

## **Detecting the Growth Pattern(s) of the EU Border Regions: A Convergence Clubs Approach**

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### **Abstract**

The efforts for establishing a Single European Market, the recent (i.e. 2004 and 2007) enlargements, the overall regional and territorial policy and the introduction of the European Neighborhood Policy, represent an array of spatial and non-spatial policies that set up the scene in the economic landscape of the European Union border regions. Within this context, the objective of the paper is to detect, on empirical grounds, the growth pattern(s) of the European Union border regions following a convergence clubs approach. The findings of the paper suggest a non-linear process of growth along the EU-27 border regions, indicating that the process of integration in Europe is still associated with significant differentiations along border areas.

**Key-Words:** EU border regions, convergence clubs, weighted least squares

**JEL:** C21, O18, O52, R11, R15

## **1. Introduction**

Under the global paradigm, borders seem to lose their traditional meaning as demarcations of the nation-state, and are perceived more like barriers for expanding international markets. Thus, the dynamics of internationalization and globalization are often understood as processes of intensification of the exchange of capital, goods, services, labor, knowledge or, even, cultural stereotypes (Brenner 2003, 2004; Jessop 2004) in a permeable world. In the European Continent, the fall of the Iron Curtain and the collapse of the East-West dividing line, have brought to the fore a new economic and political geography of border regions, affecting substantially their growth potential (Petraikos and Topaloglou 2008). In the European Union (EU), in particular, the efforts for establishing a Single European Market (SEM), the recent (i.e. 2004 and 2007) enlargements, the overall regional and territorial policy and the introduction of the European Neighborhood Policy (ENP), represent the main array of spatial and non-spatial policies that set up the scene in the economic landscape of border space (Melchior 2008). As a result, internal EU borders are becoming permeable, whereas, at the same time, external EU borders function as barriers, behind which other countries are excluded, to interaction (Moraczewska 2010).

Within this context, the objective of the paper is to detect, on empirical grounds, the growth pattern(s) of the EU border regions. In contrast to the opinion that spatial interaction means automatically convergence (De Boe et al. 2010), it seems that the relationship between interaction and convergence is far from being automatic (Decoville et al. 2010). Indeed, recent evidence shows that the increase of interaction due to penetrable borders does not always go hand-in-hand with convergence (Topaloglou et al. 2005, Alegría 2009). This indicates that EU integration often generates winners and losers (in terms of endowments, technology, economic structures, level of competitiveness), reflecting a spatial footprint of the forces and dynamics driving and shaping the integrated economy (Petraikos 2008). Does EU integration contribute to convergence of border regions (i.e. convergence among border regions, and convergence with the non-border regions)? A lucid answer to the aforementioned question will be able to offer valuable insight for both theory and policy-making.

To this end, the paper uses a convergence clubs approach (Chatterji 1992). The analysis is based on, disaggregated at the Nomenclature of Territorial Units for Statistics (NUTS) III spatial level, data, covering the period 1995-2005, derived from Cambridge Econometrics EUROPEAN REGIONAL Database and elaborated by the authors. The paper is organized as follows: The next section briefly outlines the convergence / divergence debate. The third section describes the area under consideration and provides some stylized facts. The fourth

section investigates econometrically for the emergence of regional convergence clubs among the EU regions, focusing on border regions. Finally, the fifth section summarises the findings and provides the conclusions.

## **2. The Convergence / Divergence Debate: A Brief Outline**

The issue of regional convergence / divergence has attracted considerable research interest in the regional science literature. Apart from its obvious policy implications, whether economies converge or diverge over time, this is an issue of theoretical significance. Since theories have an unclear message about the evolution of regional disparities, the study of this issue serves as an empirical test among alternative theories with sharply different implications for the allocation of activities over space.

Proponents of the neoclassical theory argue that disparities are bound to diminish with growth through the activation of the equilibrating mechanisms of the declining marginal productivity of capital (see Barro and Sala-i-Martin 1995, for a review). In contrast, other schools of thought such as the endogenous (new) growth theories (see Aghion and Howitt 1998, for a review) and the new economic geography (see Fujita et al. 1999, for a review) tend to agree that growth is a spatially cumulative process, which is likely to increase inequalities, stressing the role of policies in balancing growth patterns. In the midst of this theoretical spectrum, there are also some other recent paradigms which point out that it is quite natural to expect that groups of (regional) economies are converging but that these groups are themselves diverging from each other. These paradigms transcend the “all or nothing” logic behind conventional regional convergence / divergence analysis and maintain that convergence may come about for different groups of (regional) economies, indicating, thus, the possibility for the emergence of (regional) convergence clubs (see Azariadis 1996, for a review).

The dominant approach in the convergence / divergence literature is derived from the neoclassical paradigm, following the seminal studies of Baumol (1986), Barro and Sala-i-Martin (1992) and Mankiw et al. (1992). Two main concepts of convergence have been developed in this literature: (unconditional or conditional)  $\beta$ -convergence and  $\sigma$ -convergence. If economies are homogeneous, convergence can occur in an absolute sense (unconditional  $\beta$ -convergence) since they will converge towards the same steady-state. This concept implies that poor economies grow faster than rich ones and therefore, over a long period of time, they converge to the same level of per capita income. Conversely, if economies are heterogeneous, convergence may occur only in a conditional sense (conditional  $\beta$ -convergence) since economies will grow toward different steady-state positions. The concept of  $\sigma$ -convergence

examines the dispersion of income at a given moment in time. Thus, convergence is accepted if the dispersion (measured by the coefficient of variation) of per capita income among economies falls over time.

At the regional level, there is ample empirical evidence of this type of research (see Magrini 2004, for a review). However, most empirical studies have examined convergence / divergence processes utilising econometric or statistical models of linear specification as suggested by the neoclassical theory (Durlauf 2001). Rather recently, a few empirical studies have asserted the presence of nonlinearities in the growth process implying multiple steady-states and convergence clubs (Chatterji, 1992; Quah, 1993; Durlauf and Johnson, 1995; Hansen, 2000). These studies are based on theoretical models that yield multiple (locally stable) steady-state equilibria and classify geographical units into different groups with different convergence characteristics (for a review, see Azariadis 1996, and Islam 2003).

Since economic theory does, to a large extent, not offer much guidance, empirical studies have come to various conclusions regarding the number and characteristics of groups, affected heavily by the particular method employed. At the international level, Baumol and Wolff (1988), for instance, using a simple non-linear model, detected the existence of two groups: a high income convergence club and a low income divergence one. Quah (1993), based on non parametric analysis, identified an emergent twin-peak, implying polarization of countries into two different income classes. Durlauf and Johnson (1995), using regression tree analysis, found evidence of four regimes, each one subscribing to a different linear model, with convergence observed for high income countries and divergence for low incomes ones. More recently, at the European regional level, a few empirical studies, using a wide variety of methods, have tested and confirmed convergence club hypothesis (Canova 1999, Corrado et al. 2005, Ertur et al. 2006, Fischer and Stirböck 2006, Dall'erba et al. 2008, Ramajo et al. 2008).

An alternative approach, which requires the identification of a lead economy, to investigate the existence of convergence clubs has been proposed by Chatterji (1992). This approach relates the economic gap (i.e. the difference between the per capita Gross Domestic Product (GDP) level of the leading economy and the per capita GDP levels of the other economies) at some date with the respective economic gap at an earlier date, including further powers of those earlier levels. On empirical grounds, Chatterji (1992) shows, at the international level, the existence of two mutually exclusive convergence clubs: one including the rich countries and the other including the poor countries. Similar results are obtained by Chatterji and Dewhurst (1996) for the regions of Great Britain in the period 1977-1991. Using the same

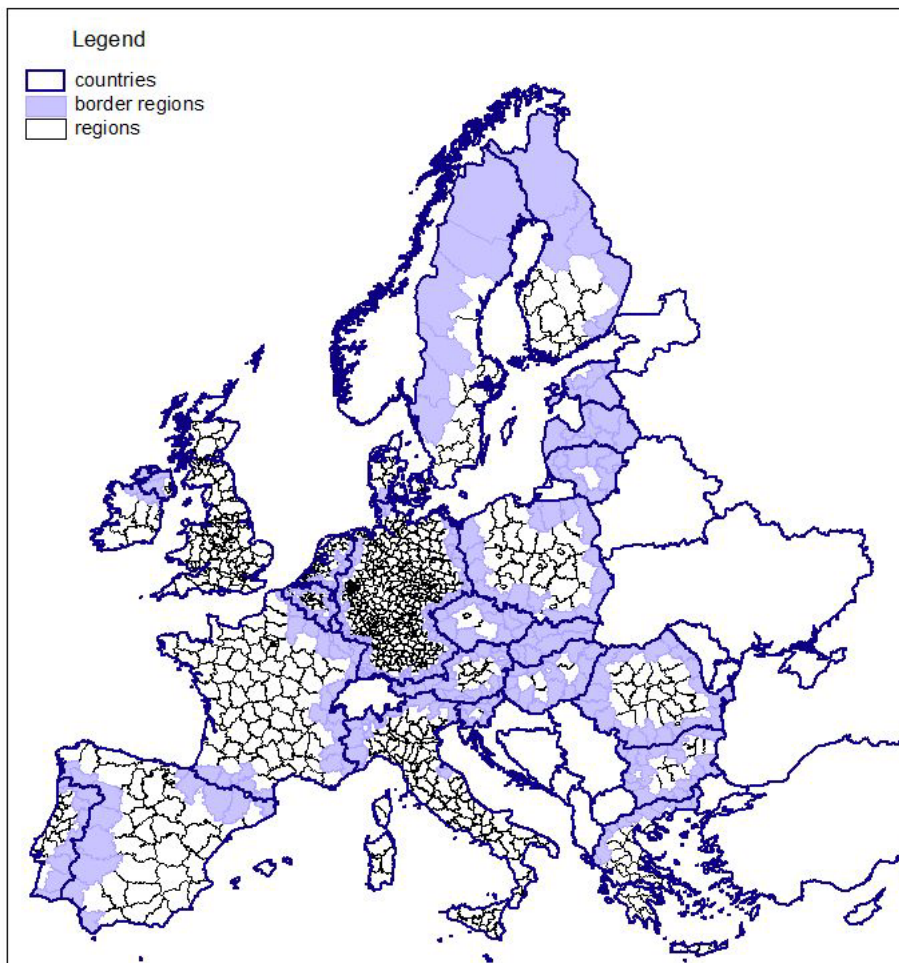
approach, Armstrong (1995) and Kangasharju (1999) do not show evidence of convergence clubs for the regions of the EU in the period 1975-1992 and the regions of Finland in the period 1934-1993, respectively. In contrast, Artelaris et al. (2010) found evidence of convergence clubs in many new EU member-states (NMS).

### **3. The EU Regions: Some Stylized Facts**

The area under consideration consists of 1,278 EU NUTS III regions, out of which 333 are border regions (ESPON 2006) (Figure 1). These regions comprise a highly heterogeneous area in terms of size, population, population density, GDP, and GDP per capita (Table 1).

In terms of size, the smallest and the largest EU border regions are also the largest and the smallest EU regions, respectively, overall. The largest EU (border) region is Norrbottens län (106,012 km<sup>2</sup>) and the smallest is Ciudad Autónoma de Melilla (13 km<sup>2</sup>). The former region is 8,155 times as much as the latter (which seems to be just like a point on the map). In terms of demography, the EU border regions with the more and the least population are Nord (2,576,000 inh.) and Außerfern (32,000 inh.), respectively. The former region is almost 81 times as much as the latter. However, this is not the highest population ratio among NUTS III EU regions since the non-border regions of Comunidad de Madrid (5,922,000 inh.) and Orkney Islands (20,000 inh.) are the EU regions with the more and the least population, respectively. In terms of population density, the most densely populated EU border region is Ciudad Autónoma de Melilla (5,087 inh./km<sup>2</sup>) and the least densely populated EU border region is Lappi (2 inh./km<sup>2</sup>). The former region is also the smallest EU region, whereas the latter is also the least densely populated region in the EU as a whole. The ratio between them is almost 2,544. In terms of GDP, the richest EU border region is Nord (54,708,000,000 €), whereas the poorest is Vildin (181,000,000). The ratio between them is almost 303. In terms of GDP per capita, the richest EU border region is (the Duchy of) Luxemburg (56,850 €/inh.), and the poorest EU border region is Botosani (1,205 €/inh.). The ratio between them is almost 48. Even though these (i.e. in terms of GDP and GDP per capita) are not the highest ratios, since there are other, non-border, regions with highest and lowest figures, the differences are still significant.

Figure 1: The EU NUTS III (border) regions (the area under consideration)



Sources: ESPON (2006) / Authors' elaboration

It is exactly the heterogeneity of the area under consideration, which dictates the “inadequacy” of linear methods – methods that follow the “all or nothing” logic – for the detection of the EU border regions’ growth pattern(s). The estimation of  $\beta$ - and  $\sigma$ -convergence can offer only a general trend concerning the level and the evolution of regional inequalities. This general trend, however, might give a misleading picture since it rules out the possibility that economies can form convergence clubs (Chatterji 1992). Hence, regional inequalities can be evaluated in a more detailed and informative way, using the approach of regional convergence clubs, as proposed by Chatterji (1992). In essence,  $\beta$ -convergence analysis, as introduced by Barro and Sala-i-Martin (1992), has been modified and extended by Chatterji (1992) in order to incorporate the possibility for the existence of convergence clubs.

Table 1: Some basic territorial, demographic and economic characteristics of the EU-27 (border) regions (year 2005)

CHARACTERISTIC		FIGURE (all regions)	FIGURE (border regions)	NAME (all regions)	NAME (border regions)
Size (km <sup>2</sup> )	Minimum	13	13	Ciudad Autónoma de Melilla (ES)	Ciudad Autónoma de Melilla (ES)
	Maximum	106,012	106,012	Norrbottnens län (SE)	Norrbottnens län (SE)
	Average	3,363	5,226		
Population (inh.)	Minimum	20,000	32,000	Orkney Islands (UK)	Außerfern (AT)
	Maximum	5,922,000	2,576,000	Comunidad de Madrid (ES)	Nord (FR)
	Average	383,000	341,000		
Population Density (inh./km <sup>2</sup> )	Minimum	2	2	Lappi (FI)	Lappi (FI)
	Maximum	20,355	5,087	Paris (FR)	Ciudad Autónoma de Melilla (ES)
	Average	114	65		
GDP (€; 2000 prices)	Minimum	138,000,000	181,000,000	Evrytania (GR)	Vidin (BG)
	Maximum	151,282,000,000	54,708,000,000	Paris (FR)	Nord (FR)
	Average	7,778,000	4,852,000		
GDP per capita (€/inh.; 2000 prices)	Minimum	1,154	1,205	Targovishte (BG)	Botosani (RO)
	Maximum	122,905	56,850	Inner London – West (UK)	Luxembourg (LU)
	Average	20,308	14,226		

Sources: Cambridge Econometrics EUROPEAN REGIONAL Database / Authors' elaboration

#### 4. The Emergence of Convergence Clubs among the EU Regions: Focusing on EU Border Regions

The investigation for the emergence of regional convergence clubs is based on the econometric estimation of the equation:

$$G_{F,l-r} = \sum_{k=1}^K \gamma_k (G_{B,l-r})^k \quad (1),$$

where  $B$  denotes the base (initial) year of estimation,  $F$  denotes the final year of estimation,  $r$  denotes the regions under consideration (the richest region is excluded),  $l$  denotes the richest of the regions under consideration (lead region),  $G$  is the difference (gap) of the logarithms of the variable under consideration (i.e. per capita GDP) between the lead and each of the other regions,  $\gamma$  (1, 2, ...,  $K$ ) is the coefficient of  $G$ , and  $k$  (1, 2, ...,  $K$ ) are the powers of  $G$ . Thus, it is possible for a non-linear relation between the income gap (among the richest and the other of the regions under consideration) in an initial year and the respective gap in a final year to be found.

In contrast to the majority of the empirical studies in the convergence / divergence literature, the aforementioned equation is going to be estimated using the Weighted Least Squares (WLS) (instead of the conventional Ordinary Least Squares (OLS)) method. OLS studies tend to overlook the relative importance (in terms of population) of each region in the national setting, treating all regional observations as equal. Yet, regions (economies) vary widely in terms of (relative) population – this is the case concerning the EU (border) regions – and this can produce unrealistic or misleading results (Petraikos et al. 2005). Even though comparisons are rarely referred to similar-sized economies, this issue has, paradoxically, been almost completely ignored in the literature, especially at the regional level. The WLS method, however, is able to overcome this major drawback, allowing regions to have an influence, which is analogous to their relative size, on the regression results (Petraikos and Artelaris 2009).

WLS allow regions (observations) to have an influence on the regression results, according to the relative population size, through the weight matrix  $W$ . The relative population of each region can be used as the diagonal element in the weighting non-singular positive definite matrix  $\mathbf{W}_{n \times n}$ , which has zero off-diagonal elements, as follows:



$$W_{n \times n} = \begin{pmatrix} p_{11} & 0 & \dots & \dots & 0 \\ 0 & p_{22} & \dots & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & \dots & p_{nn} \end{pmatrix} \quad (2),$$

where  $p_{ii} = \frac{p_i}{\Sigma p}$ . In this case, the WLS estimator and the estimated covariance matrix are:

$$\mathbf{b}_{k \times 1}^{wls} = (\mathbf{Y}'_{k \times n} \mathbf{W}'_{n \times n} \mathbf{W}_{n \times n} \mathbf{Y}_{n \times k})^{-1} \mathbf{Y}'_{k \times n} \mathbf{W}'_{n \times n} \mathbf{W}_{n \times n} \mathbf{g}_{n \times 1} \quad (3),$$

and

$$\mathbf{V}(\mathbf{b}^{wls}) = s_{wls}^2 (\mathbf{Y}' \mathbf{W}' \mathbf{W} \mathbf{Y})^{-1} \quad (4),$$

respectively.

Following the aforementioned convergence clubs approach, the dependent variable of the regional convergence clubs equation is the GDP per capita gap (between the richest and each of the other regions under consideration) in the year 2005 ( $G_{2005,l\_r}$ ) and the independent variable is the respective gap in the year 1995 ( $G_{1995,l\_r}$ ) (Table 2). The lead region is the richest region in the year 1995 (i.e. Inner London-West). The overall explanatory power of the model is very satisfactory. The  $R_{adj}^2$  figure is relatively high and the independent variable has a statistically significant impact (at the level of 1%) in all powers. Since considerable multicollinearity between the various powers of the independent variable makes difficult the choice of the best parsimonious estimation (Chatterji 1992, Chatterji and Dewhurst 1996), the final specification of the equations was made under the rule of dropping the statistically insignificant terms. When two or more equations had statistically significant coefficients, the specification with the lowest figure of the Akaike Information Criterion (Akaike 1973) was chosen. Under these rules, the third power regional convergence clubs equation was chosen.

Table 2: Convergence clubs among the NUTS III regions of EU (final per capita GDP gap on initial per capita GDP gap), Period 1995-2005

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$$G_{2005,l_r} = \sum_{k=1}^K \gamma_k (G_{1995,l_r})^k$$


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GAP2005 =	= 0.040 GAP1995 <sup>3</sup>	– 0.248 GAP1995 <sup>2</sup>	+ 1.338 GAP 1995
	(0.000)***	(0.000)***	(0.000)***

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$R_{adj.}^2 = 0.960$

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F – statistic = 105.600 (0.000)\*\*\*

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weighting variable: population 1995

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N = 1278 observations (EU NUTS III regions); 333 are the EU NUTS III border regions

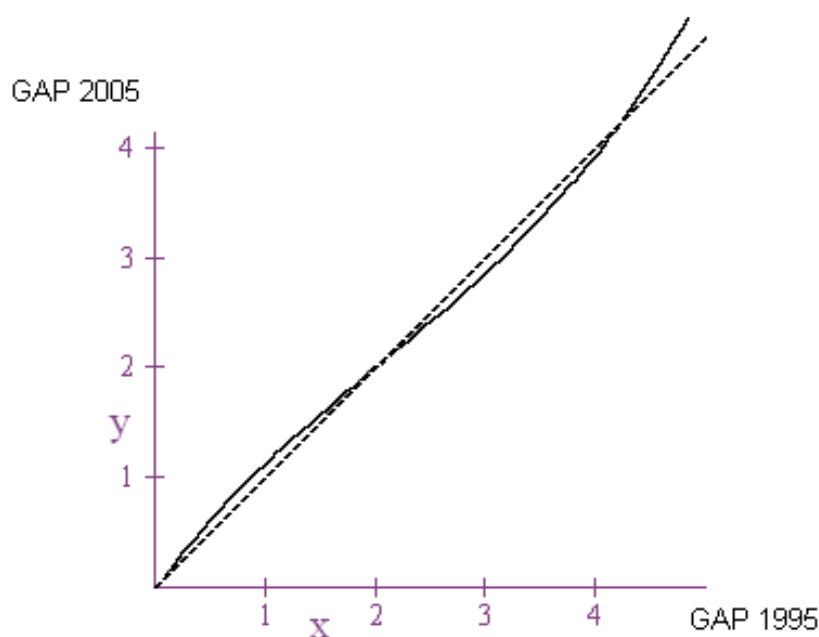
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\*\*\* statistically significant at the level of 1%

Sources: Cambridge Econometrics EUROPEAN REGIONAL Database / Authors' elaboration

The estimated function makes evident that the EU regions form convergence clubs (Figure 2). Having the function  $y = x$  (see the dotted straight line) as a benchmark, each EU region may either converge to the lead region (when the GDP per capita gap in the final year is lower compared to the respective gap in the initial year; the line of the estimated function is below the line of the benchmark function) or diverge from the lead region (when the GDP per capita gap in the final year is higher compared to the respective gap in the initial year; the line of the estimated function is above the line of the benchmark function). In particular, regions with initial gap in the interval (0, 2.13] diverge from the lead region but converge internally; regions with initial gap in the interval (2.13, 3.86] converge both to the lead region and internally; regions with initial gap greater than 3.86, diverge both from the lead region and internally. Hence, the regions of the first two groups (i.e. initial gaps in the intervals (0, 2.13] and (2.13, 3.86]) form a convergence club, since the two groups converge to point 2.13, whereas the regions of the third group diverge from the aforementioned convergence club.

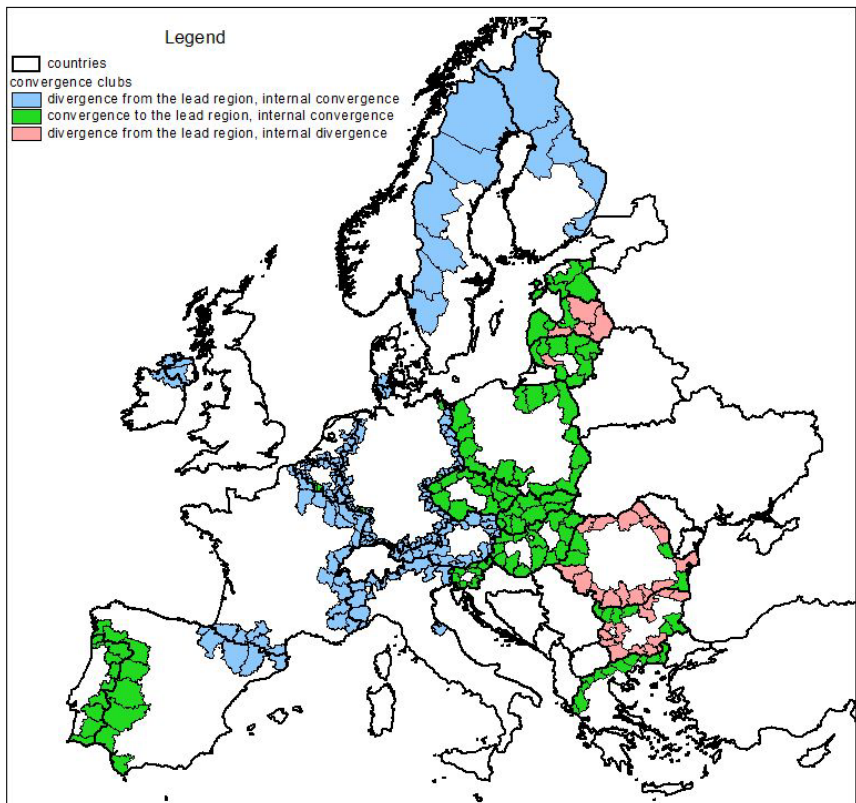
Figure 2: Convergence clubs among the NUTS III regions of EU (final per capita GDP gap on initial per capita GDP gap), Period 1995-2005



Sources: Cambridge Econometrics EUROPEAN REGIONAL Database / Authors' elaboration

The allocation of the EU border regions to the convergence clubs formed among the EU regions (Figure 3) accentuates a clear spatial pattern. The regions of Western (with the exception of the regions situated along the Spanish-Portuguese borderline) and Northern Europe diverge from the lead region and present trends of internal convergence. The majority of the regions situated in the EU NMS (exceptions include some regions in Bulgaria, Romania, Lithuania and Latvia), the border regions of Greece, and the regions situated along the Spanish-Portuguese borderline converge both to the lead region and internally. The rest of the EU border regions (i.e. regions situated in Bulgaria, Romania, Lithuania and Latvia) diverge both from the lead region and internally. Thus, the majority of the EU border regions, either diverging from the lead region or converging to the lead region, tend to form one broad convergence club. There are some EU NMS regions, however, that present clear trends of divergence (from the aforementioned convergence club and internally). It is evident that a non-linear process of growth along the EU-27 border regions seems to exist, indicating that the process of integration in Europe is still associated with significant differentiations along border areas. This heterogeneity in spatial impact, underlines the critical role that geographic location and initial conditions (in terms of institutional proximity to the EU) play in the economic performance of border regions.

Figure 3: The allocation of the EU border regions to the convergence clubs formed among the EU regions, Period 1995-2005



Sources: Cambridge Econometrics EUROPEAN REGIONAL Database / Authors' elaboration

The previously described spatial pattern allows concluding that, at a macro-geographical perspective, there seems to be a distinct differentiation in performance among the “old” and the “new” EU border regions. Nevertheless, a meticulous observation brings to light dividing lines within the “old” and the “new” EU border regions as well. In particular, the “old” EU border regions do not exhibit patterns of uniformity since the majority of border regions belonging to the EU State-founders (“old-old EU”) exhibit different growth patterns compared to more distant border regions of the countries entering the EU at a later stage (“new-old EU”). Respectively, a dividing line seems to appear among the border regions of the countries entering the EU in 2004 (“old-new EU”) and those entering the EU in 2007 (“new-new EU”).

## **5. Conclusions**

The objective of the paper is to detect, on empirical grounds, the growth pattern(s) of the EU border regions. To this end, the paper uses a convergence clubs approach (Chatterji 1992). The analysis is based on, disaggregated at the NUTS III spatial level, data, covering the period 1995-2005.

The application of the convergence clubs methodology accentuates the clear spatial pattern that characterises the EU border regions' growth process. The majority of the regions of Western and Northern Europe diverge from the lead region and present trends of internal convergence. The majority of the regions situated in the EU NMS, as well as the rest of the regions situated in Western and Northern Europe, converge both to the lead region and internally. The rest of the EU border regions diverge both from the lead region and internally. Thus, the majority of the EU border regions tend to form one broad convergence club.

The application of the convergence clubs methodology suggests a non-linear process of growth along the EU-27 border regions, indicating that the process of integration in Europe is still associated with significant differentiations along border areas. This heterogeneity in spatial impact, underlines the critical role that geographic location and initial conditions (in terms of institutional proximity to the EU) play in the economic performance of border regions.

More specifically, the findings of the paper suggest that three patterns of growth among the EU-27 border regions can be detected. The first type involves the border regions of the more advanced EU countries, located in the EU's economic core, which diverge from the lead region and converge internally. The second type includes the majority of the EU NMS border regions and also the Spanish-Portuguese and the Greek border zones which converge from the lead region and converge internally. The third type is depicted mainly along the Romanian and Bulgarian borderlines which diverge from the lead region and diverge internally.

This spatial pattern allows concluding that, at a macro-geographical perspective, there seems to be a distinct differentiation in performance among the "old" and the "new" EU border regions. Nevertheless, a meticulous observation brings to light dividing lines within the "old" and the "new" EU border regions as well. In particular, the "old" EU border regions do not exhibit patterns of uniformity since the majority of border regions belonging to the EU State-founders ("old-old EU") exhibit different growth patterns compared to more distant border regions of the countries entering the EU at a later stage ("new-old EU"). Respectively, a dividing line seems to appear among the border regions of the countries entering the EU in 2004 ("old-new EU") and those entering the EU in 2007 ("new-new EU").

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