CONVERGENCE IN AN OPEN-ECONOMY GROWTH MODEL IN MOLDOVA

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Abstract
The article tests the concept of convergence on the assumption that Moldova would join the European Union. In the literature on economic growth, much attention has been to the phenomenon of the convergence of regional economies with lower level incomes to grow faster. The authors use statistical and econometrics methods to measure and simulate the cross-country convergence. We find that the data does support the presence of absolute beta convergence.

Key words*. sigma- and beta- convergence; GDP per capita; dispersion; model.*

JEL CLASSIFICATION: C1; C13

INTRODUCTION

In the neo-classical growth model the source of convergence is the assumed diminishing returns of capital. If the ratio of capital to effective labour declines relative to the steady state ratio the marginal productivity of capital rises. If the only difference across countries is their initial levels of capital, then the prediction of the model is that countries with little capital will be poor and will grow faster than rich countries with large capital stocks. In steady state these ‘identical’ countries will have the same per capita income [2]. With a common steady state the initially poorer countries will be unambiguously farther away from their steady state. Thus, for a given savings behavior each country will tend to grow more rapidly the greater is the gap between its initial per capita income level and the steady state level. Convergence to the same steady state income is called absolute or unconditional beta convergence.

If countries are different with regard to the level of technology, propensities to save or population growth rates the neo-classical model predicts conditional convergence. This means countries will have different steady state income levels, but after controlling for the determinants of the steady state income level, poorer countries should grow faster than richer ones [4]. In other words, conditional convergence says that countries will approach some long run level of income once the differences across countries are held constant and the growth rate falls as they approach the long run level. To the extent that the determinants of steady state income are similar across countries convergence is expected. In effect, the differences between countries become stationary in the long run since each country converges towards its own steady state [2].

MEASURING THE CONVERGENCE

Empirical analyses on convergence began to appear in the economic literature from the beginning of the 1980s. One of these earlier studies was by Baumol (1986), who argued that homogenous groups of countries grow to converge towards a particular growth rate; while heterogeneous countries reveal rather divergence processes. Furthermore, empirical analyses on convergence were popularised by Barro (1989), Mankiw et al. (1992) and Barro and Sala-i- Martin (2003). Their analyses are mostly based on two methods. The first one is the Barro- regression method, where economic growth rate is regressed on the initial GDP level and other economic growth determinants. The second one is the Mankiw-Romer-Weil method, where economic growth rate is regressed on the initial income level and the variables which determine the steady-state of a given country according to the Solow model.

We discuss two concepts of convergence in this article: σ- and β-convergence. σ- convergence means that the dispersion of real per capita income tends to decline over time, while β-convergence means that there is a negative relationship between the initial level of GDP per capita and its average growth rate. The latter means that poorer regions and countries tend to grow faster than richer ones and will eventually catch up with them.

σ-convergence occurs when income differentiation between countries over time. The dispersion of income levels can be measured by standard deviation, variation, or the coefficient of variation (CV) of GDP per capita among economies [3].

In our analysis we use the coefficient of variation of GDP per capita at PPP (purchasing power parity), which is given by:

$$CV = \frac{standard\ deviation}{arithmetic\ mean} \quad (1)$$

To analyze convergence we used the time series on 20 countries of European Union in comparison with Moldova during 2005-2017 years.

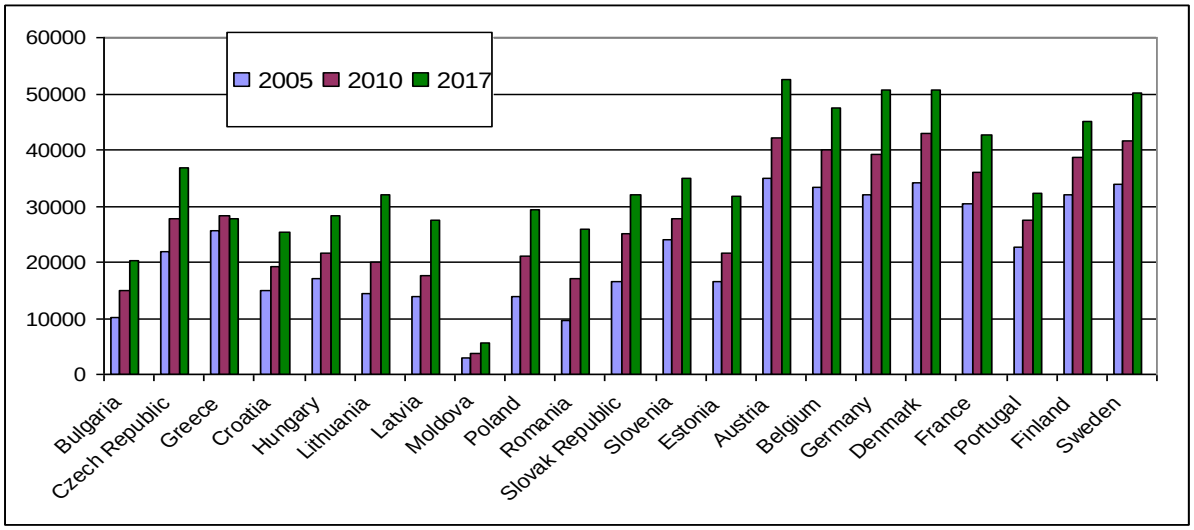

Figure 1. Dynamics of the gross domestic product per capita per annum
Source: *www.worldbank.org; author's calculation*

GDP per capita increased by 1.5-2 times compared to 2005 (except Greece).The growth rate began to slow down towards to end of the analyzed period.

The calculation results of sigma-convergence for different set of countries are presented in figure 2.

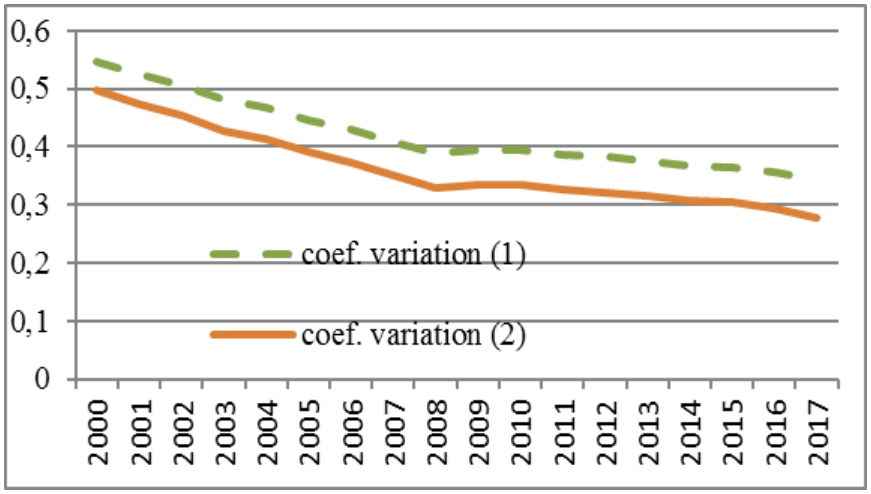

Figure 2. Sigma-convergence evolution
Source: *www.worldbank.org; author's calculation*

The concept of sigma convergence is true if there is a decrease in the GDP per capita dispersion of countries. In other words, if $\sigma_{t+T} < \sigma_t$, where σ_t is standard deviation, then sigma convergence is observed. When the dispersion increases, it means that divergence take places, if $\sigma_{t+T} > \sigma_t$.

Figure 2 illustrates that evolution of the indicator concerning the variation (coefficient of variation) of the GDP per capita confirms the existence of convergence.

In order to verify the σ-convergence hypothesis, we estimate the trend line of the dispersion in income levels among countries:

$$y_t = \alpha_0 + \alpha_{01} t + \varepsilon_t , \quad (2)$$

where explained variable is the coefficient of variation of GDP per capita, the explanatory variable is the time variable: t = 1, 2, …, 18 for the period 2000-2017 years; ε_t is the error term. If coefficient α_1.is negative, so σ-convergence exists.

Estimation result is presented in table 2.

Table 2. Econometric result of estimation the sigma convergence

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
α_0.	0.449	0.007	59.3	0.00
α_1.	-0.011*	0.001	-16.2	0.00
R-squared	0.94			
F-statistic	262.7**	Prob (F-statistic)		0.00

*coefficient is significant at level 0.05 ;
** estimated equation is significant at level 0.05
Source: *author's calculation*

The coefficient α_1.has negative sign, t-test confirms the statistical significance of the coefficient α_1, but the value of the coefficient is too small value.

Beta-convergence

Besides the sigma indicator expressed by the standard deviation, used the econometric research of various statistical cross-section or time series to reveal, by means of the regression equations and estimated trend, the convergence or divergence trend in the evolution the set of countries.

Beta convergence is a necessary but not the sufficient condition for sigma convergence. It is possible that the countries reveal beta-convergence but not a s one. β-convergence does not necessarily imply σ-convergence if each country's income level is persistently subject to random disturbances that affect country-specific growth rates [1].

The beta convergence is analysed based on the cross-sectional data: the average annual GDP per capita growth rate for a given period is regressed against the GDP per capita level from the initial level. Beta convergence occurs when less developed countries grow faster than more developed countries, meaning that there is a negative relationship between initial income level and its growth rate.

In order to verify the absolute beta convergence hypothesis based on cross-sectional data, we estimate regression in the form:

$$\frac{1}{T} log \frac{y_{i,T}}{y_{i,o}} = \beta_0 + \beta_{01} log y_{i,0} + \varepsilon_i, \quad (3)$$

where $\log(y_{i,t})$ and $\log(y_{i,0})$ are the natural logarithms of GDP per capita at PPP in country i in the last and the first year of the analyzing period; β_1 is slope (beta coefficient); β_0 is a constant; ε_t is the error term; and T indicates the duration of the period.

A major role in the econometric research is played by the estimation and interpretation of the beta coefficient of the regression equation of economic growth (see table 3).

The result of estimation shows that beta absolute convergence is observed (β_1 has the negative sign, also t-test confirms the statistical significance of the coefficient). The beta coefficient indicates that higher initial GDP per capita negatively affects the consequent growth rate.

Table 3. Econometric result of estimation the beta convergence

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
β_0.	0.212	0.028	7.55	0.00
β_1.	-0.018*	0.003	-6.14	0.00
R-squared	0.67			
F-statistic	37.8**	Prob (F-statistic)		0.02

*coefficient is significant at level 0.05; ** estimated equation is significant at level 0.02
Source: author's calculation

On base the result of estimation the beta coefficient we can calculate the speed of convergence:

$$speed\_of\_convergence = -\frac{1}{T}\ln(1+\beta_1 T) \quad (4)$$

In our case the coefficient equals 1.8%, this means that the countries of the enlarged union reduce the distance towards the common hypothetical steady-state by 1.87% annually. Thus, it is not a rapid catching-up process but the average speed of convergence.

Conclusion.

This paper estimates and analyses sigma and beta convergences for GDP per capita among the 20 European countries and Moldova. The hypothesis of the existence of sigma convergence is rejected, and divergence is observed.

The beta convergence is analysed based on the cross-sectional data: the average annual GDP per capita growth rate for a given period is regressed against the GDP per capita level from the initial level. Beta convergence occurs when less developed countries grow faster than more developed countries, meaning that there is a negative relationship between initial income level and its growth rate. Our results confirm the existence of beta convergence. The convergence occurred at the rate of 1.8% during the whole period 2000-2017.

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