Regional inequalities and convergence clubs in the European Union new member-states

Panagiotis ARTELARIS*, Dimitris KALLIORAS**, George PETRAKOS***

Abstract

The paper assesses on empirical grounds the level and the evolution of regional inequalities in each European Union new member-state (EU NMS) and examines the possibility for the emergence of regional convergence clubs. The experience of the EU NMS is a unique situation, where relatively closed economic systems opened, almost at once, to the world economy and, at the same time, market mechanisms replaced central planning. Thus, understanding the spatial pattern of regional growth in the EU NMS may provide valuable insight for theory and policy. The application of non linear econometric models, which transcend the "all or nothing" logic behind conventional convergence analysis, has shown the existence of regional convergence clubs in many EU NMS. The identification of regional convergence clubs, irrespective of the pattern that emerges in each EU NMS, highlights the heterogeneous spatial impact of the EU economic integration process.

Key words: new European Union member-states, regional inequalities, convergence clubs, Weighted Least Squares (WLS), integration

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

1. Introduction

The issue of inequalities (or convergence/divergence issue) of per capita income (or productivity) across any set of regions has attracted considerable

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research interest, especially during the last couple of decades. Apart from its obvious policy implications, whether economies converge or diverge over time is an issue of theoretical significance (Sala-i-Martin, 1996). Following Solow (1956), proponents of the neoclassical paradigm argue that disparities are bound to diminish with growth (see Barro and Sala-i-Martin, 1995, for a review). In contrast, other schools of thought, such as the endogenous growth theories (Romer, 1986; Lucas, 1988; see Aghion and Howitt, 1998, for a review) and the new economic geography (Krugman, 1991; see Fujita et al, 1999, for a review) tend to agree with the basic claim of Myrdal (1957) that growth is a spatially cumulative process, which is likely to increase inequalities.

The detection of convergence or divergence trends is a highly significant issue for the new European Union member-states (EU NMS)[1]. The experience of the EU NMS is a unique situation, where relatively closed economic systems opened, almost at once, to the world economy and, at the same time, market mechanisms replaced central planning (Petrakos, 2008). However, the market-based process of economic integration, although it is perceived to generate higher levels of aggregate efficiency (positive-sum game), can possibly be associated with higher levels of inequality (Nijkamp and Wang, 1999; Martin, 2005). In spatial terms, this is believed to lead to regional imbalances, with less advanced regions possibly experiencing, in the integration process, weaker gains, or, even, net losses, as compared to their more advanced counterparts (Camagni, 1992; Bradley et al, 2005; Kallioras and Petrakos, forthcoming). Thus, understanding the spatial pattern of development in the EU NMS may provide valuable insight for theory and policy.

Despite the considerable body of research, however, the convergence/divergence issue in the EU NMS has not attracted much interest as regards the sub-national (regional) level. Most empirical studies have focused either on the country level (see Campos, 2001; Amplatz, 2003; Dobrinsky, 2003; Workie, 2005; Jelnikar and Murmayer, 2006; Vojinovic and Próchniak, 2009) or on the regional level, examining, however, the regions of the EU NMS as a whole (see Herz and Vogel, 2003; Tondl and Vuksic, 2003; Ezcurra et al, 2007a; Paas et al, 2007). Only few studies have addressed this issue at the sub-national level, focusing on a specific EU NMS (see for example Lackenbauer, 2004, for Hungary; Iara, 2008, for Romania; Totev, 2008, for Bulgaria). As a result, there is a need for a comprehensive and systematic study addressing the convergence/divergence issue for all EU NMS at the intra-national level. Three previous studies that have explored this issue (Römisch, 2003; Petrakos et al, 2005a; Petrakos et al, 2005b) have been restricted in both short time intervals (five-year periods) and conventional linear methods (β- and σ- convergence).

[1] The notion "EU NMS" includes Slovenia, Hungary, Slovakia, Czech Republic, Poland, Latvia, Lithuania and Estonia that became EU members in May 2004, and Bulgaria and Romania that became EU members in January 2007.

The objective of the paper is to assess on empirical grounds the level and the evolution of regional inequalities in each EU NMS and examine the possibility for the emergence of regional convergence clubs. This paper, similarly to existing empirical studies focusing on EU NMS, applies the σ-convergence approach in order to examine the general trends of regional inequalities. However, an exclusive focus on this approach (the same stands for the β-convergence approach) might give a misleading picture for regional inequalities, since, as Chatterji and Dewhurst (1996) pointed out, it is quite natural to expect that groups of economies are converging but that these groups are themselves diverging from each other. In other words, conventional convergence analysis does not take into account the interesting possibility that there might exist groups of regions that form convergence clubs (see Chatterji, 1992, for an extensive critique of conventional convergence analysis). This is a very important point for both theory and policy. Convergence clubs are related with a wide variety of economic models allowing multiple regimes and different growth trajectories, such as endogenous growth models and new economic geography models (see also Azariadis, 1996). Moreover, the existence of multiple regimes necessitates state intervention in achieving balanced regional growth. As a result, an alternative method, proposed by Chatterji (1992), is used in order to investigate the existence of convergence clubs.

Unlike Chatterji (1992), however, the regressions are estimated using the Weighted Least Squares (WLS) method. This is because the conventional Ordinary Least Squares (OLS) method tends to overlook the relative importance or size of each region in the national setting, treating all regional observations as equal. The WLS method is able to overcome this major drawback allowing regions to have an influence, which is analogous to their relative size, on the regression results (Petrakos and Artelaris, 2009).

The analysis is based on, disaggregated at the Nomenclature of Territorial Units for Statistics (NUTS) III spatial level, data, derived from European Regional Database (Cambridge econometrics 2008)[2], and covers the period 1990-2005. The period of analysis is extremely significant since it includes not only the shocks of the early pre-accession (to the EU) period but also the more recent trends that the EU NMS regions have experienced.

The paper is organised as it follows: the next section describes the regional structure of the EU NMS, the third section briefly outlines the

[2] This database provides regional data at NUTS II and NUTS III level mainly based on information provided by REGIO database which is the official EUROSTAT data for territorial units in Europe and the only source providing comparable EU-wide regional data. Data is available on a yearly basis covering the period 1990-2005 for the EU NMS while all GDP series are expressed at year 2000 constant prices. This database has been used as the basis for much empirical work on convergence issue (see for example Herz and Vogel, 2003; Badinger et al, 2004; Fingleton, 2004; Ezcurra et al, 2007b; Battisti and De Vaio, 2008).

convergence/divergence issue, the fourth section assesses the level and the evolution of intra-national inequalities in the EU NMS, in per capita Gross Domestic Product (GDP) terms, in the period 1990-2005, using the conventional σ-convergence analysis, whilst the fifth section investigates econometrically the emergence of regional convergence clubs. Finally, the sixth section summarises the findings and provides the conclusions.

2. The Regional Structure of the New European Union Member-States

Covering an area from the Balkan Peninsula to the Baltic Sea, the EU NMS present high degree of heterogeneity.

Table 1 presents the basic demographic and economic characteristics (year 2005) of each EU NMS. The great majority of the EU NMS can be considered small or very small, in terms of size and population. Exceptions are Poland and Romania that are, by far, the largest EU NMS. Concerning population density, a “core-periphery” pattern seems to emerge, as the EU NMS coming from Central Europe (i.e. Czech Rep., Poland, Slovakia, Hungary, and Slovenia) are more densely populated as compared to the EU NMS coming from the Balkans (Romania and Bulgaria) and the Baltic (Lithuania, Latvia, and Estonia). Notable is the case of Romania since it holds barely the 6th place in the ranking, despite being 2nd in the corresponding rankings of size and population. In terms of GDP, the EU NMS classification is extremely interesting. Poland has, by far, the largest economy. Czech Rep., however, holds the 2nd place, recording GDP levels higher than that of Romania, even though it is smaller in terms of size and population. Analogous are the cases of Slovakia, Slovenia and Lithuania that have GDP levels greater than that of Bulgaria. In terms of GDP per capita, Slovenia presents the highest level of development, having a figure that reaches the respective figures of the EU member-states coming from the European South (i.e. Portugal and Greece). Bulgaria and Romania are far worse and, unavoidably, hold the lowest positions in the ranking.

Table 1. Basic Demographic and Economic Characteristics of the EU NMS, Year 2005

Country	Size (km^2)	Population (inhabitants)	Population density (inhabitants/km^2)	GDP (€) (2000 prices)	GDP per capita (€/inhabitant) (2000 prices)
Bulgaria	111,002	7,740,000	70	17,506,000,000	2,262
Czech rep.	78,860	10,247,000	130	73,524,000,000	7,175
Estonia	45,228	1,345,000	30	9,086,000,000	6,755
Hungary	93,029	10,087,000	108	65,511,000,000	6,495

Latvia	64,589	2,300,000	36	12,560,000,000	5,461
Lithuania	65,300	3,414,000	52	18,010,000,000	5,275
Poland	312,685	38,169,000	122	215,701,000,000	5,651
Romania	238,391	21,632,000	91	53,286,000,000	2,463
Slovakia	49,035	5,401,000	110	27,625,000,000	5,115
Slovenia	20,273	2,000,000	99	24,769,000,000	12,381

Source: Cambridge econometrics (2008) data elaborated by the authors

Table 2 presents the basic demographic and economic characteristics (year 2005) of each EU NMS at the regional level. Particularly, it shows the minimum, average, and maximum figures in terms of population and GDP per capita. To begin with, there is no general rule concerning the number of regions in each EU NMS. National particularities and (possible) policy objectives seem to prevail (Beenstock, 2005; Petrakos et al, 2005a). However, the five largest EU NMS in terms of population (i.e. Poland, Romania, Hungary, Czech Rep., and Bulgaria) have more regions than the five smallest. Of course, the rankings in terms of population do not correlate perfectly with the ranking in terms of number of regions. Slovenia is a characteristic case since it has more regions than Slovakia, Lithuania, and Latvia, even though it is smaller in terms of population. By comparing the average regional populations in the EU NMS, it results that Poland, Czech Rep., and Slovakia have the highest figures, whereas Slovenia, Estonia, and Bulgaria have the lowest ones. Internal differences between the largest and the smallest region in each EU NMS depend mainly on the capital region (in most of the cases this is the highly-populated region). The smallest differences between the minimum and the maximum regional population figures are observed in Slovakia, Estonia, and Latvia. Concerning the average regional GDP per capita in the EU NMS, it emerges that Slovenia, Czech Rep., and Estonia have the highest figures, whereas Bulgaria and Romania have, by far, the lowest ones. Notable is the fact that the average regional GDP per capita figures of Bulgaria and Romania are lower than the minimum regional GDP per capita figures of the other EU NMS.

Table 2. Basic Demographic and Economic Characteristics of the EU NMS Regions (NUTS III), Year 2005

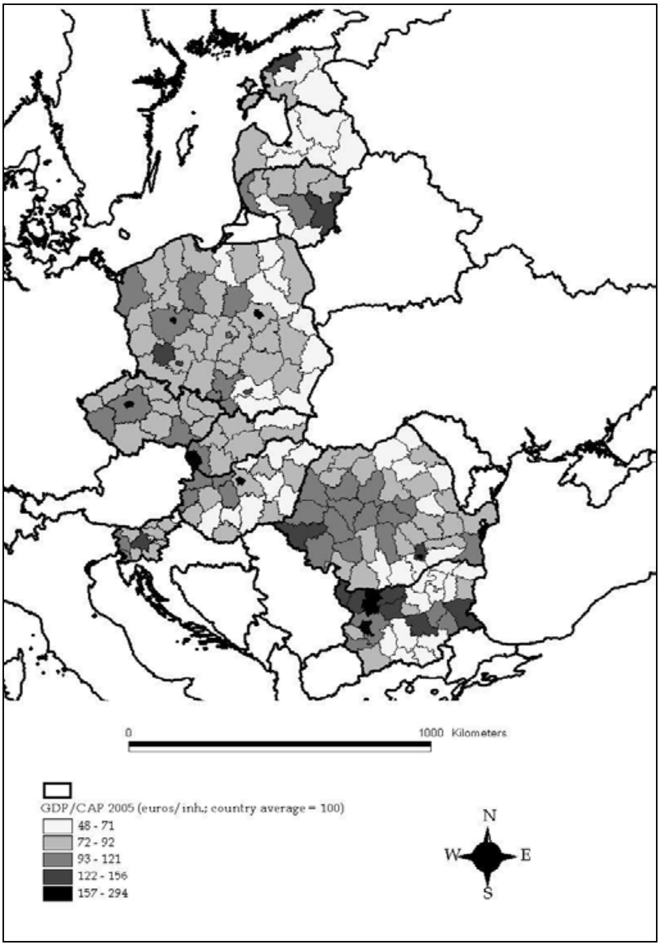
Country (number of regions)	Population (inhabitants)			GDP per capita (€/inhabitant) (2000 prices)		
	minimum	average	maximum	minimum	average	maximum
Bulgaria (28)	60,879 (Vildin)	276,421	1,225,131 (Sofia Stolitsa)	1,154 (Targovishte)	2,160	4,508 (Vratsa)

Czech Rep. (14)	304,714 (Karlovarský)	731,893	1,256,425 (Moravskoslezko)	5,489 (Karlovarský)	6,719	15,268 (Praha)
Estonia (5)	141,591 (Kesk-Eesti)	269,007	519,244 (Põhja-Eesti)	4,115 (Kirde-Eesti)	5,664	10,321 (Põhja-Eesti)
Hungary (20)	215,565 (Nógrád)	504,353	1,693,279 (Budapest)	3,581 (Nógrád)	5,523	13,308 (Budapest)
Latvia (6)	244,750 (Vidzeme)	383,348	729,748 (Riga)	2,641 (Latgale)	4,485	9,872 (Riga)
Lithuania (10)	131,042 (Taurages Apskritis)	341,389	845,723 (Vilniaus Apskritis)	2,632 (Taurages Apskritis)	4,528	7,654 (Vilniaus Apskritis)
Poland (45)	284,182 (Elcki)	848,205	2,867,593 (Centralny Slaski)	3,219 (Bialskopodlaski)	5,371	16,608 (Miasto Warszawa)
Romania (42)	223,551 (Covasna)	515,053	1,928,103 (Bucuresti)	1,205 (Botosani)	2,244	5,124 (Bucuresti)
Slovakia (8)	554,920 (Trnavský Kraj)	675,065	800,022 (Presovský Kraj)	3,064 (Presovský Kraj)	5,266	11,867 (Bratislavský Kraj)
Slovenia (12)	45,629 (Zasavska)	166,706	497,645 (Osrednjeslovenska)	8,435 (Pomurska)	10,980	17,753 (Osrednjeslovenska)

Source: Cambridge Econometrics (2008) data elaborated by the authors

Figure 1 depicts the geography of the regional economic performance in the EU NMS, presenting cartographically the GDP per capita figures (year 2005) of the EU NMS regions as a percentage of the relative country average. Even though, each EU NMS seems to develop its own spatial pattern of economic performance, the prevalence of the metropolitan regions (i.e. capital and major urban regions) is evident. However, the remark that should be made concerns the Central European EU NMS regions situated along the "east-west" borderline. These regions record relatively high levels of economic performance, indicating that border regions are not lagging-behind regions by definition since the advantages of centrality at the EU level may be stronger and offset the disadvantages of peripherality at the respective national level. The EU NMS spatial pattern of economic performance confirms the early predictions of the literature, indicating the significance of agglomeration economies (that favour metropolitan regions) and geography (that favours western border regions) (Downes 1996, Petrakos 1996, Petrakos 2000).

Figure 1. Economic Performance of the EU NMS regions, GDP per Capita (€/inhabitant; country average= 100), Year 2005



Source: Cambridge econometrics (2008) data elaborated by the authors

3. The Club Convergence Approach in the Convergence/Divergence Literature

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). Three main concepts of convergence have been used in this literature: unconditional β-convergence, conditional β-convergence and σ-convergence. If economies are homogeneous, convergence can occur in an absolute sense (unconditional β-convergence) since they will converge towards the same steady-state.

Conversely, if economies are heterogeneous, convergence may occur only in a conditional sense (conditional β-convergence) since economies will grow toward different steady-state positions. Finally, σ-convergence refers to the dispersion of per capita income at a given moment in time (presented in terms of the standard deviation or coefficient of variation). Though β-convergence is **a** necessary condition for σ-convergence, it is not sufficient (Barro and Sala-i-Martin, 1995).

At the regional level, there is ample empirical evidence of this type of research (see Magrini, 2004, for a review). Most empirical studies have examined convergence/divergence processes utilising econometric or statistical models of linear specification as suggested by the neoclassical theory (Durlauf, 2001). However, more recently, scholars have proposed new theoretical models that allow for multiple regimes and club convergence among countries (for a review see Azariadis, 1996). Azariadis and Drazen (1990), for instance, developed a model where multiple steady states emerge due to the presence of externalities. Such externalities give rise to increasing social returns to scale, once a threshold level of human capital is reached. Similarly, Durlauf (1993), Galor (1996) and Quah (1996) have demonstrated that multiple equilibria can emerge on account of differences in, among others, human capital, income distribution, capital or market imperfections, local complementarities and externalities.

Club convergence implies convergence to a common level only for economies that are both identical in their structural characteristics and similar in their initial conditions (Galor, 1996). In other words, there is convergence within each club but there is not convergence across clubs. A few empirical studies have asserted the presence of nonlinearities in the growth process implying multiple steady-states and convergence clubs (Chatterji, 1992; Quah, 1993a; Durlauf and Johnson, 1995; Hansen, 2000). These studies transcend the “all or nothing” logic behind conventional convergence analysis and maintain that convergence may come about for different groups of economies (for a review, see Azariadis, 1996; and Islam, 2003).

Since economic theory does 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. Baumol and Wolff (1988), for instance, by using a simple non-linear model, detected the existence of two groups: a high income convergence club and a low income divergence one. Quah (1993a), based on non parametric analysis, identified an emergent twin-peak, implying polarization of countries into two different income classes. Durlauf and Johnson (1995), by using the 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. Chatterji (1992) relating the economic gap (i.e. the difference between the per capita GDP level of the richest economy and the per capita GDP levels of the other economies considered) at some date with the respective economic gap at an earlier date and including further powers of those earlier levels, found the existence of two mutually exclusive convergence clubs: one including the rich countries and another including the poor countries. In turn, Liu and Stengos (1999), employing a semi-parametric partially-linear method, and Hansen (2000), relying on threshold regression, concluded that convergence is evident only for countries of the middle and upper income range. More recently, a few empirical studies, using a wide variety of methods, have tested and confirmed the convergence club hypothesis at the European regional level (Armstrong, 1995; Canova, 1999; Corrado et al, 2005; Ertur et al, 2006; Fischer and Stirböck, 2006; Dall'erba et al, 2008; Ramajo et al, 2008).

4. The Level and the Evolution of Regional Inequalities in the New European Union Member-States

The assessment of regional inequalities in the EU NMS provides empirical answers to a number of questions concerning the spatial impact of the EU economic integration. Is the process of the EU economic integration accompanied by an increase of regional inequalities? If yes, how important is this increase? Does this apply to all (or just a few) EU NMS?

The level and the evolution of regional inequalities in the EU NMS are evaluated, for the period 1990-2005, in per capita GDP terms, with the use of the coefficient of variation (also known as σ-convergence analysis) (Friedman, 1992; Quah, 1993b; Sala-i-Martin, 1996). In contrast to the vast majority of studies, this study employs the weighted rather than the unweighted coefficient of variation since regions vary widely in terms of population (Williamson, 1965). This coefficient (CVw) is expressed under the formula: $CVw_{c,t} = \sqrt{\sum_r (X_r - X_c^{avr})^2 * (P_{r/c})} / X_c^{avr}$, where t denotes the year under consideration, c denotes the country under consideration, r ($\in c$) denotes the region under consideration, X is the variable under consideration (i.e. per capita GDP), X^{avr} is the average figure of the variable under consideration, and $P_{r/c}$ is the weighting variable (i.e. relative population). CVw takes values greater than (or equal to) 0, ranging from lower to higher levels of inequality.

Table 3 presents the level of regional inequalities in the EU NMS, at the NUTS III spatial level, for selected years in the period 1990-2005. The evolution of regional inequalities in the EU NMS indicates that the market-based process of the EU economic integration has been accompanied by a significantly increasing trend. This trend, which was evident from the early pre-accession (to the EU) period, has continued to prevail in the late 1990s and the early 2000s at an undiminished pace (Römisch, 2003, Petrakos et al, 2005a, Petrakos et al, 2005b).

The highest levels of regional inequalities (CVw > 0.500) are recorded in Latvia, Estonia, Hungary, Poland, and Bulgaria. This finding allows two very important remarks to be made. The first remark is that regional heterogeneity (which is determined by the number of regions), and not country size by itself, is a criterion for the magnitude of regional inequalities (see also Beenstock, 2005, and Petrakos et al, 2005b)[3]. The second remark is that in a rather short period, after the collapse of the socialist regime, regional inequalities in many EU NMS have reached levels comparable to (or, even, greater than) the respective levels of many old EU member-states (see also Petrakos et al, 2005c).

Table 3. Level of Regional Inequalities in the EU NMS, NUTS III, CVw (GDP per Capita), Years 1990, 1995, 2000, 2005

Country	1990	1995	2000	2005
Bulgaria	0.408	0.435	0.468	0.520
Czech Rep.	0.151	0.273	0.386	0.445
Estonia	0.427	0.488	0.589	0.609
Hungary	0.285	0.390	0.494	0.536
Latvia	0.272	0.455	0.653	0.714
Lithuania	0.090	0.159	0.272	0.376
Poland	0.278	0.334	0.508	0.520
Romania	0.285	0.255	0.474	0.450
Slovakia	0.280	0.419	0.433	0.468
Slovenia	0.238	0.261	0.279	0.320

Source: Cambridge econometrics (2008) data elaborated by the authors

5. The Emergence of Regional Convergence Clubs in the New European Union Member-States

The estimation of the weighted coefficient of variation can offer the general trend concerning the level and the evolution of regional inequalities. However, this approach might give a misleading picture since it rules out the possibility that economies can form convergence clubs (Chatterji, 1992; Durlauf and Johnson, 1995; Durlauf, 2001). Hence, regional inequalities in the EU NMS can be evaluated in a more detailed and informative way, by using the approach of regional convergence clubs, as proposed by Chatterji (1992). To our knowledge, this is the first study examining the emergence of regional convergence clubs in the EU NMS (i.e. separately in each EU NMS).

[3] Spatial inequality measures are sensitive to the definition of regions. This is commonly referred to as the “modifiable areal unit problem” (MAUP), according to which the results of statistical analysis of data for spatial zones can be varied at will by changing the zonal boundaries (Arbia, 1989; Brülhart and Traeger, 2003).

The investigation for the emergence of regional convergence clubs is based on the econometric estimation of the equation: $G_{F,l\_r} = \sum_{k=1}^{K} \gamma_k (G_{B,l\_r})^k$, where B denotes the base (initial) year of estimation, F denotes the final year of estimation, r denotes the regions under consideration, 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 regions under consideration, γ (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 regions under consideration) in an initial year and the respective gap in a final year to be found.

In contrast to the previous empirical studies in the convergence /divergence literature, the regressions were estimated using the WLS (instead of the OLS) method. OLS studies tend to overlook the relative importance or size of each region in the national setting, treating all regional observations as equal. Yet, regions (economies) vary widely in terms of (relative) population and this can produce unrealistic or misleading results. 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[4] (for exceptions see Benito and Ezcurra, 2005; Tortosa-Ausina et al, 2005; Petrakos and Artelaris, 2009). 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 (Petrakos and Artelaris, 2009).

Table 4 presents the results (p-values are in parentheses) of the econometric investigation for the emergence of regional convergence clubs, in per capita GDP terms, in the EU NMS, during the period 1990-2005. The dependent variable of the regional convergence clubs equation is the GDP per capita gap (between the richest and each of the regions under consideration) in the year 2005 (G_{2005,l_r}) and the independent variable is the respective gap in the year 1990 (G_{1990,l_r}). In all cases, the lead region is considered to be the richest region in the year 2005[5]. 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

[4] Focusing exclusively at the international level, Edwards (1998), Zhang and Li (2002) Cole and Neumayer (2003) and Artelaris et al., (forthcoming) use a WLS approach in order for countries to have an influence on regression results which is analogous to their size.

[5] This holds also when the richest region in the year 2005 was not the richest region in the year 1990 (this happens in the cases of Bulgaria, Latvia, Lithuania, and Romania).

final specification of the equations was made under the rule of dropping the statistically insignificant terms.

Table 4. Convergence Clubs in the EU NMS Regions, Regression Results (Final GDP per Capita Gap on Initial GDP per Capita Gap), Period 1990-2005

Country	$G_{2005,l\_r} = \sum_{k=1}^{K} \gamma_k (G_{1990,l\_r})^k$
Bulgaria	$Y = -2.295X^3 + 3.537X^2 + 0.094X$ (0.008)*** (0.021)** (0.882)
Czech Rep.	$Y = -275.065X^4 + 324.275X^3 - 127.926X^2 + 19.508X$ (0.000)*** (0.000)*** (0.000)*** (0.000)***
Estonia	$Y = -4.136X^2 + 3.823X$ (0.015)** (0.062)*
Hungary	$Y = -1.937X^2 + 2.834X$ (0.000)*** (0.000)***
Latvia	$Y = -79.114X^3 + 71.097X^2 - 12.859X$ (0.002)*** (0.003)*** (0.005)***
Lithuania	$Y = 22.762X^2 + 0.146X$ (0.939) (0.085)*
Poland	$Y = 2.493X^3 - 5.893X^2 + 4.809X$ (0.003)*** (0.000)*** (0.000)***
Romania	$Y = 3.33X^2 - 0.218X$ (0.601) (0.000)***
Slovakia	$Y = 45.351X^4 - 84.090X^3 + 48.509X^2 - 6.940X$ (0.025)** (0.031)** (0.044)** (0.120)
Slovenia	$Y = -2.031X^2 + 2.115X$ (0.000)*** (0.003)***

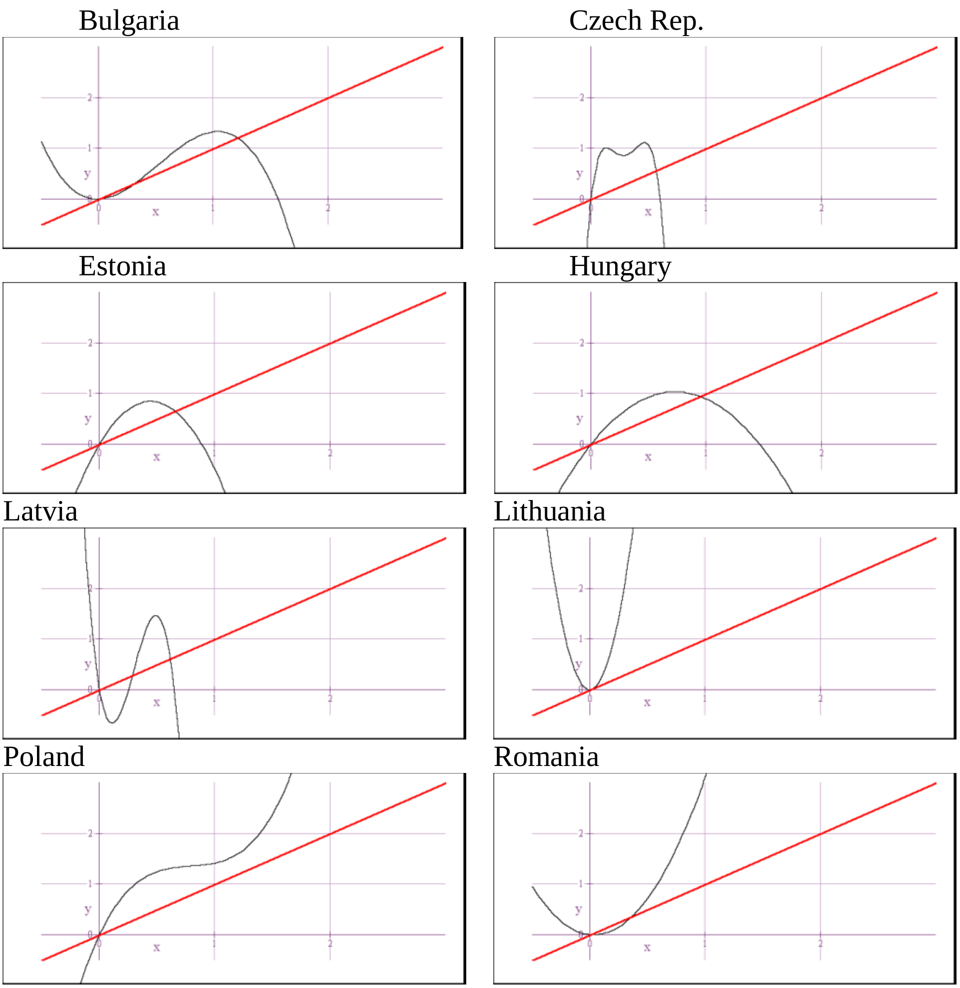
Source: Cambridge econometrics (2008) data elaborated by the authors

*** Statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.

Figure 2 depicts the estimated functions for each EU NMS. It is evident that the EU NMS regions may form convergence clubs. Having the function $y = x$ (see the straight line) as a benchmark, each EU NMS region may either converge to the lead region (when the GDP per capita gap in the final year is lower as compared to the respective gap in the initial year; the line of the estimated function is below the line of the benchmark function, in the upper right quadrant) or diverge from the lead region (when the GDP per capita gap in the final year is higher as compared to the respective gap in the initial year; the line of the estimated function is above the line of the benchmark function, in the upper right quadrant).[6]

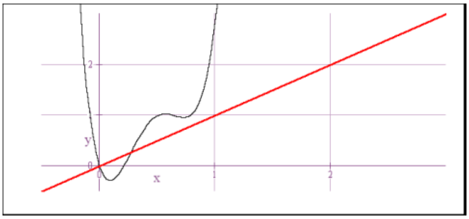
[6] The EU NMS regions that were richer than the lead region in the initial year, diverge from the lead region (the GDP per capita gap is negative in the initial year and positive in the final year; the

Figure 2. Convergence Clubs in the EU NMS, Fitted Relationship (Final GDP per Capita Gap on Initial GDP per Capita Gap), Period 1990-2005



line of the estimated function is above the line of the benchmark function, in the upper left quadrant).

Slovakia



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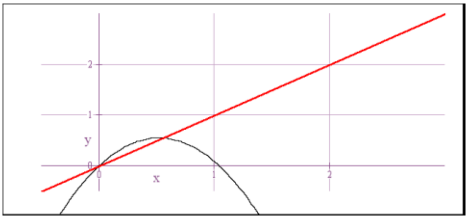

Source: Cambridge econometrics (2008) data elaborated by the authors

Table 5 presents in detail the regional convergence clubs that are formed in each EU NMS (this is possible after solving the system of the equation $y = x$ and the regional convergence clubs equation that emerges from the econometric investigation). Convergence clubs are not formed only in Poland and Slovakia since in these countries all regions diverge from the lead region. In contrast, one or two (this is the case of Bulgaria) convergence clubs are formed in the other EU NMS. The convergence club that is formed in Czech Rep., Estonia and Slovenia consists of regions that diverge from the lead region but converge internally. The convergence club that is formed in Hungary consists of two groups of regions; the first group consists of regions that diverge from the lead region but converge internally and the second group consists of regions that converge to the lead region, with the regions of the first group and internally. In Bulgaria, Latvia, Lithuania and Romania there are some regions that were richer than the lead region (the richest region in the final year) in the initial year of consideration (i.e. 1990). These regions diverge from the lead region (i.e. in the final year they became poorer). In Latvia, Lithuania and Romania one convergence club, consisting of regions that converge to the lead region, is formed. In Lithuania and Romania, however, there are also some regions that present trends of divergence since they diverge from the lead region, from the convergence club and internally. In Bulgaria, two convergence clubs are formed. The first convergence club consists of regions that converge to the lead region. The second convergence club consists of two groups of regions; the first group consists of regions that diverge from the lead region and from the first convergence club but converge internally and the second group consists of regions that converge to the lead region, to the regions of the first convergence club, to the regions of the first group and internally.

Table 5. Regional Convergence Clubs in the EU NMS, Period 1990-2005

Bulgaria	Lead region	Divergence	1st convergence club	2nd convergence club	
	(richest region in 2005)	(richer than the lead region in 1990; divergence from the lead region; internal divergence)	(convergence to the lead region)	(divergence from the lead region; divergence from the 1st convergence club; internal convergence to a gap of 1.217)	(convergence to the lead region; convergence to the 1st convergence club; internal convergence to a gap of 1.217)
	Vratsa	Stara Zagora; Sofia Stolitsa	Lovech; Sliven; Vildin; Pleven; Yambol	rest of Bulgarian regions except Smolyan	Smolyan
Czech rep.	Lead region	1st convergence club			
	(richest region in 2005)	(divergence from the lead region; internal convergence to a gap of 0.571)			
	Praha	rest of Czech regions			
Estonia	Lead region	1st convergence club			
	(richest region in 2005)	(divergence from the lead region; internal convergence to a gap of 0.654)			
	Põhja-Eesti	rest of Estonian regions			
Hungary	Lead region	1st convergence club			
	(richest region in 2005)	(divergence from the lead region; internal convergence to a gap of 0.947)	(convergence to the lead region; convergence to the 1st convergence club; internal convergence to a gap of 0.947)		
	Budapest	rest of Hungarian regions	Nógrád; Pest		
Latvia	Lead region	Divergence	1st convergence club		
	(richest region in 2005)	(richer than the lead region in 1990;divergence from the lead region;internal divergence)	(divergence from the lead region; internal convergence to a gap of 0.613)		
	Riga	Kurzeme	rest of Latvian regions		
Lithuania	Lead region	Divergence	1st convergence club	Divergence	
	(richest region in 2005)	(richer than the lead region in 1990; divergence from the lead region; internal divergence)	(convergence to the lead region)	(divergence from the lead region; divergence from the 1st convergence club; internal divergence)	
	Vilniaus	Utenos; Panevezio; Klaipedos; Siauliu; Marijampoles	Alytaus; Kauno	Telsiu;Taurages	
Poland	Lead region	Divergence			
	(richest region in 2005)	(divergence from the lead region; internal divergence)			
	Miasto Warszawa	rest of Polish regions			
Romania	Lead region	Divergence	1st convergence club	Divergence	
	(richest region in 2005)	(richer than the lead region in 1990; divergence from the lead region; internal divergence)	(convergence to the lead region)	(divergence from the lead region; divergence from the 1st convergence club; internal divergence)	
	Bucuresti	Constanta; Arad; Gorj; Galati; Cluj; Vrancea; Ialomita; Bacau; Iasi; Dolj; Vâlcea; Mures; Braila; Covasna; Brasov; Olt; Teleorman; Buzau; Prahova; Harghita; Bihor; Suceava	Neamt; Ilfov; Salaj; Calarasi; Arges; Sibiu; Bistrita-Nasaud; Dâmbovita; Maramures; Giurgiu; Mehedinti; Timis; Tulcea	rest of Romanian regions	
Slovakia	Lead region	Divergence			
	(richest region in 2005)	(divergence from the lead region; internal divergence)			
	Bratislavský Kraj	rest of Slovakian regions			

Slovenia	Lead region	1st convergence club			
	(richest region in 2005)	(divergence from the lead region; internal convergence to a gap of 0.549)			
	Osrednjeslovenska	rest of Slovenian regions			

Source: Cambridge econometrics (2008) data elaborated by the authors

The identification of regional convergence clubs in the EU NMS, irrespective of the pattern that emerges in each EU NMS, highlights the heterogeneous spatial impact of the EU economic integration process. The evidence questions the ability of markets to generate self-correcting mechanisms for regional imbalances. Furthermore, given that the EU NMS markets are not fully developed, they pose a question concerning the future evolution of regional inequalities in the EU NMS and, consequently, the challenges that the (enlarged) EU has to face.

6. Concluding remarks

By using the weighted coefficient of variation (also known as σ-convergence), the analysis has revealed that regional inequalities have increased over time in all EU NMS. In a rather short period, after the collapse of the socialist regime, regional inequalities in many EU NMS have reached levels comparable to (or, even, greater than) the respective levels of many old EU member-states. The findings confirm the early predictions of the literature according to which, in the new economic environment, agglomeration economies (favoring metropolitan regions) and geographic factors (favoring western border regions) play an important role in determining the spatial regularities of the EU NMS (Downes, 1996, Petrakos, 1996, Petrakos, 2000, Römisch, 2003, Petrakos et al, 2005a, Petrakos et al, 2005b). However, σ-convergence analysis offers only the general trend concerning the level and the evolution of regional inequalities and, as a result, might give a misleading picture since it rules out the possibility that economies can form convergence clubs.

The application of non linear econometric models, which transcend the "all or nothing" logic behind conventional convergence analysis, has shown the existence of regional convergence clubs in many EU NMS. To our knowledge, this is the first study examining the emergence of regional convergence clubs in the EU NMS at the in intra-national level. The identification of regional convergence clubs in the EU NMS, irrespective of the pattern that emerges in each EU NMS, highlights the heterogeneous spatial impact of the EU economic integration process (given the legacies from the past that may, also, affect the spatial patterns of development). Indeed, the EU NMS, that were formerly planned economies of the Eastern bloc, provide a quasi laboratory environment for the examination of the spatial impact of the EU economic integration process. The experience of the EU NMS is a unique situation, where relatively closed economic systems opened, almost at once, to the world economy (under the pressure of internal limitations and external pressures) and, at the same time, market mechanisms replaced central planning. The evidence questions the ability of markets to generate self-correcting mechanisms for regional imbalances, and necessitates state (and EU) intervention in achieving balanced regional growth.

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