Original scientific paper
UDC 338.1: 330.4](4-67 EU)

About regional convergence clubs in the European Union*

Mihaela Simionescu[1]

Abstract

The goal of this research is to present the concept of convergence club within the European Union members, starting from the hypothesis that an overall convergence cannot be identified because of the high output disparities between countries and between regions. For the analysis, the concept has been used as a method of regression based on a convergence test that supposes an innovative decomposition of the GDP per capita and enables the endogenous determination of convergence clubs. In order to achieve the objective, the paper undertakes an empirical analysis of GDP per capita convergence for EU-28 members and for 272 regions corresponding to NUTS2 level. The results of the analysis show that at national level, during 1995 – 2012 there are significant differences between foundation members and CEEC economies, while at regional level five convergence clubs were identified. The basic conclusion is that in the conditions of lack of convergence between EU-28 countries, the identification of convergence clubs helps the European Union in reducing the economic disparities across European regions.

Key words: *convergence club, beta convergence, clustering, log-t convergence test, GDP per capita*

JEL classification: *C21, C12, F43*

* Received: 01-10-2014; accepted: 10-06-2015

[1] *PhD, Senior Researcher, Romanian Academy, Institute for Economic Forecasting, Bucharest, Calea 13 Septembrie, no. 13, District 5, ZIP code 050711, Bucharest, Romania. Scientific affiliation: statistics, econometrics. Phone: +4021 318 81 48. E-mail: mihaela_mb1@yahoo.com.*

1. Introduction

Many authors were interested in determining the convergence clubs in European Union or other zones, all of them concluding that in the distribution of GDP per capita convergence clubs might be identified rather than a common growth path. A convergence club is a group of countries with similar tendencies regarding a certain economic phenomenon. A class of growth theories explained that economies are rather similar in structural characteristics but they do not converge to the same steady state equilibria, because of the differences in initial conditions. Inside the group of similar economies, a common growth path can be observed in the case of initial conditions that tend to the same steady state equilibrium. This phenomenon is known as the club convergence hypothesis.

The convergence or divergence problem across regions has attracted a major research interest mostly in the last few decades. The convergence/divergence identification is an important problem for new members of the European Union. The experience of these countries is unique, because there are relatively closed economic systems that had to open to global economy while the central planning was replaced by market mechanisms. Even if the economic integration has to bring higher efficiency, the inequality levels between new members of EU and former ones might increase.

The study uses disaggregated at the Nomenclature of Territorial Units for Statistics (NUTS) II spatial level, data, derived from European Regional Database. The covered period 1995 – 2012 is extremely significant because it includes the shocks of the early pre-accession (to the EU) period and recent trends that the new members of EU have encountered.

Many types of econometric tools were developed in order to test the club convergence assumption. Among them the regression tree analysis is very popular. The beta-convergence was widely applied in many studies, but the use of endogenous grouping had better results by maintaining unspecified factors that are responsible for multiple steady states. Even if methods of endogenous grouping identify convergence club, they are not able to confirm if these clubs can be explained by theories that determine the club convergence assumption. Against this background, we have analyzed the factors that have a drive power in the formation of multiple steady state of GDP per capita.

The research hypotheses are: there is or not an overall GDP per capita convergence in EU-28 countries and there is or not a regional convergence in NUTS2 level regions from Europe. If the convergence hypothesis is rejected, more convergence clubs will be identified in the European Union countries and regions at NUTS2 level. For the identified clubs we want to check if there is convergence to steady state path.

This paper is structured as it follows. After a brief introduction, the main results in literature regarding the problem of convergence clubs were discussed. In the following section the methods used for the identification of convergence clubs are presented and then an application is proposed for determining the convergence clubs in European Union at NUTS0 and NUTS2 levels. In the last section some brief conclusions are drawn.

2. Literature review

The convergence within a given group of countries is defined as a decline in the degree of income disparity within the group over time. In literature, the most used concepts are: beta-convergence (the poor countries tend to grow faster than rich economies) and sigma-convergence (it supposes a decrease in income variation between poor and rich economies). In case of relative convergence, the economies increase at the same rate in steady state while the absolute convergence implies the same steady-state income level. The empirical methods are oriented on the following directions: chronological series tests of unit root and co-integration (Evans and Karras (1996), Evans (1998), Kutan and Yigit (2005), Guetat and Serranito (2007), Siklos (2010), Lopez and Papell (2012)) and cross-section augmented Solow regression (Barro and Sala-i-Martin (1992)).

Phillips and Sul (2007) proposed a non-linear factor model based on a panel convergence, the convergence clubs being identified within the panels using a clustering procedure. Many empirical studies analysed the economic convergence in Europe.

Some studies are interested in regional convergence in Europe. Quah (1996) showed that in income repartition dynamics, one should take into account of spatial location and spill overs. Beta and sigma-convergence were assessed by Sala-i-Martin (1996) for real GDP per capita in 90 regions that cover 8 countries from Europe. A predictive density approach was used by Canova (2004) at NUTS2 level, showing disparities between Southern and Northern parts. Before the EMU apparition, Corrado, Martin and Weeks (2005) found that there was no income convergence in EU-15 and Norway. Mora (2005) identified convergence clubs for backward regions from Europe. Ramajo, Márquez, Hewings and Salinas (2008) applied the spatial econometric techniques to compute the convergence speed for 163 regions from EU in the period from 1981 to 1996. Their conclusions were used to consider distinct spatial convergence clubs.

Carvalho and Harvey (2005) used a multivariate structural time series method to identify two convergence clubs in euro zone area for real GDP per capita: club of low-income countries (Greece, Portugal, Spain) and club with high-income

countries (Austria, Finland and 5 core economies). Crespo Cuaresma, Ritzberger-Grunwald and Silgoner (2008) measured the beta-convergence for EU-15 for GDP per capita in the period from 1960 to 1998, the positive effect on growth being quite high for poor economies. Cunado and Perez de Garcia (2006) tested the real convergence only in 5 countries from East and Central Europe, rejecting this assumption of convergence over the period 1950-2003. Cavenaile and Dubois (2011) found conditional beta-convergence for real GDP per capita in the EU-27 over 1990 – 2007, the convergence rates of new members being quite different from those of EU-15 countries.

There are authors that studied the convergence for other variables such as: unemployment rate, industrial output, monetary aggregates, interest rates, prices. Kutan and Yigit (2005) found significant real convergence for the new members of EU over the period from 1993 to 2003. Brada, Kutan and Zhou (2005) concluded that there are limited advantages offered by EMU accession, studying the real GDP and monetary aggregate convergence in CEEC. Kutan and Yigit (2007) showed that the economic integration is useful for new member countries only on the long run, while for the founding countries the benefits are immediate.

This study is based on the recent paper of Phillips and Sul (2007) that proposed a factor model for the convergence in Western Europe. This model was also used by Bartkowska and Riedl (2012) for testing the GDP per capita convergence in 206 zones from Western Europe in the period 1990 – 2002. They obtained 6 convergence clubs, explaining their formation by GDP per capita and human capital. Fritsche and Kuzin (2011) also applied this method for testing the convergence in more variables: real GDP per capita, productivity, unit labour cost and prices level for 12 countries in euro area. The formation of the convergence clubs is explained by the spatial distance and economic development differences.

3. Methodology and methods of analysis

The methods used for identifying convergence clubs are various (graphical representation, conventional convergence test, distribution of trend coefficients, local clustering method, an econometric framework based on spatial heterogeneity). The selection of a certain method for this study was conditioned by the particularities of the analysed region. In this research, we studied the convergence clubs in EU-28 that include some economies in transition. Therefore, the most suitable method for this case with individual heterogeneity and possible time path (features of economies in transition) is the approach of Phillips and Sul (2007) that proposed a regression starting from a convergence test. Moreover, some graphical representations are provided to study the convergence clubs (a map with the EU-28 regions at NUTS2 level and a scatter diagram with 28 countries of the EU).

The regression based on convergence test is used in order to study the changing behaviour of the GDP per capita in EU over the period from 1995 – 2013. This test, developed by Phillips and Sul (2007), supposes an innovative decomposition of the analyzed variable.

$$\log y_{it} = \varphi_t \mu_t + \varepsilon_{it} \tag{1}$$

$\log y_{it}$ – logarithm of GDP per capita with time varying factor ($\log y_{it} = \left(\varphi_i + \frac{\varepsilon_{it}}{\mu_t}\right)\mu_t = \delta_{it}\mu_t$)

μ_t – common factor

φ_t – unit characteristic component

ε_{it} – error term

δ_{it} – idiosyncratic part (it absorbs the unit specific element and the error term).

The first model explains the behaviour of y_{it} on the base of the unit characteristics factors and of the common factor. The second model explains the GDP per capita only using the share of the common growth path. Therefore, a transition coefficient is introduced in order to eliminate the common growth path. This coefficient computes the economy behaviour with respect to other economies and it also reflects the relative departures of the economy I from that common path.

$$h_{it} = \frac{\log y_{it}}{n^{-1}\sum_{i=1}^{N} \log \log_{it}} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N} \delta_{it}} \tag{2}$$

h_{it} – transition path of the economy compared to the cross-section mean (it tends to 1 for all I and t tending to infinity if the convergence assumption is checked; the cross-sectional variance ($V_t^2 = \frac{\sum (h_{it} - 1)^2}{N}$) converges to zero in case of convergence and to appositive number for club convergence)).

A semi-parametric form of idiosyncratic part is:

$$\delta_{it} = \delta_i + \frac{\sigma_i \vartheta_{it}}{L(t)t^{\alpha}} \tag{3}$$

$L(t)$ – slowly varying factor

α – decay rate

$\vartheta_{it} \rightarrow iid(0,1)$

σ_i – idiosyncratic scale parameter.

For testing the convergence, the assumptions are:

H_0: $\delta_i = \delta$ and $a \geq 0$

H_1: $\delta_i \neq \delta$ for any i or $a < 0$

This method that has been proposed by Phillips and Sul (2007) detects the convergence even if there are cases of transitional divergence, even if the stationary tests do not provide the expected results. Phillips and Sul (2007) proposed a procedure with several steps:

The computation of cross-sectional variance ratio: $\frac{V_1^2}{V_t^2}$

The log t regression is built:

$$\log\left(\frac{V_1^2}{V_t^2}\right) - 2\log L(t) = a + b\log t + u_t, \quad t = [rT][rT] + 1, ..., T \text{ and } r \in (0,1) \quad (4)$$

Applying Monte Carlo method, the authors have obtained that for low sample (less than 50 observations), $r = 0.3$ and $L(t) = \log t$, in order to test the inequality of the null assumption $\alpha \geq 0$, it used a HAC (heteroscedasticity and autocorrelation) robust t-test and $\hat{b} = 2\hat{a}$.

The hypothesis if convergence is rejected if the t-computed is less than -1.65 for a level of significance of 5%.

The rejection of convergence hypothesis imposes the procedure application to subgroups using the clustering mechanism. The elements are ordered (descending order) and the club core group and convergence club are formed by applying log t test if the computed t of b is greater than -1.65. The log t test is applied many times for all the units in the sample. If the units do not converge the three steps are applied to the elements that remained in the sample. The units diverge if there is no convergence clubs detected.

The dependent variable has two components: residual spatial variable and the filtered non-spatial variable. If d is the distance the statistic G_i stops its increase and starts its decrease. The filter observation is:

$$y_i = \frac{y_i\left[\frac{W_i}{n-1}\right]}{G_i(d)} \quad (5)$$

W_i – sum of all spatial connections w_{ij}

$G_i(d)$ – spatial autocorrelation statistic

n – number of observations

$$G_i(d) = \frac{\sum_j w_{ij}(d) y_j}{\sum_j y_j}, \; i \neq j \tag{6}$$

An estimate of the speed of convergence is computed as:

$$speed = \frac{-\ln(1-\varphi_i)}{T} \tag{7}$$

where T is the number of years in the mentioned period.

4. Data and empirical analysis

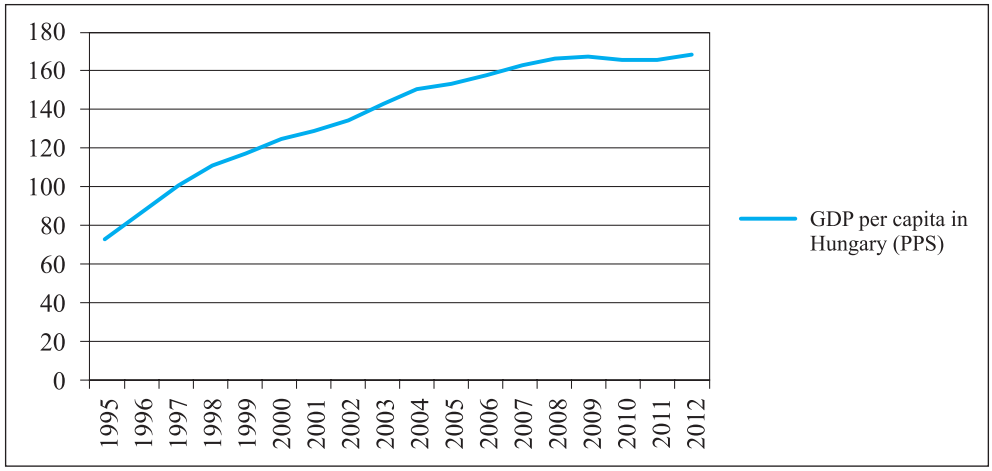
The GDP per capita is an approximation for the value of goods that were produced per person in a certain country. It is computed as a ratio between country's GDP and the total number of population from that country.

The data for GDP per capita in PPS over 1995 – 2012 for the countries of the European Union (EU-28) are provided by Eurostat. Purchasing power parities (PPPs) are indicators of price level differences across countries. PPPs are used to convert national accounts aggregates such as GDP of different countries into comparable volume aggregates. PPPs are expressed as the exchange rates of countries' national currencies against the PPS. PPPs express the number of currency units per PPS. The real expenditures are defined as expenditures in national currency converted to PPS using PPPs. These are denominated in PPS.

Regional GDP in PPS is employed to identify the regions that are eligible for financial support from the European Union Structural Funds. The indicator is used for many analytic purposes, especially for offering background information that is necessary for policymaking in the European institutions. The regional GDP per capita in PPS is also used by international organizations (World Bank or International Monetary Fund) and in national governments. There are not high changes in GDP per capita in EU-28 countries, excepting Hungary that registered high increases in GDP per capita from a year to another. Therefore, we considered necessary to present in a graph only the evolution of GDP per capita in Hungary that can be seen in Figure 1. In 2010, because of the economic crisis, the GDP per capita decreased by 1.52% compared to 2009, but in 2011 the descending trend was retaken.

Some transformations are made to the GDP per capita time series. Before constructing the log t regression, the data are transformed in order to filter the business cycle variations. In this case, the Hodrick-Prescott filter was applied to extract the cycle component in the data series.

Figure 1: The evolution of GDP per capita in Hungary during 1995 – 2012



Source: Author's graph

Moreover, the spatial components in the GDP per capita time series are removed by applying Getis' filter proposed by Getis and Griffith (2002). This transformed data series is used in checking the regional convergence hypothesis.

5. Results and discussion

Hadri (2000) test is applied under the null hypothesis of overall convergence. The statistic value is 8.549 and the p-value is 0.00, fact that implies the rejection of overall economic convergence in the EU-28 over 1995 – 2012.

For 272 NUTS2 regions from Europe the log t convergence t test is applied to the log of GDP per capita over the period from 1995 to 2012 and the convergence assumption is rejected for a significance level of 5%. Under this hypothesis of divergence, the clustering mechanism is applied, 10 clusters and 3 diverging zones being identified. After merging the subgroups to form larger convergence clubs, we obtained 5 clubs.

For European convergence clubs some relevant aspects should be noted: the regions from the same country generally cluster together as Barro and Sala-i-Martin (1992) previously stated. This conclusion is more obvious for countries like Switzerland, France and Austria.

The regions that include the capitals are in a higher club compared to neighbouring zones. This is the case of Inner London, Attiki from Greece, Vienna or Lisbon. The agglomeration effects could explain this situation.

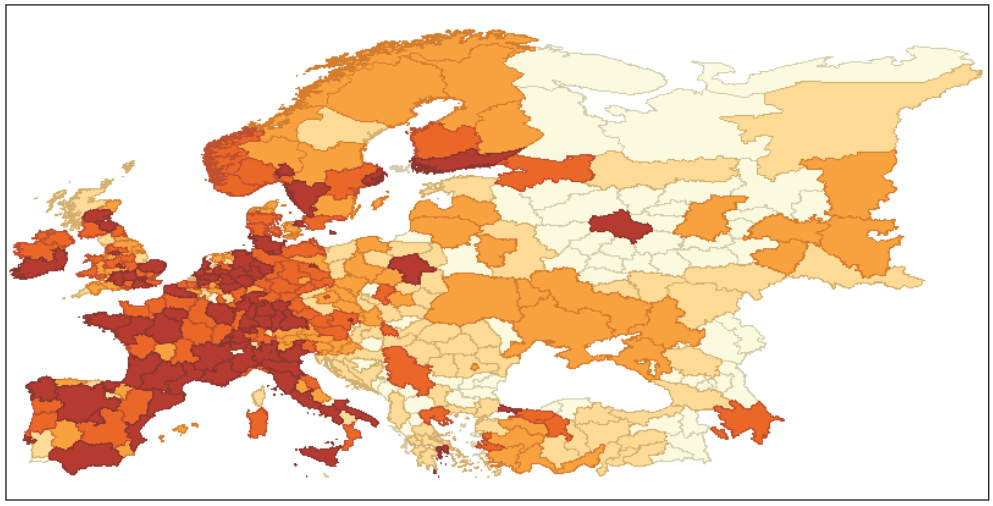
Table 1: Regional convergence clubs in EU-28 (NUTS2 level)

Club	Number of regions	Estimate	Standard error	Average GDP per capita (in PPS)
1	51	-0.1645	0.1156	60
2	132	-0.0968	0.0943	45
3	48	-0.0223	0.0772	37
4	32	0.0533	0.1332	26
5	10	0.4735	0.0859	16

Source: Author's computations

For 2012 a map with 5 clubs represented by different colours is realized in GeoDa software. The regions of the same colour are placed in the same club. As we can see from the map, there are cases when the regions in a country are located in different clubs. The darkest colour indicates the regions with the highest GDP per capita.

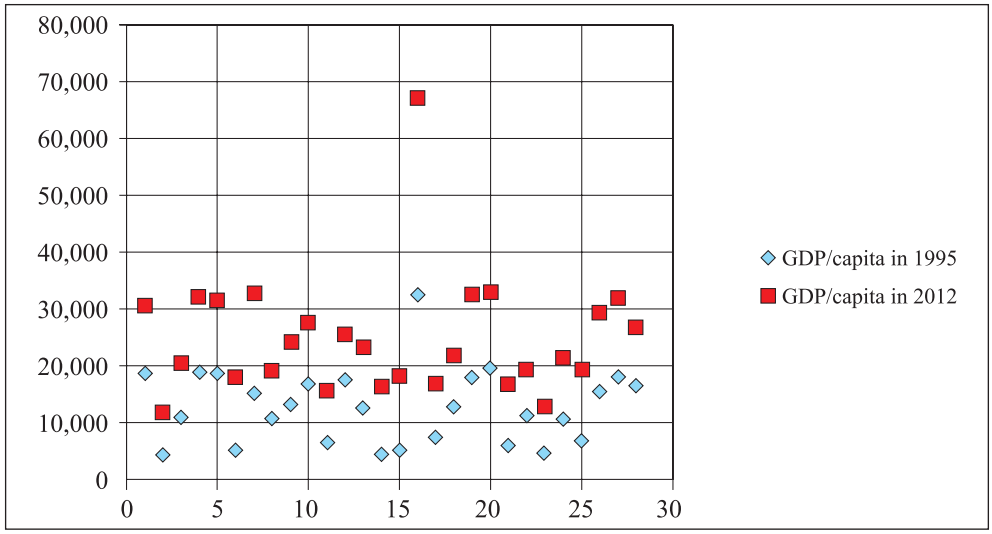
Figure 2: The map of convergence clubs in Europe in 2012



Source: Author's graph made in GeoDa software

The assumption of economic convergence was rejected for 5% level of significance in all panels. Luxembourg, as it is seen in the graph, presents a different growth dynamics. This country is always on a transition path above the other countries in EU-28 over the period 1995 – 2012. It has an idiosyncratic growth path. For the first two clubs there is enough evidence of convergence during the analyzed period, but relative growth rate differentials have the tendency to diminish over time.

Figure 3: The GDP per capita in 1995 and 2012 in the EU-28 countries



Note: The EU-28 countries are: 1. Belgium, 2. Bulgaria, 3. Czech Republic, 4. Denmark, 5. Germany, 6. Estonia, 7. Ireland, 8. Greece, 9. Spain, 10. France, 11. Croatia, 12. Italy, 13. Cyprus, 14. Latvia, 15. Lithuania, 16. Luxembourg, 17. Malta, 18. Hungary, 19. Netherlands, 20. Austria, 21. Poland, 22. Portugal, 23. Romania, 24. Slovenia, 25. Slovakia, 26. Finland, 27. Sweden, 28. United Kingdom

Source: Author's graph

Club 1 includes Western European countries that are quite rich. In the second club we met rich countries like UK, Germany, Belgium, Finland and Denmark. It is interesting that countries like Slovenia and Estonia converge to these developed countries, one explanation for this situation being well implemented economic reforms after the independence war as Adam, Kristian and Tomsic (2009) observed.

Table 2: Convergence clubs across EU-28 countries (1995 – 2012)

Club	Countries	Estimate	Standard error	Speed convergence
1	SWE, AUT, IRE, NED	-0.456	0.0563	-0.214
2	BEL, EST, FIN, UK, GER, DEN, SLO	0.187	0.421	0.097
3	CRO, CZE, LAT, GRE, LIT, SVK, ITA, ESP	0.077	0.0884	0.032
4	BUL, HUN, POL, CYP, MAL, POR	0.061	0.112	0.033
Diverging	LUX, FRA, ROM	0.004	0.164	0.008

Source: Author's computations

The third and the fourth club include the post-communist countries. These countries cluster below the EU mean. Greece, Spain and Italy, some Mediterranean countries are located in the third cluster. The other Mediterranean countries are placed in the fourth club with some post-communist economies, having very low GDP per capita. We observed 3 diverging countries: Romania, Luxembourg and France.

6. Conclusions

This research brings novelty in the convergence evaluation aspects regarding the existence of convergence clubs in EU-28 rather than the presence of an overall or regional convergence during 1995 – 2012. The rejection of the hypothesis of overall convergence determined us to extend the research in order to identify some groups that tend to similar steady states. Within the identified clubs a relative convergence was observed at country level (four convergence clubs) and at regional level (five convergence clubs). There are clear differences between EU foundation members and CEEC economies that had transition paths that are lower than the average. This conclusion is in accordance with the expectations and with the previous results from literature, an example being the study of Mora (2005). The high differences between economies in transitions and the other EU countries determined us to choose the approach of Phillips and Sul (2007) as a method for identifying convergence clubs. This approach takes into account the features of CEEC countries as individual heterogeneity and possible time path. The results of this method for NUTS2 regions showed that the regions that include the capitals are in a higher club compared to neighbouring zones. The convergence club analysis at country level revealed the existence of three diverging countries like France, Luxembourg and Romania. The limits of the research are conditioned by the time period considered in the analysis. The application of the methods on a quite long period 1995 – 2012 which also includes the economic crisis effects conducts us to particular results. Moreover, the recent members of the EU (Croatia and post-communist countries) have lower values for GDP per capita compared to old members and hence, to overcome the gap between countries is difficult to achieve. A future research should consider the convergence analysis on more time periods. This convergence assessment helps us recommend more economic efforts and viable economic policies as to reduce the gap between recent members of the EU and foundation members. A sufficient condition for convergence is that poorer countries follow reasonably efficient economic policies, especially protection of private property rights and open trade. The economic policy of convergence proposes the reduction of economic disparities across European regions. The regional redistribution is necessary to compensate for the shocks imposed by increasing economic integration. The existence of certain convergence clubs that were identified in this study will help EU in distributing the budget for cohesion policy.

References

Adam, F., Kristan, P., Tomsic, M. (2009) "Varieties of capitalism in Eastern Europe (with special emphasis on Estonia and Slovenia)", *Communist and Post-Communist Studies* 42 (1), pp. 65–81.

Barro, R. J., Sala-i-Martin, X. (1992) "Public finance in models of economic growth", *The Review of Economic Studies* 59(4), pp. 645–661.

Bartkowska, M., Riedl, A. (2012) "Regional convergence clubs in Europe: Identification and conditioning factors", *Economic Modelling* 29(1), pp. 22–31.

Brada, J. C., Kutan, A. M., Zhou, S. (2005) "Real and monetary convergence between the European Union's core and recent member countries: a rolling cointegration approach", *Journal of Banking & Finance* 29(1), pp. 249–270.

Canova, F. (2004) "Testing for Convergence Clubs in Income Per Capita: A Predictive Density Approach", *International Economic Review* 45(1), pp. 49–77.

Carvalho, V. M., Harvey, A. C. (2005) "Convergence in the trends and cycles of Euro-zone income", *Journal of Applied Econometrics* 20(2), pp. 275–289.

Cavenaile, L., Dubois, D. (2011) "An empirical analysis of income convergence in the European Union", *Applied Economics Letters* 18(17), pp. 1705–1708.

Corrado, L., Martin, R., Weeks, M. (2005) "Identifying and Interpreting Regional Convergence Clusters across Europe", *The Economic Journal* 115(502), pp. 133–160.

Crespo Cuaresma, J., Ritzberger-Grünwald, D., Silgoner, M. A. (2008) "Growth, convergence and EU membership", *Applied Economics* 40(5), pp. 643–656.

Cunado, J., Perez de Gracia, F. (2006) "Real convergence in some Central and Eastern European countries", *Applied Economics* 38(20), pp. 2433–2441.

Evans, P. (1998) "Using panel data to evaluate growth theories", *International Economic Review* 39 (2), pp. 295–306.

Evans, P., Karras, G. (1996) "Convergence revisited", *Journal of monetary economics* 37(2), pp. 249–265.

Fritsche, U., Kuzin, V. (2011) "Analysing convergence in Europe using the non-linear single factor model", *Empirical Economics* 41(2), pp. 343–369.

Getis, A., Griffith, D. A. (2002) "Comparative spatial filtering in regression analysis", *Geographical Analysis* 34(2), pp. 130–140.

Guetat, I., Serranito, F. (2007) "Income convergence within the MENA countries: A panel unit root approach", *The Quarterly Review of Economics and Finance* 46(5), pp. 685–706.

Hadri, K. (2000) "Testing for stationarity in heterogeneous panel data", *The Econometrics Journal* 3(2), pp. 148–161.

Kutan, A. M., Yigit, T. M. (2005) "Real and nominal stochastic convergence: Are the new EU members ready to join the Euro zone?", *Journal of Comparative Economics* 33(2), pp. 387–400.

Kutan, A. M., Yigit, T. M. (2007) "European integration, productivity growth and real convergence", *European Economic Review* 51(6), pp. 1370–1395.

Lopez, C., Papell, D. H. (2012) "Convergence of Euro area inflation rates", *Journal of International Money and Finance* 31(6), pp. 1440–1458.

Mora, T. (2005) "Evidencing European regional convergence clubs with optimal grouping criteria", *Applied Economics Letters* 12(15), pp. 937–940.

Phillips, P. C., Sul, D. (2007) "Transition modeling and econometric convergence tests", *Econometrica* 75(6), pp. 1771–1855.

Quah, D. T. (1996) "Empirics for economic growth and convergence", *European economic review* 40(6), pp. 1353–1375.

Ramajo, J., Márquez, M. A., Hewings, G. J., Salinas, M. M. (2008) "Spatial heterogeneity and interregional spillovers in the European Union: Do cohesion policies encourage convergence across regions?", *European Economic Review* 52(3), pp. 551–567.

Sala-i-Martin, X. X. (1996) "Regional cohesion: evidence and theories of regional growth and convergence", *European Economic Review* 40(6), pp. 1325–1352.

Siklos, P. L. (2010) "Meeting Maastricht: Nominal convergence of the new member states toward EMU", *Economic Modelling* 27(2), pp. 507–515.

O regionalnim konvergencijskim klubovima u Europskoj uniji

Mihaela Simionescu[1]

Sažetak

Cilj ovog istraživanja je predstaviti koncept konvergencijskog kluba unutar članica Europske unije, počevši od pretpostavke da se ukupna konvergencija ne može prepoznati zbog visokih izlaznih razlika između zemalja i između regija. Za analizu se taj koncept koristi kao metoda regresije koja se temelji na konvergencijskom testu koji pretpostavlja inovativnu dekompoziciju BDP po stanovniku što omogućuje endogeno određivanje konvergencije klubova. Da bi se postigao cilj, u radu se provodi empirijska analiza konvergencije BDP-a po stanovniku za članice EU-28 i za 272 regije koje odgovaraju NUTS2 razini. Rezultati analize pokazuju da na nacionalnoj razini, tijekom 1995. – 2012. postoje značajne razlike između država članica osnivača i SIE gospodarstava, a na regionalnoj razini je utvrđeno pet konvergencijskih klubova. Temeljni zaključak je da u uvjetima nedostatka konvergencije zemalja EU-28, identificiranje konvergencijskih klubova pomaže Europskoj uniji u smanjenju ekonomskih razlika diljem europskih regija.

Ključne riječi*: konvergencijski klub, beta konvergencija, grupiranje, log-t konvergencijski test, BDP po stanovniku*

JEL klasifikacija*: C21, C12, F43*

[1] *Doktorica ekonomskih znanosti, Romanian Academy, Institute for Economic Forecasting, Bucharest, Calea 13 Septembrie, no. 13, District 5, ZIP code 050711, Bukurešt, Rumunjska. Znanstveni interes: statistika, ekonometrija. Tel.: +4021 318 81 48. E-mail: mihaela_mb1@yahoo.com.*