CONVERGENCE REGIONAL STUDY COMPARING EU MEMBER STATES

Abstract

Following the great interest shown by the EU to the concept of regional convergence as objective of its cohesion policy, as well as of the theoretical and applied debates carried out by scientific researchers, I realized a brief statistical analysis of the economic evolution of a few member states considered as representative for the stage and role they played in the economic development of the Union in the period covering both last extension waves. To this purpose, I applied the concept of β- and σ-convergence, defined in the frame of the neoclassical growth model developed by Barro and Sala-i-Martin, in analyzing the statistical data, i.e. the GDP per capita at NUTS3 level in the 2000-2011 period, provided by EUROSTAT for France, Germany, and Greece.

INTRODUCTION

Regional convergence is one of the main objectives pursued by the Cohesion Policy devised by EU, the strategy for efficiently attaining this goal being financially supported by the Structural Funds in order to meet the needs of the disadvantaged countries and regions. Lower financial assistance is required for closing the gaps if convergence has reached a high level. Whereas, in the case of a low degree of convergence, there is a demand for a more substantial material aid. Seen as a declared and determining aim since the moment of the Union´s establishment the setting up of a balanced and prosperous Single Market, together with the diminishing of discrepancies turned out to be the topics of endless heated debates over the concepts involved in the perspective of this impressive accomplishment. Moreover, certain economic and political developments that came after, such as the accession of Eastern Europe closed economies in the EU (Artelaris, P., Kalioras, D., Petrakos, G., 2010), as well as the wide and heterogeneous range of socio-economic and cultural aspects highly representative of our continent have added complexity to this endeavor.

This background favored the world wide appearance of a rich literature concerning not only theoretical, but also empirical aspects of the regional convergence models, research focused on quantifying this

economic phenomenon. Although for the time being a satisfying answer is far from having been found. Anyhow, two concepts of this complex process have been identified, theorized and made measurable so far, namely β- and σ-convergence.

Regional convergence is a process in which different levels of local economic development are likely to meet in the long run, either by themselves or under control, so that finally disparities will come to an end. In spite of its being challenged in account of its failure to grasp all the details that generate this process or have an impact on it, GDP per capita has been adopted as the measuring unit for the efficiency of the EU cohesion policy.

In the frame of the regional convergence theory, this study aims at identifying a possible impact of the EU enlargement on the different European countries economy using the published econometric data. Using the special instruments and techniques necessary for the empirical econometric research this paper concerns also understanding the evolution of some foremost reference economies of the EU. Therefore, for each of the three chosen EU member-states, we have decided to identify a subinterval of convergence between the NUTS3 regions belonging to the same NUTS1 region.

We were also interested in emphasizing some facets specific to the correlation between the two statistical concepts of convergence, meaning between β and σ behaviour. This study is covering the first decade of the XXI century, i.e. 2000-2011, a relatively short but crucial period in building up EU27, and most important for which we could access corrected statistical data.

Our work is structured into five chapters. The chapter next to the Introduction defines the theoretical basics of the used statistical model and the quantitative formulae used in performing the empirical analysis of the database presented in Chapter 3. The corresponding description of data processing and the obtained results are given in Chapter 4 by plots and tables. Finally, Chapter 5 presents briefly the most important conclusions of this report.

β-CONVERGENCE AND σ-CONVERGENCE

The concept of β-convergence emphasizing the process through which poor regions undergo a more rapid development than the richer ones, was introduced by Solow (1955) and is based on the well-known economic principle of diminishing rate of return all along production. This means that during its development an economy shows a tendency to reach a *steady state* and this process is actually the result of a gradual diminishing of its growth rate until the economy has attained its stability level. Therefore, assuming that

the poor countries, which built up their economies from scratch develop faster during the time they will be able to catch up with the richer ones in the process of convergence. In case a set of economies are going to reach the same *steady-state* we are speaking about *absolute* β-convergence, and if the economies are going to reach different *steady-states* due to some specific mechanisms it's about a *conventional* one.

Studies carried out by Barro and Sala-i-Martin (1992), Mankiw (1992), have triggered significant theoretical debates especially addressing the problem of quantitative determination of the divergence/convergence process under a great number of aspects, in an attempt to clear up its definition as possibly closer to the real economy dynamics. Analysis in this field continues to throw light on new facets of the convergence process, also taking into account the influence of neiborhood across regions, such as revealed by spatial analyses, by panel analysis (Eckey, Turck 2006, Dunford 2009). It has generally been agreed to base β-convergence measurement on the GDP per capita value, but other approaches such as GDP per worker or income per capita, can also be considered.

In this work, the β-convergence is calculated from the following linear dependency:

$$\gamma_{i,t,t+T} = \alpha - \beta \ln(y_{i,t}) + \varepsilon_{i,t}$$

where γ represents the economic growth of the region *i* for interval of *T* years, since the moment *t* (2000) until the moment *t*+*T* (2011, *T*=12 years), β represents the gradient (positive in case of convergence), and *ε* represents the error.

The concept of σ-convergence, as a means of evaluating disparities over time, offers a description of income dispersion across regional economies (Young, Matthew, Higgins 2008). Although it seems to be closely related to β-convergence, actually it is representing only the necessary, but not the sufficient condition, too, for σ-convergence existence. The relationship between β- and σ-convergence is demonstrated by the results reported in this work.

σ-convergence can be measured in terms of standard deviation or using coefficient of variation of the GDP per capita, as follows:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}[\ln(y_{i,t}) - \mu_t]^2}{N}}$$

or

$$K_V K_V = \sigma^{pond} \sigma^{pond} / \mu$$

In spite of the extension and differentiation of its theoretical area, as well as that of its empirical means of evolution the study of convergence still remains indebted to the new classical model set by Barro and Sala-i-Martin. Using the main concepts mentioned above, in the followings I report a statistical analysis on the evolution of β- and σ- regional convergence in 3 EU member states.

DATABASE

The numerical data sets have been supplied by the EUROSTAT database and they refer to the GDP per capita at the level of the EU NUTS3, expresed in €.

The fundamental reason for choosing the time period lower limit was the availability of relevant data for all the member states at the NUTS3 level, thus being free to extend the geographic area of research. The upper limit was established by the most recent data available on EUROSTAT. Therefore, the chosen series of statistical values refer to the best covered interval 2000-2011. The data have been processed and organized using MS-Office Excel and eViews program. The number of processed data varies from country to country, according to the number of its territorial units NUTS1 and the number of the included territorial units NUTS3.

RESULTS

After studying a whole range of European countries, I focused on three of them: France, Germany and Greece, for their significant role played during EU development. In fact, France and Germany laid the Union foundation in 1957, together with Belgium, Luxembourg and Holland and their economies rank foremost in point of strength and stability. On the other hand, Greece, which joined the Union in 1981 as an economically assisted country represents besides Portugal the first experiment of economic development subsidized by EU.

β-convergence was determined using the growth equation proposed by Sala-i-Martin (1996). Based on the EUROSTAT data for each NUTS3 unit, I calculated the logarithm of GDP per capita (namely ln y) for both limits of the time interval, i.e. for 2000 and for 2011. The regional economic growth (γ) for every NUTS3 unit was calculated as the mean value of the series of logarithms of the y_2011/y_2000 ratio. Further, the regression for the independent value of ln y_2000 and the dependent value γ was applied.

Secondly, σ-convergence was determined using the well-known Barro equation (1992). For each year of the selected time period, I added up the

squared values of the difference between the logarithm standing for the GDP per capita ascribed to each territorial unit NUTS3, and the average logarithm value of all the NUTS3 units belonging to the same NUTS1 unit, in every country. The standard square deviation generically named σ represents the measure of dispersion was calculated in terms of the ratio between the above mentioned sum and the number of years which make up the period of time under study.

France

I studied β-convergence for the NUTS3 territorial units corresponding to all the 98 departments organized in 8 NUTS1 territorial units (afterwards excluding the NUTS1-Île de France, for not being relevant to this regional research; in the high level of agglomeration within Paris and its surroundings the GDP per capita values diverge of the rest of the country, so the effect on the general situation could be misleading). Consequently, I processed a number of 1164 data expressing the GDP per capita values at regional European NUTS3 level for the twelve years period 2000-2011. The figures used by me were obtained from the EUROSTAT database, which is published by EU based on statistics reported by each country national institute.

The numerical values of the statistic parameters obtained by applying the non-linear regression are shown in the Table 1. It can be noticed that within the 2000-2011 period, the GDP per capita varies between its maximum value of 39.000€ per habitant in the NUTS3-Rhône, belonging to the NUTS1-Centre-Est and the minimum value of 15.900€ per habitant in the NUTS3-Haute-Corse, belonging to NUTS1-Mediteranée.

As can be observed in *Table 1*, excepting one case, the σ non-linear regression has been applied on two different sub-intervals of the period under study, in order to emphasize the clear empirical tendency. The NUTS3-Sud-Ouest region offers the image of a statistically significant σ-convergence for both sub-intervals, whereas β is divergent.

β- and σ- convergence for France 2000-2011

Tabel 1

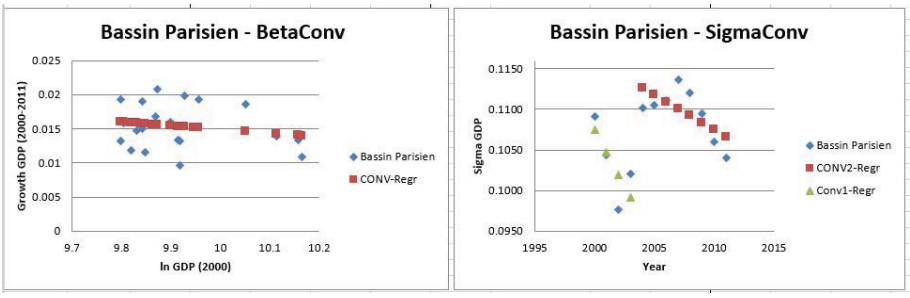
FRANCE (NUTS1)	β	σ		
Bassin Parisien	-0,0055145	2000-2003	2004-2011	
		-0,0027783	-0,0008594	
Nord – Pas-de-Calais	-0,0029157	2000-2006	2009-2011	
		-0,0023838	-0,00025628	
Ouest	0,0097777	2000-2003	2004-2007	2009-2011
		0,00175	-0,000707	-0,000111
Sud-Ouest	0,00748165	2000-2005	2007-2011	
		0,0030829	-0,00092103	
Centre-Est	-0,0004064	2000-2005	2007-2011	
		-0,00101015	-0,00129019	
Méditerranée	0,0067397	2000-2006	2007-2011	
		-0,0001569	0,0013798	

(Source: Author, 2015)

The Western NUTS1 regions (located on the Atlantic Ocean coast) display a low β-divergence, meanwhile recording a quite significant σ-convergence, especially in the case of NUTS1-Sud-Ouest (*Table 1*).

Non-linear regression emphsizing β- and σ-convergence for the NUT3 units belonging to NUTS1-Bassin Parisien of France, calculated for the 2000–2011 time period

Figure 1



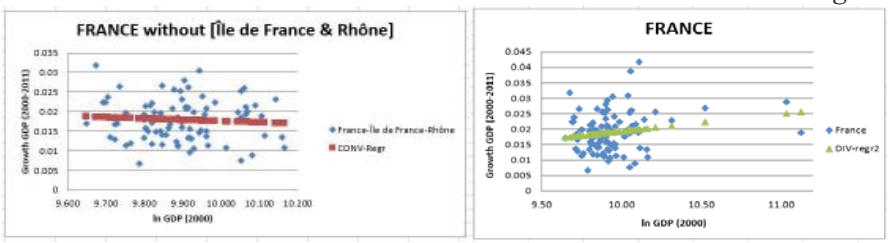
(Source: Author, 2015)

As shown in Figure 1 for the NUTS1-Bassin Parisien region, the empirical behavior is clearly convergent for both statistical values, but the σ-convergence is obviously marked by 2005.

For France as a whole, the statistical analysis of all the NUTS3 units reveals a β-divergent behavior with β = +0.0056. In case there are excluded NUTS1-Île de France and NUTS3-Rhône, the behaviour becomes convergent with β = –0.0032, as shown by the *Figure 2*.

For the period 2000-2011 the France economy behavior is showing β-divergence, but β-convergence if excluding NUTS1-Île de France and NUTS3-Rhône

Figure 2



In conclusion, it can be stated that excepting the highly agglomerated areas, at the NUTS3 level, France economy is showing a good β-convergence for the period 2000-2011.

GERMANY

β-convergence was investigated for all the territorial units NUTS3 representing the 694 districts organized in nine German regions NUTS1. This means that I worked out 8328 data covering the GDP per capita values at the European regional level NUTS3, over the same twelve years' time period 2000-2011.

The statistical data have been taken from the EUROSTAT database which stores information delivered by the national institutes of statistics of all the EU member states.

In the case of Germany, the GDP per capita for the 2000-2011 period varies between the extreme values of maximum 108.900€ per inhabitant in NUTS3-Wolfsburg Kreisfreie Stadt situated in the NUTS1-Niedersachsen and the minimum of 11.600€ per inhabitant in the NUTS3-Südwestpfalz belonging to NUTS1-Rheinland-Pfalz.

The numerical values of the statistical parameters obtained by non-linear regression applied on the calculated β and σ values corresponding to all the NUTS3 units as organized in NUTS1 administrative areas are displayed in *Table 2*.

From a total of nine, seven regions NUTS1 are showing β-convergence, and two β-divergence, the corresponding statistical parameters values

obtained by the non-linear regression being listed in the *Table 2*. Excepted NUTS1-Schleswig-Holstein for which the σ-standard behavior is showing three distinct time sub-periods for the rest of them there are emphasized only two. The σ-regression statistical parameters values are listed in the *Table 2* for all the sub-periods. It is worth to note that in the great majority of NUTS1 units, both β and σ have the same type of tendency, excepted two antagonistic cases, meaning NUTS1-Bayern showing β-convergent with σ-divergent, and NUTS1-Niedersachsen showing β-divergent with σ-convergent.

β- and σ-convergence for 2000-2011 in Germany

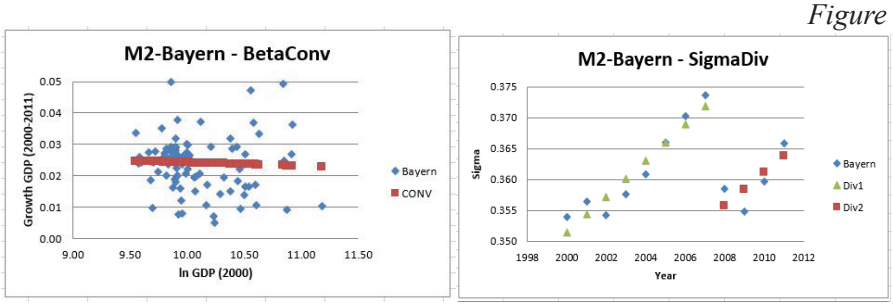
Table 2

GERMANY (NUTS1)	**β** 2000-2011	**σ**		
Baden-Württemberg	-0.00863	2002-2006	2007-2011	
		-0.003170075	-0.00211861	
Bayern	-0.00109	2000-2007	2008-2011	
		0.002913835	0.002709473	
Nordrhein-Westfalen	-0.0071	2000-2006	2006-2011	
		-0.00446324	-0.00982079	
Niedersachsen	0.00303	2000-2004	2005-2009	
		-0.004093826	-0.00409383	
Hessen	-0.01454	2002-2006	2007-2011	
		-0.004323431	-0.00418941	
Rheinland-Pfalz	-0.00551	2000-2003	2004-2011	
		-0.00219914	-0.00195885	
Saarland	0.01896	2000-2008	2009-2011	
		0.007241928	0.010204448	
Schleswig-Holstein	-0.00241	2000-2004	2004-2007	2008-2011
		0.006523	-0.006109	-0.005343
Thüringen	-0.03335	2000-2008	2009-2011	
		-0.007752977	-0.002995859	

(Source: Author, 2004: 31)

The opposite behavior for NUTS1-Bayern: β-convergence and two distinct sub-periods of σ-divergence in the time period 2000–2011

Figure 3



(*Sourse:* Author, 2015: 31)

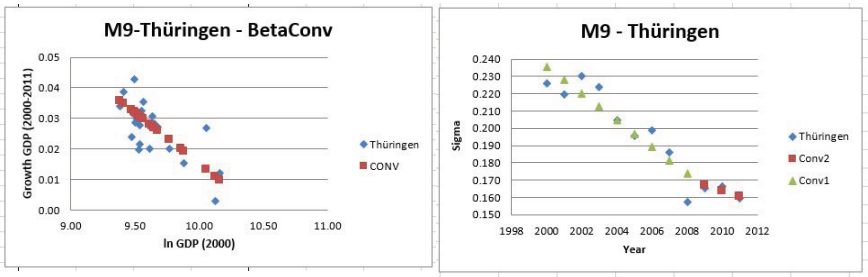
The absence of the σ-convergence for the NUTS3 units belonging to NUTS1-Bayern represents a clear example that the convergence of β is

necessary, but not sufficient for the σ-convergence (Sala-i-Martin, 1992). This kind of behaviour could be assigned to a conditional β-convergence, a process during which the given economies are not reaching the same „steady-state" (*Figure 3*).

Finally, should be noted that the impact of the 2008 economic crisis is clearly reflected by a sudden change in σ-behaviour of all the German NUTS1 units, i.e. NUTS1- Thüringen (see *Figure 4*), excepted NUTS1-Niedersachsen. Similarly, the EU enlargement is reflected by a change of σ-behaviour by most of NUTS1 units of Germany.

Both β and σ show convergency in the case of NUTS3 belonging to the German NUTS1-Thüringen in the time period 2000–2011

Figure 4



(Sursa: Author, 2015: 31)

Greece

I had to evaluate the β-convergence across the 51 territorial units NUTS3 belonging to the seven regions NUTS1 of Greece therefore, to do that, I processed over 600 data representing the values of logarithm of per capita GDP at the regional level NUTS3. The data were taken out from the same EUROSTAT database. The values of the GDP per capita measured for each territorial unit NUTS3 oscillate between a maximum of 27.700€ per capita in the NUTS1-Andros, Thina, as well as in NUTS1-Nisia, Angin, Kriti, and a minimum of 7800€ per capita corresponding to NUTS3-Ileia belonging to NUTS1-Kentriki.

β and σ convergence for Greece 2000-2011

Table 3

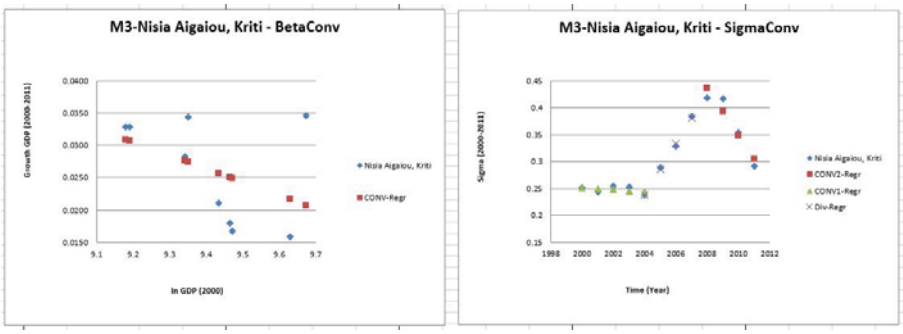
GRECIA (NUTS1)	β	σ		
		2000-2004	2004-2008	2008-2011
Voreia	-0,01055	-0,00415	0,02837	-0,01331
Kentriki	-0,02661	-0,01893	0,03000	-0,3286
Nisia	-0,0206	-0,00193	0,045863	-0,04421

(Sourse: Author, 2015)

It can be noted that the calculated σ values were statistically analyzed by applying the non-linear regression on three distinct sub-periods: 2000-2004, 2004-2008 and 2008-2011 in order to emphasize their tendency. Although all three NUTS1 regions show a significant β-convergence, σ retains a divergent behaviour in all cases during the 2004-2008 time middle sub-period, as shown by the statistical parameters values listed in the *Table 3*.

Statistical analysis of β-convergence and σ-convergence for Greece NUTS3 units belonging to NUTS1-Nisia, Aigaiou, Kriti for the time period 2000-2011

Figure 5



(*Sourse:* Author, 2015)

In conclusion, even if β-convergence exists in the Greece as a whole, σ-convergence couldn't be confirmed over the 2004-2008 period, when the dispersion of regional incomes was more sensible. Anyhow, the fact that σ-convergence gained momentum after 2004 comparing with the preceding years reflects a healthy trend towards recovery, obviously with the help received from the EU.

CONCLUSIONS

This work aims at revealing the correspondence between some of the significant stages in the evolution of the EU and their impact upon regional convergence at NUTS3 level, by showing the way in which an aggregate body made up of apparently separate elements responds to outside influences of socio-economic and cultural cohesion.

In analyzing the history landmarks of the EU development, we cannot overlook the major importance of the economic effort required by its extension in 2004, when ten new member states joined the Union, as well as the consequences of the economic crisis of 2008. France and Germany, responsible in their capacity as economically advanced countries for the foundation of the Union, are models of development dedicated to Europe's dive towards a straight, constant and effective commitment in the recovery of the economies that still lag behind. Greece can serve as an example of a country sustained by the EU Group and represents an early experience of this type.

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