COHESION IN THE EUROPEAN UNION – USED MARKOV CHAINS METHOD

Liviu-Stelian BEGU[*]

Abstract: *This analysis is based on the estimated σ- and on Markov chains. The study deals with the economic convergence of the European countries and especially the convergence of the EU countries, including Romania. In this paper we present applications of indicators and patterns of convergence on the example of European Union member countries and some current economic impact assessments on European convergence process.*
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JEL Classification: F_{15}, C_{13}, C_{15}.

1. Introduction

"Sigma" convergence measures the dispersion of real GDP per capita (in constant prices) between regions or countries based on standard deviation of the cross-section series (Barro, R.J., 1992, p. 169). In probability theory and statistics, the variance/dispersion is used as a measure of how far a set of numbers are spread out from each other. It is one of several descriptors of a probability distribution, describing how far the numbers lie from the mean. When the standard deviation is falling (rising) over time, the differences of GDP per capita between regions or countries in absolute terms gradually decrease (increase) and convergence (divergence) is approached. If standard deviation does not show any clear tendency but instead, increases or decreases successively, then a mixed process of convergence and divergence is realized. A different way of measuring the 'sigma' convergence is to use the coefficient of variation which results by dividing the standard deviation with the mean of the sample. The coefficient of variation is a measure of relative variability and is expressed usually, as

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[*] The Academy of Economic Studies, Romania, liviubegu@yahoo.co.ukp.

percentage and not via the units of data in which is referred. If the coefficient of variation decreases over time we have convergence otherwise we have divergence.

In mathematics, a Markov process or a Markov chain is a stochastic process which has the property that, given its present state, future states are independent of the past. The current status of such a process holds all information about the whole evolution process.

A Markov chain is a multistage experiment consisting of a sequence of trials in which the state, or outcome, of each trial depends on the state of the trial that immediately precedes it. The goal in a typical problem involving Markov chain is to compute the probability that the system will be in a particular state at a specified time.

For a Markov chain with *m* states, the transition matrix *P* is the *m x n* matrix in which the entry p_{ij} is the probability of going from state *i* to state *j* in one step.

2. Convergence sigma

A commonly used indicator for measuring convergence is the variation coefficient on the level of GDP/capita, denoted by σ. This indicator is used to measure Sigma convergence. It can be used to evaluate the real convergence level by measuring the dispersion of GDP/capita over a one year period, using for this purpose cross series (countries and regions). In this case, the relevance of the convergence indicator appears only when making comparisons.

In our study, we have used this indicator to measure and predict the real convergence level for some EU countries, specifically the group of EU 12. Data series refers to the 1998-2007 period. They will be symbolized with UE12 and are: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

Sigma convergence values for this period are: 0,6656; 0,6774; 0,6427; 0,6098; 0,5817; 0,5692; 0,5398; 0,4918; 0,4512; 0,3841.

The considered indicator concerning the GDP/capita variation coefficient of the EU countries shows an increase during 1998-1999. This increasing process reveals a divergent growth of the economies inside this group of countries, with the real possibility that every less developed country will strive for higher levels of development. During 2000-2007 the evolution of the variation coefficient of GDP/capita is a decreasing one,

which indicates the tendency of increasing convergence of the economies of the mentioned countries.

The Theil index is a particular case of the Generalised Entropy Index with coefficient 1. The following figure displays the Theil index for 1998-2008 periods.

Figure no. 1 - Theil Index in EU-12

The value of the index shows a reduction of disparities among EU-12 countries which is in line with the results obtained above with other measures. However, it clearly appears that this reduction is due to the fact that disparities among Members States are strongly decreasing. The most simple and frequently used non-parametric density estimator is the histogram (see, for instance, Boldrin and Canova, 2001). However, this instrument suffers from two severe limitations. First, histograms are not smooth, and second, they depend on end points of the sub-intervals selected to cover the data values.
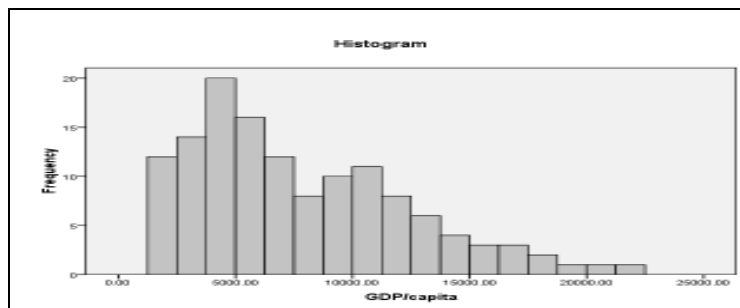

Figure no. 2 - Histogram for EU-12

The evolution of the distributions between 1998 and 2008 indicates a convergence process at work for the EU-12. Frequencies around the mean significantly increase, while they tend to decrease for values below 80% and above 120% of the EU-12 average.

Total crossing matrix between 1998 and 2007 is presented in the following table. We used eight stages for indicator GDP/inhabitants. All data are expressed in Euros.

Total matrix of GDP/inhabitants stages

	[1400-3650)	[3650-5900)	[5900-8150)	[8150-10400)	[10400-12650)	[12650-14900)	[14900-17150)	[17150-19400)	1998
[1400-3650)	19	3	1	1					24
[3650-5900)		28	3	1	1				33
[5900-8150)			11	3		1			15
[8150-10400)				9	2				11
[10400-12650)					11	1			12
[12650-14900)						4	2		6
[14900-17150)							3	1	4
[17150-19400)								3	3
2007	19	31	15	14	14	6	5	4	108

Based on this matrix we calculated the matrix of probability.

	[1400-3650)	[3650-5900)	[5900-8150)	[8150-10400)	[10400-12650)	[12650-14900)	[14900-17150)	[17150-19400)	1998
[1400-3650)	0.791667	0.125	0.041667	0.041667					1
[3650-5900)		0.848485	0.090909	0.030303	0.030303				1
[5900-8150)			0.73333	0.2		0.66667			1
[8150-10400)				0.818182	0.181818				1
[10400-12650)					0.916667	0.083333			1
[12650-14900)						0.666667	0.333333		1
[14900-17150)							0.75	0.25	1
[17150-19400)								1	1
2007									

Probability vector is:

[1400-3650)	[3650-5900)	[5900-8150)	[8150-10400)	[10400-12650)	[12650-14900)	[14900-17150)	[17150-19400)
17.59259	28.7037	13.88889	12.96296	12.96296	5.555556	4.62963	3.703704

The forecast based on probability vector for the next three years is as follows:

	[1400-3650)	[3650-5900)	[5900-8150)	[8150-10400)	[10400-12650)	[12650-14900)	[14900-17150)	[17150-19400)
2008	13.93	26.55	13.53	14.99	15.11	5.71	5.32	4.86
2009	11.03	24.27	12.91	16.35	17.38	5.97	5.90	6.19
2010	8.73	21.97	12.14	17.16	19.64	6.29	6.41	7.67

We can say there are increases the probability for higher stages, for example the last stage [17150-19400) increase from 4.86% in 2008 to 7.67% in 2010 and on the other hand the first stage [1400-3650) decreases from 13.93% in 2008 to 8.73% in 2010.

3. Conclusions

This paper has reviewed a number of methods and instruments developed for the analysis of economic and/or social inequalities and that can be used for examining disparities among EU12 countries.

One objective of the paper was to produce an update analysis of the convergence process among EU countries. Another was to show that instruments vary significantly in terms of their specificities and qualities and that it is therefore important to be aware of their limits when measuring the extent and evolution of countries disparities within the EU. These results also underline that the analysis of convergence is in fact complex.

Finally, even if the analysis of countries disparities is conducted thoroughly, it says little about the effectiveness of EU Cohesion Policy. Keeping track of countries disparities and monitoring their evolution is definitely of key importance for the design and management of Cohesion Policy. However, it must be kept in mind that the analysis of disparities, whether pointing to the presence or absence of convergence, generally

cannot be used to infer firm conclusions concerning the success or failure of the policy. For this, it is necessary to proceed to further analysis, notably by controlling other variables likely to affect the convergence process, as a proper econometric analysis would do.

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