

Trends in the relation between regional convergence and economic growth in EU

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Abstract

The purpose of this study is to investigate the relation between regional convergence inside of countries in EU and economic growth, and, based on it, to establish some relevant behavioural regimes. As data sources, we are using data from NUTS 2, EUROSAT, for the period 2000-2014. Thus, initially a number of 276 regions grouped in 28 countries were considered. Then, because six countries (Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta) are not divided in regions in NUTS 2 we made few aggregations, finally resulting 24 countries or groups of countries. As usually in specialised literature, to study the correlation between the real convergence and economic growth we focused on the dynamics of GDP per capita expressed in case of EU in PPS (Purchasing Power Standard). On the one hand, in order to estimate a trend of convergence/divergence among regions within a country or group of countries we used the dynamics of the coefficient of variation. On the other hand, within EU, we used for each country or group of countries the dynamics of the ratio between the individual level of GDP per capita and the average EU GDP per capita in order to evaluate how the position of a country changed. Based on such methodology, we succeeded to elaborate a general typology that permitted us to classify countries of EU in four major groups: 1) countries that improved their position in EU (as GDP per capita), but by sacrificing the regional convergence; 2) countries in which it was registered a regional convergence, but by worsening their position in EU; 3) countries for which both their position in EU was decreasing and a regional divergence registered (the most unfavourable dynamics); 4) countries for which both their position in EU was increasing and a regional convergence was registered (the most favourable dynamics).

Keywords: growth; convergence; nonlinear model; GDP per capita; behavioural regimes

JEL codes: C31; E17; O11; O15; O47; O52

1. Introduction

The convergence inside of a group of countries or regions simply supposes in case of those positioned under the average level of income to grow faster and in case of those placed above the average level to grow slower. However, in real economic systems the convergence problem is so far from a simple one.

Based on available data, after a short literature review, in this study we estimated trends in real convergence in EU both at the level of countries and at regional level. We shall try to demonstrate that there are significant differences between the two levels of analysing.

Initially, Kuznets (1955) formulated the relation between economic inequality and economic development. It could be presented graphically as an inverted U curve, showing that, at a historical scale, as much as, on horizontal axis, economic development is advancing, on vertical axis, the inequality in an initial stage is increasing till a maximum level after that it is going down towards a final stage.

There is a large literature that studies convergence process in the European Union. Key contributions in this area have been put forward by Barro and Sala-i-Martin (1992), Mankiw et al. (1992), Evans (1998) or Lopez and Papell (2012). In addition to this, a considerable amount of academic attention was oriented towards investigating convergence at a regional level. Works like Petrakos and Saratsis (2000), Petrakos (2001), Martin and Sanz (2003), Badinger et al. (2004), Canova (2004), Carvalho and Harvey (2005), Semmoud (2006), Crespo Cuaresma et al. (2008), Le Pen (2011) or Bartkowska and Riedl (2012) shed light on different aspects regarding the dynamics of European regions in terms of convergence.

More recently, Guastella and Timpano (2015) studies the economic growth in the regions of the EU, considering as key factors the human capital, agglomeration and the concentration of knowledge. On the basis of a modelling approach that incorporates nonlinear and threshold effects and also spatial dependence, the authors notice a high division in the patterns of growth for developed and emergent regions. The authors argue that these disparities of income are an effect of divergent economic structures.

Chapman and Meliciani (2016) study the determinants of regional variations in terms of GDP per capita in the enlarged EU. Using a nonparametric approach and classical regressions, the authors observe that in spite of an apparent convergence at the level of the EU, there are

significant signals of divergence across regions. The authors comment that socio-economic factors and innovation are relevant factors for all the considered regions.

Dapena, Vázquez and Morollón (2016) consider the modifiable areal unit problem (MAUP) arguing that may occur at a smaller level than the regional NUTS 2 or NUTS 3 approach. They explore the way the influence of the MAUP approach in convergence studies and document on the relevance of spatial scale modifications.

Coming from some of our old studies (Albu et al., 2014; Raileanu-Szeles and Albu, 2015; Albu, 2016; Albu and Caraiani, 2016) and based on recent published data at regional level, we try to develop an evaluation methodology of convergence in order to classify countries in EU. Moreover, we try to separate, within the general process of economic development in EU, several behavioural regimes in matter of convergence. They could be useful for policy makers when macroeconomic models would be simulated in order to prefigure future perspectives or to a better allocation of resources for regional development.

2. Empirical evidences on the real convergence at the level of groups of countries

Since 2000, in studies on convergence in EU usually there are considered two groups of countries: EU11 – former Eastern communist countries already adhered to EU after 2000 (Bulgaria, Croatia, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) and EU15 – old members (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and UK).

As real convergence, it is used GDP per capita (expressed in euro, PPS, Purchasing Power Standard). Starting from some our old studies on convergence in EU (Albu et al, 2014 and 2015), here we present new results which then are used for a deeper analysis and to build a methodology for the regional level.

In European Union after 2000, as it is illustrated in Figure 1, it was a continuous convergence between EU11 and EU15, where $g\%$ is the ratio between the average level of GDP per capita (euro PPS) in a group of countries and the average EU28 level. Thus, the average level of GDP per capita (in euro PPS) in case of EU11 increased from 44.4% of average EU28 level in 2000 to 65.7% in 2014 (in the same time, the ratio between GDP per capita in EU15 and average level for EU28 decreased from 116.0% to 108.9%).

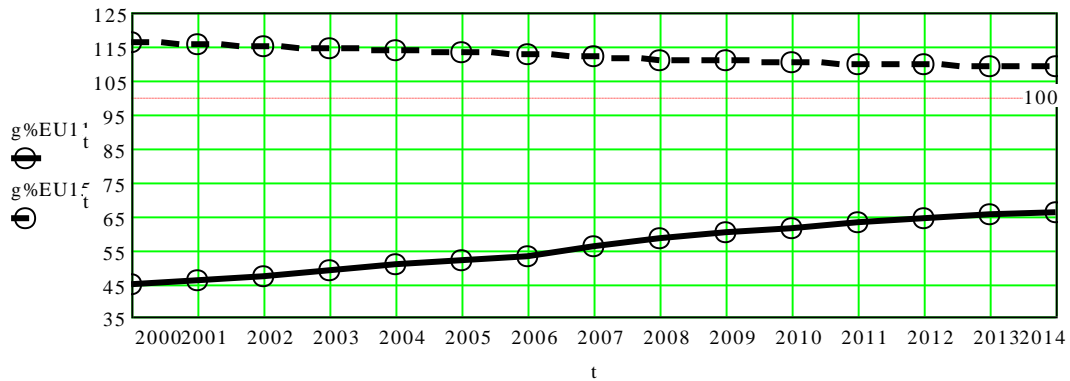


Figure 1. Convergence in relative terms in EU28, 2000-2014

Moreover, as an important fact, since 2007, together with the convergence in relative terms between the two groups of countries in EU, a convergence in absolute terms was started (the difference decreased from a maximum level of 14594 euro PPS as GDP per capita in 2006 to 11807 in 2014). However, only inside of EU11 group it was registered a convergence during the period 2000-2014, as dynamics of the variation coefficient (as %), $\sigma\%$, is shown in Figure 2. Contrary, during the same period, in case of EU15 it was registered a divergence process. To note, the discrepancies among countries within EU11, expressed by values of variation coefficient, still continue in 2014 to be higher than those registered among countries inside of EU15 (12.5% and respectively 10.6%).

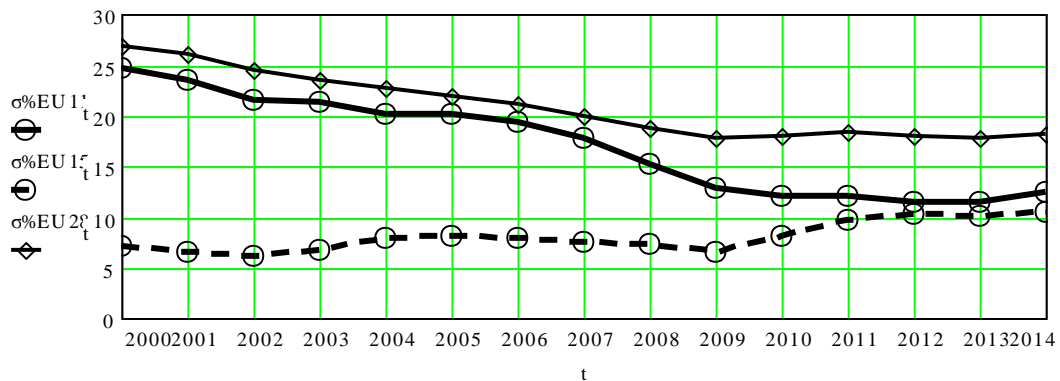


Figure 2. Convergence/divergence inside of the two groups of EU, 2000-2014

During the period 2000-2014, in all countries of EU the growth rate of GDP per capita (in PPS) was positive, at the level EU28 it being of around 40%. Highest rate of GDP growth registered all countries of EU11 (Romania 204%, Lithuania 171%, Estonia 149%, Latvia 147%, Bulgaria 133%, Slovakia 118%, Poland 102%, Hungary 77%, Croatia 68%, Czech Rep. 65%, and Slovenia 46%). From the group of old member states of EU only three countries registered higher growth rate, Luxembourg (49%), Germany (47%), and Ireland (43%). In countries like Italy, Greece and UK it was registered smallest growth rates (14%, 19%, and respectively 26%).

In order to prepare a modelling scheme to simulate the transition from a behavioural regime to another, it is useful to compare the groups of countries on the base of the values of correlation coefficient between the GDP per capita and the coefficient of variation (as a measure of dynamics of convergence). Thus, our estimation results, for the period 2000-2014, show a strong negative correlation between the average GDP per capita (yM) and the variation coefficient ($\sigma\%$) in case of EU11 (-0.960). Contrary, in case of EU15 it was a significant positive correlation (+0.739) between the average GDP per capita and the variation coefficient. This means that, at the level countries, in Eastern group of countries (EU11) the economic development is followed by a positive dynamics of convergence inside the group, and contrarily in Western group of countries (EU15) this is followed by a moderate increasing divergence. The dynamics of the correlation growth-convergence/divergence in the period 2000-2014 is illustrated graphically in Figure 3 (where yM is in thousand euro PPS).

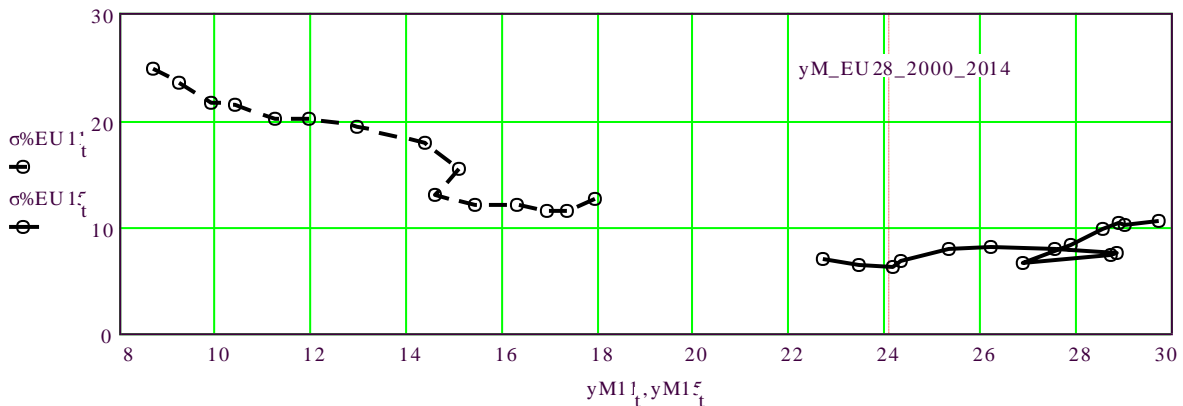


Figure 3. Correlation between economic growth and convergence/divergence, 2000-2014

From Figure 3 at least two behavioural regimes in which the groups of countries in EU are functioning can be separated: a) on the left side of the graphical representation, under a GDP per capita of around 24 thousand euro PPS (corresponding to the average level of GDP per capita in EU28 for the whole period, $yM_{EU28_{2000_{2014}}}$), there is a general trend of convergence along with the increasing level of economic development; and b) on the right side of the graph, where for very high level of GDP per capita it is emerging a general trend of a slow increasing divergence. The branch on the left side represents the trajectory for countries in the Eastern group of countries (left-bottom area of the graph). The trajectory on the right side (right-bottom area of the graph) represents the dynamics registered in the Western group of countries.

In absolute terms, at the level of EU28, GDP per capita increased from around 19.6 to 27.3 thousand euro PPS. Higher growth of GDP per capita was registered in Luxembourg, Lithuania, Estonia, Slovakia, Germany, Ireland, Latvia, Romania, Austria, Poland, Czech Rep., Netherlands, Denmark, Sweden, and Hungary.

3. Typology of convergence at regional level

Regarding the analysis of the real convergence at the regional level we used the data provided by NUTS 2 database for the EU28 countries in the period 2000-2014 (276 regions). The basic indicator to study the real convergence in EU is the GDP per capita in euro PPS. Moreover, because Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are not divided in regions in NUTS2 database, we made some aggregations from which finally resulted 24 countries or groups of countries, thus EU24.

In this period, the value of coefficient of variation computed by year decreased almost continuously from 33.6% in 2000 to 28.3% in 2014. Most important, during the analysed period, at the level of EU it was demonstrated a strong fundamental inverse correlation (-0.935) between the average GDP per capita in PPS and its coefficient of variation.

Available data at regional level for EU28 (276 regions registered in NUTS2 statistics), re-grouped in EU24, facilitated deeper insights in matter of convergence analysing. For instance, in Figure 4 it is shown the detailed distribution by regions and countries for the whole period 2000-2014 of the correlation between $g\%$ and the coefficient of variation, noted here as $\sigma\%_y$ (subscript m means countries, being 24 countries, and on the graph there are 360 points = 15 years * 24

countries; and subscript t are years). This time, again the correlation between convergence/divergence (represented by the dynamics of correlation coefficient, $\sigma\%$) and the position of a country related to the average EU28 (or EU24) GDP per capita (represented by the dynamics of variable $g\%$) is negative, but not so significant ($\text{corr}(\sigma\%, g\%) = -0.167$).

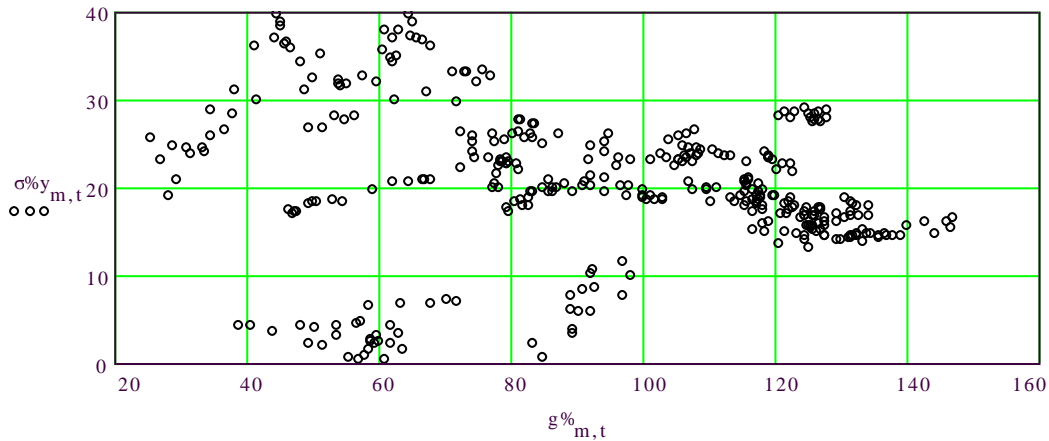


Figure 4. Correlation between the variable g and convergence in EU24, 2000-2014

A deeper analysis of the relation between the changes in g and changes in σ (coefficient of variation) for each country in EU24 could be useful for outlining a typology of convergence, g being $yM / yEU24$, where yM is average GDP per capita in a country (computed by aggregating its regions), and $yEU24$ – average GDP per capita at the EU24 level. To note, as a general rule, for each system comprising a set of components, the distribution of individual relative deviations from the average level looks like in Figure 5, where, as example, it is shown in case of those 276 regions of EU for the period 2000-2014 (thus, there are 4140 points = 15 years * 276 regions). Because it is at individual level similar to the coefficient of variation at the whole system level, it is written here as $\sigma\%$ (expressed as percentage), i are regions in EU24, and t years. Thus, $\sigma = |y - yEU| / y$. As it results from the computation formula, on the right side of the graphical representation (corresponding to higher values of g) there is an asymptotical slow trend to the unit (100 as percentage) for extreme large values of g .

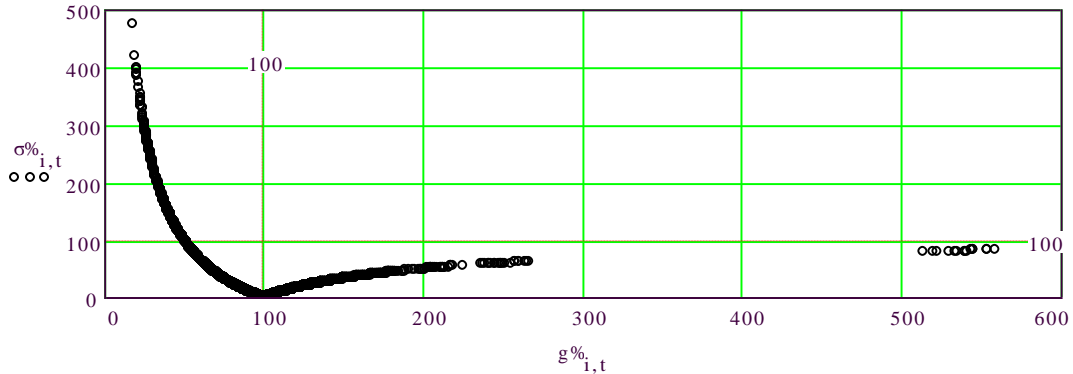


Figure 5. Correlation between variables g and σ in EU24 at the regional level, 2000-2014

The values of aggregated indicators related to the convergence inside of each country or group of countries in EU24 are synthetically presented in Table 1. In this Table yM is expressed in thousand euro PPS, g and σ are expressed as percentage ($g\%$ and $\sigma\%$). Additionally, Δ means for yM changes in absolute terms and for $g\%$ and $\sigma\%$ changes in percentage points, and $\Delta\%$ in case of yM means growth in relative terms. Finally, based on the aggregated regional data we propose the following typology, graphically expressed as in Figure 6.

According to the graphical presentation in Figure 6, there are four main classes of countries or groups of countries that are corresponding to the four dials (numbered in the trigonometric sense) in which the dynamics between 2000 and 2014 can be accounted. They are as follows:

D1) Countries that improved their position (as proportion in EU average GDP per capita level) but in the same time registered a divergence among regions (Bulgaria, Czech Rep., Baltics, Ireland, Croatia, Hungary, Poland, Romania, Slovakia, and Slovenia); thus $\Delta g > 0$ and $\Delta\sigma > 0$.

D2) Countries for which their position (as proportion in EU average GDP per capita level) was decreasing and in the same time they registered a divergence among regions (Denmark, Greece, France, Sweden, and UK); thus $\Delta g < 0$ and $\Delta\sigma > 0$.

D3) Countries for which their position (as proportion in EU average GDP per capita level) worsened but they registered a convergence among inside regions (Belgia&Luxembourg, Italy, Cyprus&Malta, Netherlands, Austria, Portugal and Finland); thus $\Delta g < 0$ and $\Delta\sigma < 0$.

D4) Countries for which their position (as proportion in EU average GDP per capita level) was increasing and in the same time they registered a convergence among regions (Germany).

Table 1. Convergence indicators in EU24, 2000-2014

		yM:				g%:			σ%:		
		2000	2014	Δ	Δ%	2000	2014	Δ	2000	2014	Δ
1	Belgium&Lux	25.0	34.5	9.5	37.9	128.0	125.7	-2.3	28.8	27.5	-1.3
2	Bulgaria	5.5	12.8	7.3	132.4	28.2	46.7	18.5	19.1	35.8	16.8
3	CzechRep	14.1	23.2	9.1	64.1	72.5	84.7	12.3	22.4	24.9	2.5
4	Denmark	24.9	33.3	8.4	33.8	127.5	121.6	-6.0	14.6	18.1	3.6
5	Germany	23.4	34.5	11.2	47.9	119.6	126.0	6.4	19.1	16.8	-2.2
6	Baltics	7.6	19.7	12.1	159.1	38.9	71.8	32.9	4.2	7.1	2.8
7	Ireland	25.7	36.8	11.1	43.2	131.6	134.2	2.6	17.2	18.0	0.8
8	Greece	16.8	19.9	3.1	18.6	85.9	72.5	-13.3	20.8	26.4	5.6
9	Spain	18.8	25.0	6.2	32.7	96.5	91.2	-5.3	20.3	20.7	0.4
10	France	22.6	29.3	6.7	29.9	115.6	106.9	-8.6	20.7	24.5	3.7
11	Croatia	9.6	16.1	6.5	67.1	49.4	58.8	9.4	2.3	2.5	0.2
12	Italy	23.1	26.4	3.2	14.0	118.5	96.2	-22.3	24.1	23.4	-0.7
13	Cyprus_Malta	17.5	22.8	5.3	30.6	89.4	83.2	-6.2	4.0	2.3	-1.6
14	Hungary	10.5	18.6	8.1	77.3	53.8	68.0	14.2	32.4	36.1	3.7
15	Netherlands	27.1	35.6	8.5	31.3	139.0	130.1	-8.9	14.6	14.1	-0.5
16	Austria	25.7	35.5	9.8	38.1	131.6	129.5	-2.1	16.9	14.1	-2.8
17	Poland	9.2	18.6	9.4	101.4	47.3	67.8	20.6	17.2	20.8	3.6
18	Portugal	15.5	21.4	5.9	38.2	79.4	78.1	-1.2	22.8	19.9	-2.9
19	Romania	4.9	15.2	10.2	206.6	25.3	55.3	30.0	25.8	31.7	5.9
20	Slovenia	15.5	22.7	7.1	45.9	79.6	82.7	3.1	17.2	18.0	0.8
21	Slovakia	9.7	21.1	11.4	118.1	49.5	77.0	27.4	26.8	32.8	6.0
22	Finland	23.0	30.2	7.3	31.7	117.7	110.4	-7.3	20.3	18.3	-2.0
23	Sweden	25.5	33.7	8.2	32.0	130.8	123.0	-7.8	16.6	18.0	1.4
24	UK	23.3	29.5	6.2	26.8	119.2	107.7	-11.5	23.4	26.6	3.1

Source: computed based on EUROSTAT data

In D1 there are all Eastern members of EU (plus, atypically Ireland), they having initially relatively low position in matter of GDP per capita. They registered a significant convergence towards the EU average level, but by sacrificing internal convergence among component regions.

In D2 there is the most unfavourable dynamics, countries located here registering concomitantly a decrease against the EU average level of GDP per capita and a divergence among their regions. Countries in this class have an initial relatively high level of GDP per capita (Denmark, France, Sweden, and UK) or close to the average EU level (Greece and Spain).

In D3 are located countries that obtained improvement in matter of internal convergence among regions, but concomitantly with a decreasing in their position against average level of GDP per capita in EU. Here there are countries having an initial relatively high level of GDP per capita (Belgium&Luxembourg, Italy, Netherlands, Austria, and Finland) or relatively close to the average EU level (Cyprus&Malta and Portugal).

In D4 there is the most favourable situation in matter of correlation between economic growth and internal convergence. In this class, comprising only Germany, it was registered improvements both in matter of position against the average level of GDP per capita and in the convergence process among component regions.

Schematically, similar to the Kuznets curve, the dynamics of convergence process in EU should follow one of the three curves (roads of convergence, depending from initial position where the dynamics started in 2000), as it is shown in Figure 7. Under this interpretation the maximum point of each curve could be viewed as a point-attractor.

In case of our study, the countries in D1 have gone up toward the maximum point, coming from the left branch on a dashed curve type (less Ireland that was moving in the same way but on a dotted curve type). Countries in D2 have gone up toward the maximum point on the right branch of a dotted curve type (less Greece and Spain that were moving in the same way but on a dashed curve type). Countries in D3 have gone down on the left part of the maximum point on a dotted curve type (Belgium&Luxembourg, Netherlands, Austria, and Finland), on a solid curve type (Italy), and on a dashed curve type (Cyprus&Malta and Portugal). Countries in D4 have gone down on the right side of the maximum point on a dotted curve type (Germany).

4. Conclusions

Coming from results of our study, in case of the actual European Union (EU28), at least for the period after 2000 there are the following two rules: a) as a country or a group of countries is placed in matter of GDP per capita far on the left side of the average level of GDP per capita in EU, it is expected for it to grow faster but concomitantly with an internal divergence among its components; and b) as a country or a group of countries is placed on the right side of the average level of GDP per capita in EU, it is expected for it to grow slower concomitantly with a slow trend of internal divergence among its components, interrupted eventually by temporal passages

of convergence. Important for less developed countries are two facts: a) the initial level discrepancy among its regions (estimated by the value of the variation coefficient), and b) on the road of a faster economic development to not ignore internal convergence and to prepare certain periods dedicated to attenuate discrepancies among regions.

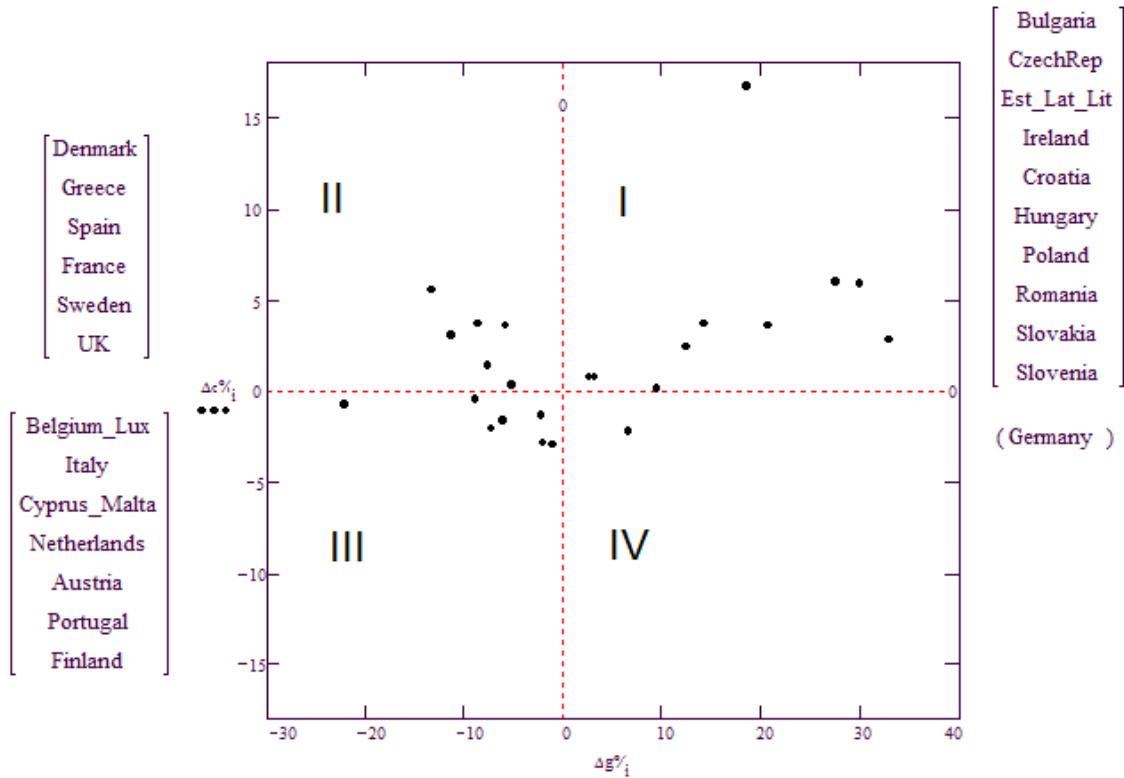


Figure 6. Typology of convergence in EU24 at the regional level, 2000-2014

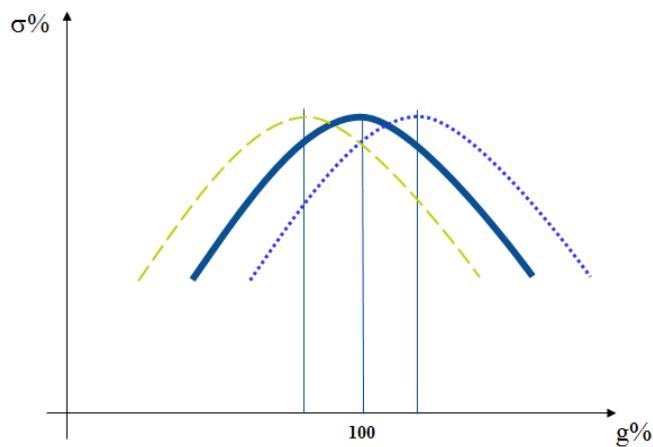


Figure 7. Roads of convergence in EU

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REFERENCES

- Albu, L. L. et al, 2014. A Nonlinear Model to Estimate the Long Term Correlation between Market Capitalization and GDP per capita in Eastern EU Countries, *Journal of Economic Computation and Economic Cybernetics Studies and Research*, 3, pp 5-22.
- Albu, L. L., 2016. Convergence and divergence in EU. A nonlinear approach to regional level. In: *Selected Issues in Macroeconomic and Regional Modelling. Romania an emerging country in EU*. (Eds.: Dobrescu, E. et al). Nova Science Publishers, Inc., New York. Fothcoming 2016.
- Albu, L. L. and Caraiani, P. (eds.), 2016. *Non-Linear Modeling of the Impact of the Crisis on the Interactions among Financial Markets and Macroeconomic Variables in CEE Countries*. Nova Science Publishers, Inc., New York. Fothcoming 2016.
- Badinger, H. et al, 2004. Regional Convergence in the European Union (1985-1999): A Spatial Dynamic Panel Analysis. *Regional Studies*, 38, pp. 241-53.
- Barro, R. J. and Sala-i-Martin, X., 1992. Convergence. *Journal of Political Economy*, 100 (2), pp 223–251.
- Bartkowska M. and Riedl, A., 2012. Regional convergence clubs in Europe: Identification and conditioning factors, *ECONOMIC MODELLING*, Volume 29, Issue 1, January 2012, pp 22–31.
- Canova, F., 2004. Testing for convergence clubs in income per capita: A predictive density approach. *International Economic Review*, 45, pp 49–77.
- Carvalho, V. M. and Harvey, A. C., 2005. Convergence in the trends and cycles of Euro-zone income. *Journal of Applied Econometrics*, 20 (2), pp 275–289.
- Chapman, S. and Meliciani, V., 2016. Behind the Pan-European Convergence Path: The Role of Innovation, Specialisation and Socio-economic Factors. *Growth and Change*, doi: 10.1111/grow.12148.

- Crespo Cuaresma, J. et al, 2008. Growth, convergence and EU membership. *Applied Economics*, 40 (5), pp 643–656.
- Dapena, A. D. et al, 2016. The role of spatial scale in regional convergence: the effect of MAUP in the estimation of b-convergence equations. *The Annals of Regional Science*, Volume 56, Issue 2, pp 473-489.
- Evans, P., 1998. Using panel data to evaluate growth theories. *International Economic Review*, 39 (2), pp 295–306.
- Guastella, G. and Timpano, F., 2015. Knowledge, innovation, agglomeration and regional convergence in the EU: motivating place-based regional intervention, *Review of Regional Research*, DOI 10.1007/s10037-015-0104-x.
- Kuznets, Simon (1955) Economic Growth and Income Inequality. *American Economic Review* 45 (March): 1–28
- Lopez, C. and Papell, D. H., 2012. Convergence of Euro area inflation rates. *Journal of International Money and Finance*, 31 (6), pp 1440–1458.
- Mankiw, N. G. et al, 1992. A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107 (2), pp 407-437.
- Martin, C. and Sanz, I., 2003. Real Convergence and European Integration: The Experience of the Less Developed EU Members. *Empirica*, Volume 30, Issue 3, pp 205-236.
- Le Pen Y., 2011. A pair-wise approach to output convergence between European regions, *Economic Modelling*, Volume 28, Issue 3, May 2011, Pages 955–964.
- Petrakos, G., 2001. Patterns of Regional Inequality in Transition economies. *European Planning Studies*, Volume 9, Issue 3, pp 359-383.
- Petrakos, G. and Saratsis, Y., 2000. Regional inequalities in Greece. *Papers in Regional Science*, Volume 79, Issue 1, pp 57-74.
- Raileanu-Szeles, M. and Albu, L. L., 2015. Nonlinearities and divergences in the process of European financial integration. *Economic Modelling*, vol. 46(C), pp 416-425.
- Semoud, B., 2006. Development levels in Mediterranean area: Divergences and convergences. *Bulletin d'Association de Geographes Francais*, Volume 83, Issue 3 pp 281-301.