0,363393612 | 0,254464162 | 0,324264609 |
| **2003** | 0,338218546 | 0,228498387 | 0,310679054 |
| **2004** | 0,315929369 | 0,212792935 | 0,295687141 |
| **2005** | 0,29973288 | 0,188266437 | 0,292753311 |
| **2006** | 0,281477605 | 0,16356659 | 0,284000021 |
| **2007** | 0,271142336 | 0,146305634 | 0,273409302 |
| **2008** | 0,266281 | 0,158064088 | 0,256987787 |
| **2009** | 0,286257611 | 0,182339782 | 0,276435605 |
| **2010** | 0,276994807 | 0,170138483 | 0,281534311 |
| **2011** | 0,269661542 | 0,141828703 | 0,277107908 |

Source: Authors calculation based on World Bank data.

**Figure 2- Sigma convergence (Coefficient of variation) estimated upon GDP/capita**




Source: Authors calculation based on World Bank data

The use of sigma convergence enables an objective evaluation of the degree of convergence or divergence between different sub-groups considered. Regarding the group of countries that joined EU in 2004 and adopted euro the data shows almost a continuous decreasing of the coefficient of variation which means an increase of the degree of convergence within that certain group. The overall tendency of decreasing the coefficient of variation expressed by the level of GDP/capita is more pronounced in the group of

countries that adopted euro until now namely, Malta, Slovenia, Slovakia, Cyprus and Estonia. Even though between the level of the coefficient of variation estimated upon the level of GDP/capita between EU 12 and EU 5 is a considering difference, it should be noted the fact that overall in both cases the general tendency is of increasing the convergence between economies rather than increasing the divergence. Analyzing the graphic regarding sigma convergence we may conclude that each economy less developed from an economic point of view tends to achieve superior levels of development aiming the alignment to the standards required by the countries with more increased performance. These may only lead to a dynamic of the economies that had recently joined to European Union, especially of those that adopted euro until now, with real perspectives of achieving higher rates of convergent growth.

The obtained results are similar to those provided by other specialized studies that have focused on the analysis of sigma convergence for the new member states. One of them is developed by Ingiani A., and Zdarek V. (2007), who tested sigma convergence at the level of the new entrants in EU and obtained clear results in what concerns the reduction of income dispersion between economies. Also Matkowski, Próchniak (2007) confirms the existence of sigma convergence among the new EU group of countries using different data sources (Groningen, UNECE or the IMF).

## 5. Conclusions

The majority of the studies concentrating upon the convergence between new member states of European Union concluded the fact that there were a series of positive effects steaming from the membership to this structure namely:

- The increase of trade, as a result of abolition of the import taxes between member states;
- The mobility of productivity factors, including the capital flows and the mobility of labor force;
- The existence of a common market;
- The so called cumulative effect: the transfer of funds that contribute to the intensification of the convergence process.

The main purpose of this study was to test the sigma convergence hypothesis among the new EU member states based upon the GDP/capita. This convergence was tested by dividing the sample in three major groups: the

first group included all 12 new member states of EU; the second group included only the states that became recently member of EU and also of EMU and the third group the states that are members of EU but are still on the path on adopting the common currency. The overall conclusion is that sigma convergence is more pronounced in the group of countries that already adopted euro, one of the main reason being the fact that these countries already harmonized their macroeconomic policies with the one required by EU and EMU, as a mandatory condition for adopting euro. The other group of countries that are in process of adopting euro register not so intense convergence patterns, but are concentrating in reducing the disparities among them, which will lead in the end at achieving stable convergence rates. Our results support the idea promoted by the neo-classical growth models which were in favor of convergence among countries, unlike the endogenous one which were more skeptical about this phenomena.

Taking all these points into consideration we may conclude that even though the general tendency is of reducing the gap between economies at least in what concerns the GDP/capita, there are still a multitude of aspects that should be taken into account when referring to an optimal level of convergence. Here we can discuss about convergence in what concerns productivity, unemployment convergence, investment behavior convergence and much more. In order for the gap between economies to decrease, one should take into consideration all the aspect mentioned above. Only a combination of all these aspects will assure a smooth path towards what it's called optimal degree of convergence. And if all these conditions are accomplished still remains the question what period of time the process of convergence will need in order to be successfully fulfilled?

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