PATTERNS OF SPATIAL DEVELOPMENT: EVIDENCE FROM RUSSIA

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Abstract

The aim of the paper is to analyze the trends of spatial inequality in Russia in 1994-2015 based on the convergence concepts. Russia faced the problem of inter-regional inequality as well as most countries. The situation is aggravated by the external economic and domestic factors in recent years. The fall in energy prices and Western sanctions had a negative impact on the country's economic development. Russia is compelled to take into account geopolitical interests in the implementation regional policies in some regions (the Far East, the Crimea, the Kaliningrad region, the republics of the North Caucasus, the Arctic). Many regional budgets have budget deficit, highly debt load. They optimize spending on the social sphere and reduce investments in the real economy. Russia is emerging from the crisis despite the difficult situation. A review of the theoretical positions of the four types of convergence concepts (σ-, β-, γ-, ρ-convergence) was made. The spatial inequality evaluation was carried out on the basis of σ-convergence and absolute β-convergence concepts. The Williamson coefficient, the Hoover index, the Theil index and the Atkinson index were used to analyze spatial inequality based on the σ-concept. Differentiation has increased over the analyzed period, but gap decreased after 2005. The convergence speed is 1.79% in Russia. Regions with a low initial level of development have higher growth rates than regions with a higher initial level of development

Keywords: spatial inequality, spatial development, β-convergence, σ-convergence, Russia
JEL classification: D63, O52, R1, R58

1. Introduction

Most countries consider the problem of spatial inequality to be a priority when developing regional policy. For example, the EU countries pursue a regional cohesion policy to catch up Central and Eastern Europe countries' level with the Western European countries' level.

In applied research, both the inequality between countries and the inequality between regions within one country are studied. Research methods used to measure inequality between countries can be used when measuring interregional inequality. Linkage between economic growth and the level of interregional inequality is always a key issue when studying interregional disparity. According to Williamson (1965), countries in the initial period of development are characterized by economic growth, which is accompanied by an increase in inequality. This conclusion is confirmed by European data on the growth of spatial inequality within the 12 "new" EU countries, which by the level of economic development lagged far behind the "old" Eurozone members. Interregional inequality in the "new" countries increases at first and then decreases somewhat due to a faster growth of regions within countries that have advantages in the context of globalization. At the same time the general inequality between all EU countries and 15 "old" ones decreases (Crescenzi, Percoco, 2013). The level of spatial inequality in Russia is rather high: disproportions are formed under the influence of several strong regions, such as Moscow and Moscow region, St. Petersburg, oil and gas production regions. Inequality is influenced by many factors, including economic growth.

For Russia, high interregional differentiation is typical. Interregional disparity is revealed when comparing the main relative sub-federal level indicators per capita: GRP, incomes, investment volume, industrial output, fixed assets and other indicators, as well as the rate of their growth. Russia is not a unique country in this sense. All countries face the problem of interregional differentiation and are forced to pursue an inequality mitigation policy. For example, inequality in the developed Western European countries (Germany, France, and England) is moderate. Europe has faced new challenges after German reunification and the

EU accession of the former socialist countries, which had a lower level of economic development. Given the division of the Eurozone into NUTS 2 level regions, the magnitude of interregional inequality within the EU has increased significantly. The EU consistently pursues a policy of regional cohesion in order to equalize interregional disproportions. Russian partners in the BRICS such as China, India and Brazil pursue a state policy to mitigate differentiation. Russia also implements measures of state regulation of regional development conducting inter-budgetary equalization.

Lagging regions always carry the risk of a social explosion or aggravation of ethnic conflicts, which sometimes threatens the integrity of the country. However, interregional differentiation does not always act as "a necessary evil." Disproportions in the regions development force the regions to compete for resources: federal aid, investments, human capital, etc., ie. act as a source of development. It is important to limit interregional differentiation within certain limits for sustainable development of Russia and its regions, considering that high differentiation threatens to increase the level of the potential for conflict in certain regions, and very low differentiation excludes competition between regions for resources and eliminates incentives for development.

Russia has been pursuing an active state policy to mitigate interregional inequality. It conducting interbudgetary leveling and creating conditions for the development of growth poles since the beginning of the 2000s. However, Russia has faced difficulties due to external economic and domestic factors in recent years. The fall in energy prices and Western sanctions had a negative impact on the country's economic development. Russia is compelled to take into account geopolitical interests in the implementation regional policies in some regions (the Far East, the Crimea, the Kaliningrad region, the republics of the North Caucasus, the Arctic). Many regional budgets have budget deficit, highly debt load. They optimize spending on the social sphere and reduce investments in the real economy. Russia is emerging from the crisis despite the difficult situation. It's making serious efforts to support depressed regions by providing them with interbudgetary transfers from the federal budget and government loans with a low interest rate. Regions form a favorable business environment. Russia ranks 35th in the Doing business ranking in 2017. Russia creates an integrated system of strategic planning for regional development. Each region (subject of the Russian Federation) has its own strategy for social and economic development, implements targeted programs within the framework of the 'management by objectives' principle. The strategy of spatial development of the Russian Federation will be adopted in the near future. Undoubtedly, state regional policy contributes to solving the problem of spatial inequality and is characterized by certain successes.

2. Theoretical background

The convergence of development levels of countries or regions can occur on income, growth rates of the economy, employment, investment, economic structure, living standards and other key indicators.

As a rule, the process of convergence-divergence is estimated by the productivity indicators of economies, for example, per capita GDP or per capita GRP. Most studies on economic growth and convergence are based on the Solow Growth Model (1956).

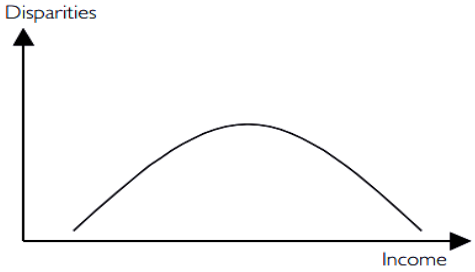
There are two types of convergence: σ-convergence and β-convergence. σ-convergence refers to a change in the distribution of income characteristics over a certain period, and β-convergence refers to a mobility of income characteristics within the same distribution to determine whether the growth rate of poor territorial units outpaces the growth rate of rich territorial units (Sala-i-Martin,1996).

σ-convergence eventually leads to a decrease in the differences between countries. Existence of σ-convergence can be detected by a simple comparison of the countries differentiation indicators when the indicator at the final moment of time is smaller than the indicator at the initial moment of time ($\sigma(t+n) < \sigma(t)$, where σ is the differentiation indicator, t is initial moment of time, t+n is the final moment of time). It is the most convenient to trace the dynamic changes in the differentiation indicators using a diagram.

Kuznets (1955) believed that income inequality depends on the development level of the country. In countries at the first stages of development inequality will grow as the national economy grows. Williamson (1965) has developed this theory in relation to regional

economies and has empirically shown that interregional inequality increases in the early stages of economic growth and decreases when the country achieves a certain economic level. σ-convergence dynamics is described graphically by a U-shaped inverted curve (figure 1).

Figure 1: Williamson Curve



Source: Williamson (1965)

β-convergence suggests faster growth of countries with a low level of economic development in comparison with highly developed countries. β-convergence can be absolute and conditional. Absolute β-convergence is explained by the fact that economically weak regions with a higher marginal product, compared to rich regions with a low marginal product, will have a high capital inflow. For this reason, lagging regions will develop more rapidly than developed regions. In the case of absolute β-convergence, all countries converge to the same long-term sustainable rate of growth. The study of absolute β-convergence is based on the determination of the Barro regression coefficients (1)-(4). Conditional convergence in this case takes place when b coefficient has negative values. Complete convergence is achieved when b=-1 (Romer, 1996). According to Barro and Sala-i-Martin (1992), convergence speed β is calculated according to the formula 3. β is positive if b is negative. High positive convergence speed provide faster convergence, i.e. regions with a low initial level of development show higher growth rates than regions with a higher initial level of development.

$$\frac{1}{T} ln \left(\frac{Y_{it}}{Y_{i1}}\right) = a + b \cdot \ln Y_{i1} + \varepsilon \quad (1)$$

$$b = -\left(1 - e^{\beta T}\right) \quad (2)$$

$$\beta = -\frac{\ln (b \cdot T+1)}{T} \quad (3)$$

$$t = \frac{ln2}{\beta} \quad (4)$$

where Y_{it} – indicator of the ith region at the point of time T;
Y_{i1} – indicator of the ith region at the initial moment of time;
ε – random deviation;
β – convergence speed;
t - half-period of convergence.

The dependent variable in the equation reflects the growth rate and the independent variable is the initial level of economic development. In the case of conditional β-convergence, it is assumed that the territorial units have structural differences and the convergence process is different, i.e. the countries converge to their own long-term stationary state due to a significantly different economic base. Additional variables are incorporated in the equation (5) in order to account for the influence of endogenous and exogenous regional factors.

$$\frac{1}{T} ln \left(\frac{Y_{it}}{Y_{i1}}\right) = a + b \cdot \ln Y_{i1} + \gamma Z_i + \varepsilon \quad (5)$$

where Y_{it} – indicator of the *i*th region at the point of time *T*;
Y_{i1} – indicator of the *i*th region at the initial moment of time;
Z_i – regional factors;
ε – random deviation.

Existence of β-convergence is a necessary but insufficient condition of σ-convergence, since β-convergence is theoretically possible without σ-convergence. Indeed, the mobility of territorial units can happen in accordance with economic growth rates in case of constant σ-

convergence. At the same time σ-convergence is sufficient but not necessary condition of β-convergence.

Friedman (1992) and Cheshire and Magrini (2000) noted that the income characteristics average values of territorial units do not provide a complete picture of the convergence as regression is practically constructed based on mean values. The observed decrease in inequality can be accompanied by a process of polarization into homogeneous groups of regions with the same development path. Groups of territorial units that share the same development path are characterized by club convergence. Such groups of regions have similar initial conditions and structural characteristics.

In this regard Boyle and McCarthy (1997, 1999) suggested defining γ-convergence using Kendall's coefficient of concordance in conjunction with measurement of σ-convergence. The value of the γ-convergence index varies from zero to one. The closer the index to zero, the greater the degree of mobility in the distribution of regions. With stable σ-convergence or even σ-divergence, it is possible to detect significant changes in the distribution of regions due to the high mobility of regions and the γ-convergence process.

β-convergence can be in the forward and backward direction (Wodon, Yitzhaki, 2006), which causes problems in the analysis. To solve this problem, the concept of ρ-convergence is proposed (Lucke, 2008). ρ-convergence is considered as an inverse β-divergence in time. On the basis of the covariance matrix, where the variances of the indicators the initial and final instants of time are on the main diagonal, and the off-diagonal elements are the covariance between the indicators at the initial and final instants of time $\begin{vmatrix} \sigma_1^2 & \sigma_{1n} \\ \sigma_{1n} & \sigma_n^2 \end{vmatrix}$, ρ is calculated by the formula (6). ρ varies from -1 to 1.

$$\rho = \frac{\sigma_{1n}}{\sigma_1 \sigma_n} \quad (6)$$

where σ_{1n}- off-diagonal element covariance matrix;

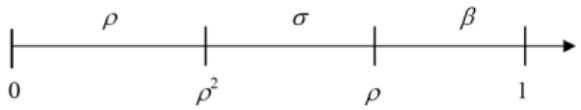
σ_1^2, σ_n^2 – the variance of the inequality indicator at the initial moment t_1 and at the final moment t_n.

Then β-convergence will be detected for $|\beta| < 1$,

σ–convergence for $|\beta| < |\rho|$,

ρ-convergence for $|\beta| < \rho^2$ (figure 2).

Figure 2 - Types of convergence (B. Lucke, 2008)



Source: B. Lucke (2008)

Groups of territorial units that share the same development path are characterized by club convergence. Such groups of regions have similar initial conditions and structural characteristics. It can be assumed that countries with similar determinants of economic growth converge to the same long-term sustainable rate of economic growth. If some countries have similar factors of economic growth, then club convergence can occur in the course of time. However, club convergence can eventually turn into an absolute convergence under the influence of exogenous factors. There are two models of club convergence: quadratic model of absolute club convergence (Baumol and Wolff, 1988) and disparity model between the leading region and all the others (Chatterji and Dewhurst, 1996).

There are many methods used to research spatial inequality: the Markov chains, developed by Quah (1993), were used to evaluate the change in income characteristics and their distribution; and the model of convergence with spatial autocorrelation (Rey and Montouri, 1999).

The purpose of the paper is to research dynamics of spatial inequality in Russia on the basis of σ-convergence analysis and to determine the presence or absence of outstripping development of the poorest regions in comparison with the developed regions on the basis of β-convergence analysis.

3. Data and research methods

The information basis of the research constituted the statistical data of Russian Federal State Statistics Service for the period of 1994-2015. The analysis on the basis of σ-convergence concept includes 83 Russian subjects (statistics on the Chechen Republic were included since 2005, Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug – Yugra, Yamalo-Nenets Autonomous Okrug were included since 2011). The analysis on the basis of β- convergence concept includes 79 subjects (with the exception of the Chechen Republic, Nenets Autonomous Okrug, Khanty-Mansi Autonomous Okrug – Yugra, Yamalo-Nenets Autonomous Okrug, the Republic of Crimea and the city of Sevastopol due to the lack of statistical data in the initial period in 1994).

The Williamson coefficient, the Hoover, Theil and Atkinson indices (Williamson, 1965; Hoover, 1936; Theil, 1967; Atkinson, 1970) (7)-(10) were used to analyze spatial inequality based on the σ-concept. Все индикаторы неравенства учитывают размер региона посредством численности населения региона.

$$V_w = \frac{\sqrt{\sum_i^N (y_i - \overline{Y})^2 \cdot \frac{P_i}{P}}}{\overline{Y}} \cdot 100\% \quad (7)$$

where V_W – the Williamson coefficient;
y_i – GRP per capita of the *i*th region;
$\overline{Y}$ – average Russian GRP per capita;

$$I_H = \frac{1}{2} \sum_{i=1}^{N} |\alpha_i - \beta_i| \quad (8)$$

where I_H – the Hoover index;
N – number of the regions;
α_i – a share of the *i*th region indicator in the total indicator across all the totality of the regions;
β_i – a share population of the *i*th region in the total population.

For the first Theil index (Theil, 1967) and the Hoover index, the absolute equality will be fixed at zero, positive index values for the first Theil index correspond to inequality, unit index values for the Atkinson index correspond to the maximum inequality (9), (10).

$$I_T = \sum_{i=1}^{N} \frac{y_i}{y} ln \left(\frac{y_i / p_i}{y / p} \right) \quad (9)$$

$$I_A = 1 - e^{-I_T} \quad (10)$$

where I_T – the first Theil index;
I_A – the Atkinson index;
N – number of the regions;
y_i – GRP of the *i*th region;
y – the aggregate GRP of the country;
p_i – population of the *i*th region;
p – population of the country.

Real indicators. which were adjusted taking into account the cost of living in the regions, were used instead of indicators nominal rates, to eliminate the effect of price differentiation across the regions. Minimum subsistence level (11) were used to calculate real indicators throughout the interval under study.

$$Y_{ikor} = Y_i \cdot \frac{MSL}{MSL_i} \quad (11)$$

where Y_{ikor} - real value of the indicator of the *i*th region;
Y_i – the nominal value of the indicator of *i*th region;
MSL – the average Russian minimum subsistence level;
MSL_i - minimum subsistence level of the *i*th region.

4. Research results interpretation and its analysis

A dynamics analysis of interregional inequality has showed a strongly pronounced divergence before 2005 with small periods of its decline and convergence after 2005, which has recently slowed down (Figure 3-6). The maximum value of the inequality was recorded in 2005; it is 2 times higher than the original level of 1994. Throughout the studied period,

spatial inequality has increased by 1.5 times that characterizes process of σ-divergence. The findings are consistent with Williamson's idea about inequality increasing in the early stages of development and reducing over time as the territorial unit achieves a certain level of development. However, after 2005 it is possible to speak about σ-convergence, since the level of spatial inequality in 2015 has decreased by 20 % compared to 2005.

The graphs of the four indices of inequality have a same dynamics. In general, interregional inequality is increasing during the period under study. The first Theil and Atkinson indices grow 1.4 times, the Hoover index increases 1.1 times, the Williamson coefficient increases 1.2 times.

Figure 3: The First Theil index

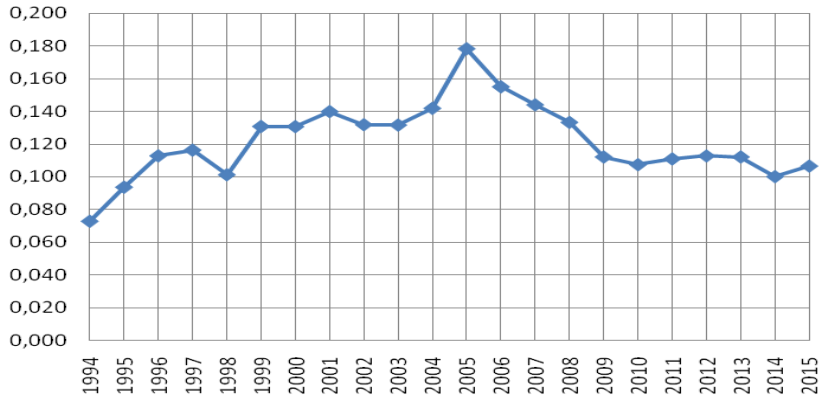


Figure 4: The Atkinson index

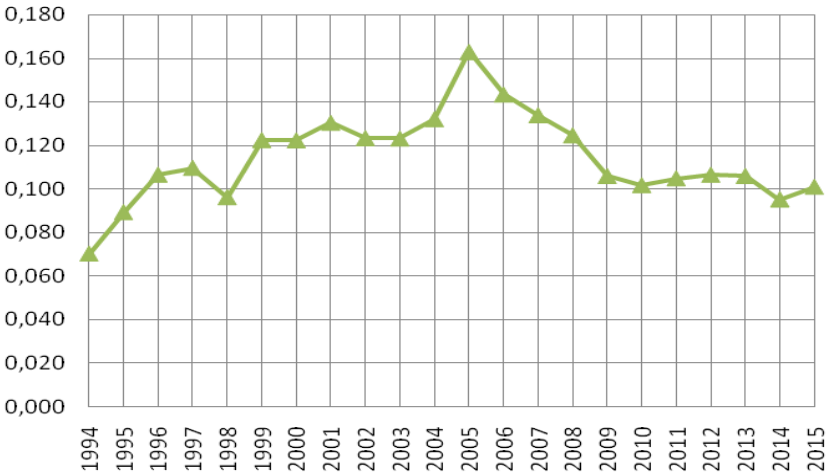


Figure 5: The Hoover index

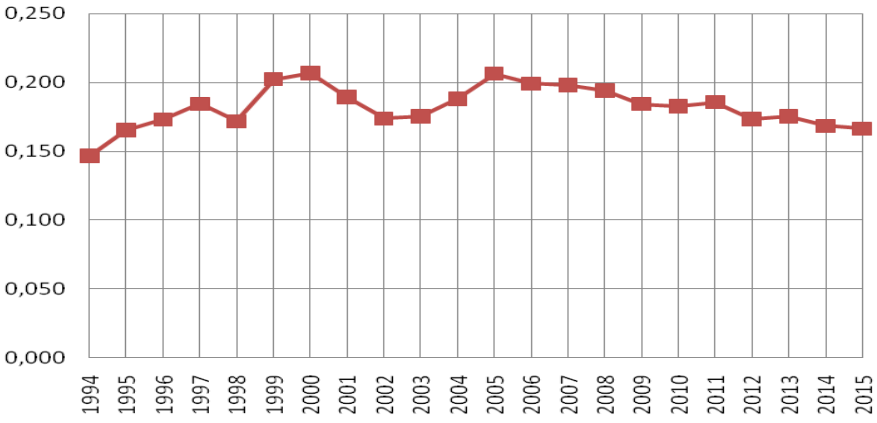
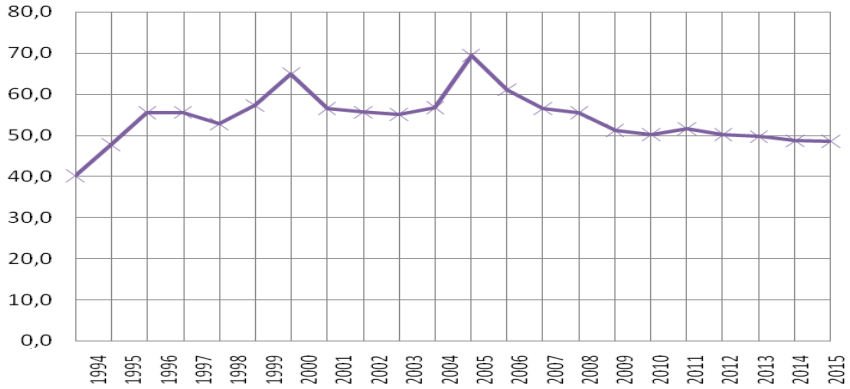


Figure 6: The Williamson coefficient, %



An analysis of the dynamics of inter-regional inequality showed divergence until 2005 with small periods of its decline and convergence after 2005, which has recently slowed. In 2000-2001, the Nenets Autonomous Okrug, the Khanty-Mansi Autonomous Okrug – Yugraand the Yamal-Nenets Autonomous Okrug began to be counted separately from the regions to which they relate. In this regard, the inequality has slightly increased. First, the three autonomous okrugs considered are hydrocarbon production regions and have very high average per capita GRP. The maximum value of the inequality is fixed in 2005, when statistics on the Chechen Republic appear. The Chechen Republic had extremely low rates of economic development, which affected the magnitude of inequality. Secondly, the differentiation of the budget revenues of the regions also reached its peak at that time (Kolomak, 2008). The consistent reduction of spatial inequality after 2005 we can be explained by an effective policy of equalizing the budgetary security of the regions, which began after 2004. It is proved that the convergence of tax revenues is accompanied by the convergence of regional economies. Both processes have the same speed of convergence (Skuli, 1991). Kolomak (2008) shows a decrease in the coefficients of variation for total incomes and tax revenues of the regions' budgets after 2004. Spatial inequality and economic growth in Russia have unidirectional dynamics: high rates of economic growth are accompanied by an increase in inequality. The correlation coefficients are positive and equal to 0.68 between the first Theil index and the increase in aggregate GRP and between the Atkinson index and the increase in aggregate GRP. The findings are consistent with Williamson's idea of increasing inequality in the early stages of development and of reducing it over time as the territorial unit achieves a certain level of development.

The distribution of regions has a positive skewness. This means that the distribution is skewed to the right (figure 7, 8).

Figure 7: The distribution of regions on per capita GRP at 1994

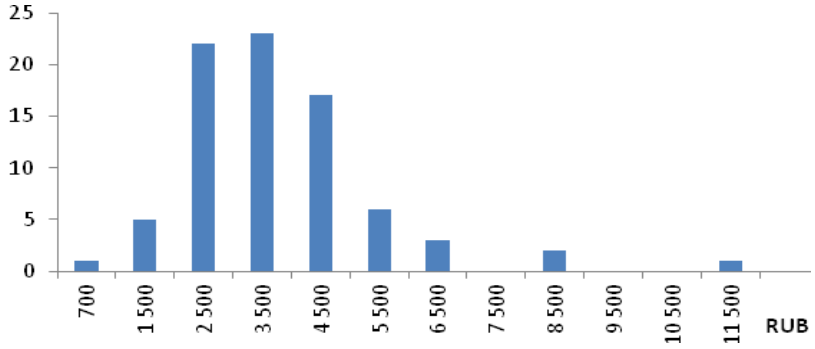
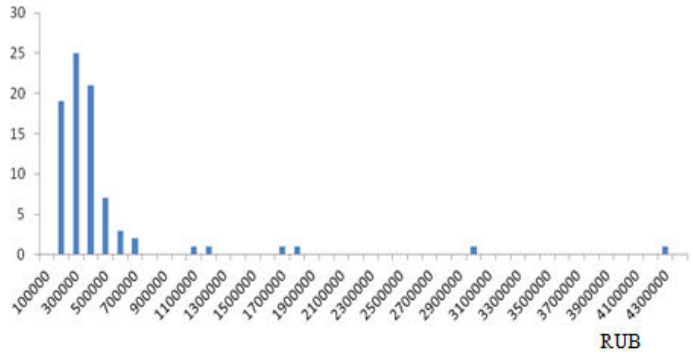


Figure 8: The distribution of regions on per capita GRP at 2015



A Barro regression equation was constructed to verify the existence of absolute β-convergence throughout the whole investigated interval. The hypothesis of β-convergence existence was confirmed (tabl. 1). The Barro regression is based on the average annual growth rate relative to the initial level. It does not reflect variation within the distribution in all areas of the period under review, therefore the period is divided into subperiods to estimate the variable under consideration at individual intervals in some studies (Lanzieri, 2010). We divide the period under study into several intervals: 1994-2001, 2001-2005, 1994-2005, 2005-2015 (table 1).

Table 1. Estimation of regression models parameters of absolute β-convergence

Parameter	1994-2015	1994-2001	2001-2005	2005-2015
a	0.331	0.5	0.64	0.307
standard error a	0.032	0.098	0.121	0.055
b	-0.015	-0.024	-0.044	-0.016
standard error b	0.004	0.012* insignificant	0.011	0.0048
R	0.38	0.22	0.4	0.36
convergence speed β, %	1.79	2.7	4.9	1.76
half-period of convergence t, years	38.7	26.0	13.9	39.4
convergence/not convergence	convergence	not convergence	convergence	convergence

Source: calculated by the author

Absolute β-convergence was detected (the parameters are statistically significant) at the three study intervals (1994-2015, 2001-2005, 2005-2015). Throughout the investigated interval, the convergence rate was 1.79%, the half-period of convergence was 38.7 years (3), (4). Positive values of convergence rate indicate higher growth rates of regions with a low initial level of development compared to regions with a higher initial level of development at three intervals.

5. Conclusion

The aim of the paper was to evaluate the convergence-divergence process among Russian regions. The evaluation was carried out on the basis of σ-convergence and absolute β-convergence concepts. The convergence speed is 1.79% in Russia. It is slightly lower than at the Eurozone, whose value is 2%. Indeed, many Russian researchers noted that during the crises (1998, 2008, 2013-2014), the greatest decline was observed in the most developed regions, and the lagging regions suffered less from crises. This is an indirect confirmation in favor of faster growth of the least developed regions.

In contrast, the analysis that was done through the concept of σ-convergence revealed the increase differentiation on all investigated interval. From the graphical analysis, it was

evident that before 2005 there was divergence between the RF regions. Disparity decreased after 2005.

On the one hand, stagnation, Western sanctions, a drop in oil prices have had a negative impact on the Russian economy. On the other hand, the state regional policy to smoothing interregional inequalities and a stagnation led to a decline and stabilization of spatial interregional inequality.

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