

Comparative Analysis of σ - and β -Convergence of the Economic Growth of the Southern Russia Regions

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ABSTRACT

The article substantiates the strengthening of differentiation of economic growth in the Southern Russia regions during the introduction of international sanctions, reveals the trend of delayed and negative growth dynamics, which should be considered when developing a short-term forecast of economic growth in the Southern Russia macroregion. The calculated data of the GRP β -convergence regression model for SFD-12 and NCFD confirmed the hypothesis of absolute GRP β -convergence only in the period before the introduction of international sanctions (1998-2014). Calculations of unconditional convergence indicate the absence of a single trajectory of balanced growth for all regions of the South of Russia: there is a process of divergence, stratification of the population in terms of living standards, and increased social tension. The σ - and β -convergence model's study confirms the club convergence effect's presence and shows the need to form differentiated regional development strategies to reduce the gap between rich and poor Southern Russia regions. Cluster analysis of the socio-economic development of Southern Russia (NCFD and SFD) regions shows an unstable cluster and intra-cluster grouping of regions by economic and demographic indicators before and after the introduction of international sanctions. The convergence analysis in the conditions of increasing external shocks confirms the presence of different catch-up development rates in the Southern and North Caucasus macroregions. That can lead to a slowdown in the macroregion's economic growth and indicates the need for early formation of mechanisms to smooth out exogenous factors' negative effects on the region's trajectory of economic growth.

Keywords: β - and σ -convergence, Economic growth, Gross regional product, Regression model of convergence, Territorial clusters.

1. INTRODUCTION

In recent years, there has been an increase in the differentiation of socio-economic development of the South of Russia's peripheral regions, which creates several problems for the state associated with the need to direct part of the resources to equalise the imbalances, and not to stimulate their development. The increase in the polarisation level of economic development in introducing anti-Russian sanctions leads to increased social tension and increased separatist sentiment and disintegration processes. The need to reduce the socio-economic development differentiation level is also noted in the Spatial Development Strategy of the Russian Federation for the period up to 2025 [1]. Therefore, the study of the vectors of convergence of economic growth in the South of Russia's

problem regions before and after introducing international sanctions allows us to develop timely preventive measures to reduce the impact of negative trends on the balanced development and country's economic security.

2. RESEARCH METHODOLOGY

The methodological aspects of the decomposition of economic growth are considered in the works of Russian researchers A. Iodchin [2, pp.475-482], S. Drobyshevsky [3]. Also, the analysis of the influence of exogenous and endogenous factors on the dynamics of economic growth of the North Caucasus macroregion is presented in the scientific publication of the Institute of Socio-Economic Research of the Dagestan Federal Research Centre of the Russian Academy of Sciences [4, p.249-253].

Convergence issues in European regions are discussed in the works of J. Lopez-Rodriguez [5, pp.1-7], W.J. Baumol [6, pp.1072-1085], convergences in the Canadian provinces - P.C. Afxentiou and A. Serletis [7, pp.11-26], convergences in the Chinese economy - Aileen McCabe [8, p.2]. Studies of income convergence and economic growth deserve attention. Barro [9, pp.107-158; 10], F. Caselli [11, pp.679-741], W. Wong [12, p.4], E. Wolf [13, pp.565-579], A. Bernard [14, pp.1037-1044].

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In economic analysis, σ -convergence refers to the process of reducing the differentiation of indicators of development of a country or region. The presence of σ -convergence implies a decrease in interregional variance and an approximation of the analysed indicators' trajectories during the study period, which leads to the levelling of differences between these indicators by the end of the study period.

The economic content of β -convergence is expressed in the negative dependence of growth rates on the initial level of development of countries and regions, i.e., with the convergence of this type, less developed economies approach more developed ones. It should be noted that σ - and β -convergence are interrelated, but not equivalent categories: σ -convergence does not always indicate the presence of β -convergence.

The method of a quantitative assessment of σ - and β -convergence is formalised within the framework of endogenous economic growth models. The differentiation of statistical approaches to the definition of σ - and β -convergence should be noted. The analysis of σ -convergence is based on mathematical statistics using classical indicators: variance, standard deviation, and variation. The test of the hypothesis about the presence of β -convergence (a

long-term trend of levelling the levels of regional development) is based on regression modelling.

Simultaneously, it should be considered that convergence, even in neoclassical growth models, takes place only under an extreme condition of homogeneity of the economies under consideration (unconditional convergence of growth trajectories to equilibrium ones). For heterogeneous economies, neoclassical models predict conditional convergence, i.e. the convergence of each economy's growth trajectory to the individual or group trajectory of equilibrium growth. Growth theory is not limited to neoclassical models; several alternative theories go beyond the neoclassical paradigm, which does not give any definite predictions about economic inequality dynamics. There are several strong proofs that σ -convergence implies β -convergence, but σ -convergence does not follow from β -convergence. According to Caselli F. [11, pp.679-741], the empirical analysis of β -convergence only allows us to determine whether the behaviour of economies has some properties resulting from a particular modification of the neoclassical growth model, and nothing more.

This section of the study's primary purpose is to model and analyse intersubjective inequality dynamics according to the σ - and β -convergence criteria. The quantitative assessment was based on the calculation of the coefficient of variation according to the following formula:

$$\sigma_t = \frac{\sqrt{\frac{1}{n} \sum_{i=1}^n (M_i - M_{cp})^2}}{M_{cp}} \quad (1)$$

where M_i – the value of the considered indicator (GRP) for the i -region; M_{cp} – the average value of the considered indicator (GRP) for all macroregion subjects; n – the total number of macroregion subjects.

The definition of β -convergence involves comparing the growth rates for the regions under consideration over time. Based on the β -convergence model, two of its characteristics can be calculated: the speed (v) and time (τ) of intersubjective inequality reducing by two times.

The calculation of speed (v), time (τ), and β -convergence is based on the following economic equations:

$$\frac{\ln M_{iT} - \ln M_{i0}}{T} = \beta_0 + \beta_1 (\ln M_{i0}) + \varepsilon, \quad (2)$$

$$v = -\frac{\ln(1+T\beta_1)}{T}, \quad (3)$$

$$\tau = \frac{\ln 2}{v}, \quad (4)$$

where β_0, β_1 – the parameters of the equation of convergence; i – number of the object; T – period; M_{i0} – the value of this indicator for the object in the initial period; M_{iT} – the value of this indicator for the facility over the past period; ε – the residual term.

It should be noted that there is a distinction between conditional and absolute convergence. Absolute convergence, or unconditional convergence, is observed when

developing countries (regions) tend to grow faster than rich ones because a small initial GDP size allows for a high growth rate. Conditional convergence indicates a decrease in each country's GDP growth rate as it approaches a stable state. In a formalised form, the absolute β -convergence can be represented as follows:

$$y = \beta_0 + \beta_1 x, \tag{5}$$

where $= \frac{\ln M_{iT} - \ln M_{i0}}{T}$; $x = \ln M_{i0}$.

The estimation of β -convergence parameters is carried out based on regression analysis. The conclusion about the presence of β -convergence is made based on the analysis of the sign for the parameter of β_1 equation (5): a negative sign for the parameter β_1 indicates the presence of β -convergence, in the opposite case, there is a β -divergence.

3. STUDY RESULTS

This study's unique feature is a comparative analysis of σ - and β -convergence results before (1998-2014) and after introducing international sanctions (1988-2018). As objects of study selected all the South of Russia regions except the Chechen Republic, the Republic of Crimea and Sevastopol which do not have the required statistics for the study period. In this study, regression modelling of β -convergence was carried out separately for the North Caucasus Federal District and 12 subjects of Southern Russia (SFD-12), including the Krasnodar Territory, Stavropol Territory, Rostov, Volgograd, Astrakhan Regions, the Republics of Adygea, Kalmykia, Dagestan, Ingushetia, North Ossetia – Alania and Kabardino-Balkar, Karachay-Cherkess Republics.

The results of the σ -convergence estimation are presented in table 1.

The calculated parameters of econometric modelling of β -convergence by gross regional product (GRP) for SFD - 12 and NCFD before introducing sanctions (1998-2014) are presented in table 2.

The regression model of β -convergence in GRP for SFD-12, SFD-6, and NCFD has the form:

$$Y_{SFD12} = 7,193 - 0,412 * X_{SFD12} \tag{6}$$

$$Y_{NCFD} = 10,215 - 0,797 * X_{NCFD} \tag{7}$$

The parameters of the adequacy of regression equations (table 2) are within acceptable limits: standard errors are insignificant, the value of the P-value at a significance level of 0.05 is mainly less than 0.01, the calculated values of the Student's criterion in absolute value exceed the table value of 2.16-2.45, so the coefficient of β -convergence is statistically significant. We can accept the hypothesis of the presence of β -convergence since, in our case, the F calculated is greater than the F tabular. Therefore, we can accept the hypothesis that there is a catch-up effect among the subjects of Southern Russia (SFD-12), separately for the Southern Federal District (SFD-6) and the North Caucasus Federal District (NCFD-6).

Calculation of β -convergence in the period after the introduction of international sanctions (1998-2018) showed the following value (see table 3):

SFD-12: $Y = -0.173 X - 0.178$, $\beta = -0.173$, i.e. convergence is observed

SFD-6: $Y = -0.312 X + 0.923$, $\beta = -0.312$, i.e. convergence is observed

NCFD-6: $Y = -0.57 X + 2.171$, $\beta = -0.57$, i.e. convergence is observed

Table 1. Comparative analysis of σ -convergence of Southern Russia regions

	The regression equation 1998-2014	Note	The regression equation 1998-2018	Note
SFD-6	$Y = -0.001X + 0.3071$ $R^2 = 0.462$	Convergence	$Y = -0.0019X + 0.3017$ $R^2 = 0,1705$	Convergence
NCFD-6	$Y = -0.0162X + 0.4674$ $R^2 = 0,685$	Convergence	$Y = -0.02X + 0.62$ $R^2 = 0.765$	Convergence
SFD+ NCFD	$Y = -0.0017X + 0.3976$, $R^2 = 0,21$	Convergence	$Y = 0.0006X + 0.3814$ $R^2 = 0.0205$	Divergence

Source: author's calculations.

Note: SFD - 12 – Southern Federal District, NCFD - North Caucasus Federal District.

Table 2. Parameters of the β -regression equation for GRP

Macro region	Parameter	The parameter value	Standard mistake	Criteria Student	P-value	F-table (0.05)	F-calc (0.05)	Rate of β -convergence (ν)	Time reducing the backlog in 2 times, (τ)
	β_0	7.1932	1.3496168	5.3298078	0.00033	4.84	7.0265		
	β_1	-0.4119	0.1629562	-2.527389	0.0300				
	β_0	10,21458	1.7670591	5.7805586	0.00444	7.71	13.2437		
	β_1	-0.7969	0.2189893	-3.63919	0.02198				

Source: author's calculations.

Note: SFD -12 – Southern Federal District, NCFD - North Caucasus Federal District.

4. RESULTS DISCUSSION

The σ -convergence assessment results on the example of Russia's 12 southern regions during the introduction of international sanctions show divergence.

Analysis of the β -convergence by the Fisher criterion over the period 1998-2018 (table 3) shows the excess tabular values over the calculated ones. Hence, the conclusion that there is an absolute convergence of economic growth dynamics in 12 regions of Southern Russia is unfounded.

Based on the design data of tables 2, 3 and the regression model of β -convergence of the GRP, it is possible to draw the following conclusions: for the SFD and NCFD-12 period 1998-2014 confirmed the hypothesis of absolute β -convergence of the GRP.

The unconditional convergence model implementation allows concluding that there is no uniform trajectory of proportional growth for all Southern Russia regions. The study of the model of σ -and β -convergence indicates the effect of cluster convergence, the need to form differentiated strategies for regional development.

5. CONCLUSIONS

The conclusion that there is an unconditional convergence in the period 1998-2018 is unfounded, which in our

Table 3. Parameters of the β -regression equation for GRP

Macro region	Parameter	The parameter value	Standard mistake	Criteria Student	P-value	F-table (0.05)	F-calc (0.05)	Rate of β -convergence (ν)	Time reducing the backlog
SFD-12	β_0	-0.178	1.50	-0.119	0.9079	4.84	0.5715		
	β_1	-0.173	0.2289	-0.755	0,4671				
NCFD - 6	β_0	2.171	1.5676	1.384	0.238	6.61	5.3553		
	β_1	-0.57	0.2465	-2.3141	0.0817				
SFD-6	β_0	2.171	2.3079	0.404	0.7068	7.71	0.831		
	β_1	-0.312	0.3422	-0.911	0.413				

Source: author's calculations.

Note: SFD-12 – NCFD+SFD, SFD - 6 –Southern Federal District (Republic of Crimea, Sevastopol), NCFD - 6 -

view is a manifestation of the influence of exogenous factors associated with international sanctions.

Thus, the analysis of the economic space of Southern Russia based on the concept of convergence in the conditions of growing external shocks confirms the presence of the different speed of catching-up development in the SFD and NCFD that may lead to a slowdown in the economic growth of the macroregion and suggests mechanisms to mitigate the negative effects from the impact of external shocks on region's economic dynamic.

REFERENCES

1. The Russian Federation's spatial development strategy for the period up to 2025, Order of the Government of the Russian Federation No. 207-r of February 13, 2019.
2. A.A. Iodchin, Decomposition of inter-regional convergence in Russia, *Audit and financial analysis* 4 (2007) 475-482.
3. S. Drobyshevsky, Factors of economic growth in the Russian Federation regions, S. Drobyshevsky, O. Lugovoy, E. Astafyeva, D. Polevoy, A. Kozlovskaya, P. Trunin, L. Lederman. Moscow: IEPP, 2005, 278 p.
4. N.C. Gichiev, Caspian vector of integration of the Shanghai cooperation organisation: exogenous and endogenous factors of development, *Economy of region* 4 (2012) 249-253.
5. J. Lopez-Rodriguez, Regional Convergence in the European Union. *Economics Bulletin* Vol.18 (2008) 1-7.
6. W.J. Baumol, Productivity growth, convergence, and welfare: what the long-run data show, *American Economic Review* 76 (1986) 1072-1085.
7. P.C. Afxentiou, and A. Serletis, Convergence across Canadian Provinces, *Canadian Journal of Regional Science* 21 (1998) 11-26.
8. Aileen McCabe, China's Economy on Pace to Become World, *Gazette Montreal* 2 (2010) 2.
9. R. Barro, and X. Sala-i-Martin, Convergence across States and Regions, *Brooking Papers on Economic Activity* 1 (1991) 107-158.
10. R. Barro, Economic Growth in a Cross-Section of Countries. *Quarterly Journal of Economics*, Iss. 106, 1991.
11. F. Caselli, Accounting for Cross-Country Income Differences, *The Handbook of Economic Growth*, Vol. 1 (2005) 679-741.
12. W. Wong Economic Growth: A Channel Decomposition Exercise. *The B.E. Journal of Macroeconomics* Vol. 7 Iss. 1 (2007) 4.
13. Wolf E. Capital Formation and Productivity Convergence. *American Economic Review* Vol. 81 Iss. 3 (1991) 565-579.
14. A. Bernard, C. Jones, Technology and Convergence, *Economic Journal* Vol. 106 Iss. 437 (1996) 1037-1044.