Convergence of Russian industrial regions

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Abstract. The research of socio-economic differentiation and regional convergence development allows us to give an objective assessment of the current state of the country's economy at the sub-territorial level. Research of the process of industrial regions convergence of the Russian Federation for the development of proposals aimed at eliminating the identified proportions. Check the scientific hypothesis about the presence of significant differences in the degree of development processes convergence among various groups of Russian regions, formed according to the principle of industry specialization of the production complex. The research uses economic, mathematical, and statistical information processing methods. The theoretical framework of the study is based on the works of Russian and foreign researchers in the field of regional development. The information basis includes statistical databases for the period 1999-2019. As a result of the analysis, it was revealed that for the regions of the Russian Federation it can be considered that there are no convergence processes. When conducting research on industrial regions with different specialization of the industrial complex, it was revealed that convergence processes were periodically observed among agricultural ones, including due to β-convergence, while regions with raw materials and industrial specialization had a pronounced divergence of development.

Keywords. economic growth, regional differentiation, convergence.

1 Introduction

The presence of serious interregional imbalances in development is a threat to the integrity of the country's economy. Therefore, researches aimed at identifying these imbalances are relevant. Due to the nature of economic relations in market conditions between separate territories within the same community (country or intercountry economic region), disintegration processes increase, and interregional disproportionality develops. However, to achieve sustainable development of the country's economy, it is necessary to ensure its integrity. Indicators of socio-economic development and living standard in certain regions of one country should not have significant differences. Otherwise, the disintegration of a single economic system into atomic components is possible. Therefore, one of the main strategic development goals of the Russian Federation is to reduce interregional imbalances. The interregional disproportionality of development is characterized by the deviation of

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indicators that characterize the state of the regional economy from the corresponding average indicators for the country. At the same time, both indicators of the level and quality of life of the population and indicators of the efficiency of economic activity (GRP, labor productivity, tax deductions) are used as characterizing indicators. But when analyzing interregional disproportions, it is more important not just to identify the percentage of deviation of the indicator from the national average, but to determine the dynamics of the ongoing processes. It is important to determine if there is a convergence or divergence of regions. In addition, it is necessary to understand whether convergence occurs due to improved indicators in lagging regions, whether they are approaching the average Russian indicators (positive effect of convergence), or convergence has occurred due to deterioration of indicators in the leading regions, while the situation in lagging regions remains unchanged (negative effect convergence).

2 Literature review

The existence of interregional socio-economic disproportionality is indicated in the basic theories of the regional economy. In the last 20–25 years, the dominant factor of disproportionality in the world has been the processes of globalization, the formation of value chains, technological innovations and their diffusion. Researches aimed at studying the economic disproportionality of development were primarily associated with an analysis of the degree of lag of developing countries from the leading countries, as well as the search for factors to reduce the lag. The theoretical basis for these researches was the theory of convergence, developed at the end of the XX century. The methodological apparatus was based on R. Solow's convergence model. The development of these models in the works of R.J. Barro & X. Sala-i-Martin [1, 2] made it possible to diagnose inter-territorial disparities, as well as their absence, at a certain point in time. At the same time, a distinction is made between σ-convergence, which characterizes the presence of processes of convergence of the studied indicator for a certain sample of territories to the average indicator for the sample, and β-convergence, which characterizes a higher growth rate of the studied indicator in lagging territories, which will eventually lead to the leveling of inter-territorial differences.

A feature of these concepts is their applicability to both the analysis of regional and intercountry convergence. The σ- and β-convergence hypotheses are related but not equivalent. Absolute σ-convergence indicates the presence of convergence of the studied territories in terms of the analyzed indicator, but this convergence can be both due to β-convergence, that is, due to an improvement in indicators in lagging regions / countries, and due to a deterioration in indicators in the leading countries, then is without β-convergence.

The choice of the initial object of research predetermines the choice of the indicator, based on which the analysis of the level of development of the territories is based. The analysis of interregional differentiation can be based on the analysis of the following indicators of the socio-economic development of regions: GRP per capita, average per capita income, the level of wages of the employed population. In this study, we analyze industrial regions, therefore, first of all, we are interested in the level of the economy of the territories. In works [2, 3, 4, 5, 6], conclusions are drawn about the most effective use of the GRP indicator per capita, since if this indicator really has convergence, then this characterizes the movement of the economy towards a steady state.

The research of inequality in economic growth between countries is the subject of an extensive literature on convergence clubs [3]. At the first stage, the work was devoted to the analysis of convergence to stable, both absolute and conditional, considering the differences in the "conditioning" variables [7]. The research further focused on identifying convergence clubs, subgroups of economies or regions with similar initial conditions, investigating factors associated with club formation, for example, human capital, technology, openness, and fixed

capital investments [8, 9]. and consideration of multivariate analysis of factors associated with club formation [10]. Despite significant methodological developments "the primary conclusion of this massive literature has been rejection of the global convergence hypothesis, based on evidence of multi-modality or other measures of polarization" [11]. Researchers note that for a qualitative analysis of the convergence of regional economies, the initial conditions, and the history of the development of regions / countries are important. It was revealed that there is a dependence of the research result on whether the development path of the studied territories is the same [12]. This often leads to exclusion from the range of analyzed territories with different initial conditions [13, 14]. However, the question arises which territories can be excluded from the general sample. Rodrik [15] concluded that there is unconditional convergence in the manufacturing industries. This result requires confirmation in different countries, since the presence of different institutional conditions of management makes its own adjustment to the development of the economy in general and industries in particular. It is also necessary to confirm the presence / absence of convergence in other industries, not just manufacturing.

The main goal of convergence researches at the subterritorial level is to identify the degree of integrity of associations (for example, the countries of the European Union) or the integrity of a country (when analyzing regional economies). Thus, in a modern study [16], covering 28 European Union countries and 11 major OECD economies, the hypothesis of growing spatial differences in Europe has not been confirmed. In [17], convergence at the subterritorial level of Europe is considered, on the basis of spatial models with the control of beta convergence, the relationship is estimated for 247 European regions of NUTS2, for 189 regions of UE15 and 56 regions of CEE, and it is concluded that the convergence processes are multidirectional for different parts of Europe. in particular, there is a lack of convergence in the countries of CEE. This confirms the fact that when a certain level of convergence is identified for the entire sample of a large number of regions, for a specific group of regions formed according to a certain sectoral or territorial characteristic, the convergence processes may differ.

3 Method and Data

The purpose of this research is to study the convergence processes of the industrial regions of the Russian Federation. We exclude regions with different initial conditions and economic structure from the total number of subjects of the Federation.

Analysis is based on the GRP per capita indicator, given in 2019 prices. The information basis includes statistical databases for the period 1999-2019.

After analyzing all 85 regions of Russia, the hypothesis of the absence of absolute convergence was confirmed. The analysis was built on a longer time series, including 2018 and 2019 (in the study, the time range is limited to 2014, in the study - 2010). Figure 1a shows a graph characterizing σ-convergence for all regions of the Russian Federation, which demonstrates an increase in the divergence of regions from the average value.

A hypothesis is formulated that, despite the processes of divergence between regions in Russia as a whole, there is convergence in regional communities formed according to the sectoral principle. The object of this study is the industrial regions of the Russian Federation, that is, the regions in the economic structure of which basic industries occupy a significant share. The grouping of regions by industry was carried out based on cluster analysis by indicators for 2018-2019: 1) the structure of the formation of GRP, 2) the structure of employment, 3) the structure of shipment of finished products. As a result, out of 85 constituent entities of the Russian Federation, 59 regions were included in the further analysis of convergence: 8 regions specializing in extractive industries (Khanty-Mansiysk AO - Yugra, Yamalo-Nenets AO, Kemerovo, Magadan, Sakhalin, Komi Republic, Yakutia,

Chukotka), 19 regions specializing in agricultural sectors (Belgorod, Voronezh, Kostroma, Tambov, Volgograd, Rostov, Stavropol, Orenburg, Penza, Saratov, Omsk, Altai and Altai`s Krai, Adygea, Kalmykia, Mari-El, Mordovia, Krasnodar, Kamchatka), 32 regions with a specialization in the manufacturing industry (Bryansk, Vladimir, Ivanovskaya, Kaluga, Lipetsk, Moscow`s region, Ryazan, Smolensk, Tverskaya, Tula, Yaroslavl, Arkhangelsk, Vologda, Kaliningrad, Leningradskaya, Novgorod, Pskov, Nizhny Novgorod, Samara, Kirov, Ulyanovsk, Kurgan, Sverdlovskaya, Chelyabinsk, Tyumen (without autonomous regions), Perm, Karelia, Bashkortostan, Tatarstan, Udmurtia, Chuvashia, Krasnoyarsk)

The σ-convergence hypothesis is valid if the variance of the indicator for a group of regions decreases over time. The hypothesis of absolute β-convergence is valid in the case of a negative statistical relationship between the growth rate of the indicator and its initial level. To do this, it is necessary to determine the coefficients β_0 and β_1 in the equation:

$$\ln \frac{V_{t1}}{V_{t0}} = \beta_0 + \beta_1 \ln V_{t0}, \tag{1}$$

where V_{t1} is the value of the indicator in the t-th interval; V_{t0} is value of the indicator in the initial period of time.

In the analysis, the entire 20-year period is divided into three-year periods, which made it possible to identify the β-convergence coefficients in periods with different external conditions for the functioning of the regional economies.

4 Results

When analyzing the σ-convergence of the industrial regions of Russia without separating them into separate clubs, we find that an even stronger process of divergence is observed in these regions (Fig. 1a). However, one can single out the period of convergence - 2003-2006, the crisis year 2009. There is also a period of strong acceleration of the divergence of regions - 2010-2011 and 2015-2018.

Table 1. Indicators characterizing σ-convergence
of industrial regions of Russia (1999-2019).

Indicators	Variance growth rate	Growth rate of the ratio of the mean to the median
Total for Russian Federation	275.888	111.493
Total for the sample of industrial regions	684.477	123.111
Regions with a specialization in the manufacturing industry	223.458	96.705
Agricultural regions	213.373	104.723
Extractive industries specialized regions	1131.687	128.601

The selection of branch clubs (Fig. 1 b, c, d) made it possible to reveal that the main role in the growth of the divergence of regions was played by regions with a specialization in raw materials (Fig. 1d). Initially, in 1999, the divergence of these regions was minimal, and they also had the highest growth rate of the variance of the indicator under study (by 11.3 times), as well as the maximum indicator of differences between regions within one group (an increase in the ratio of the average value to the median over 20 years was 28%). The reason is the significant difference in GRP volumes between oil and gas producing regions and regions that produce other raw materials. Comparing graphs 1a and 1d, it can be seen that the
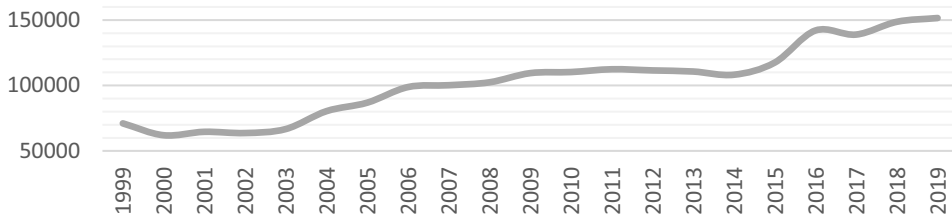
resource regions have the strongest impact on the overall analysis of the convergence of the industrial regions of Russia.
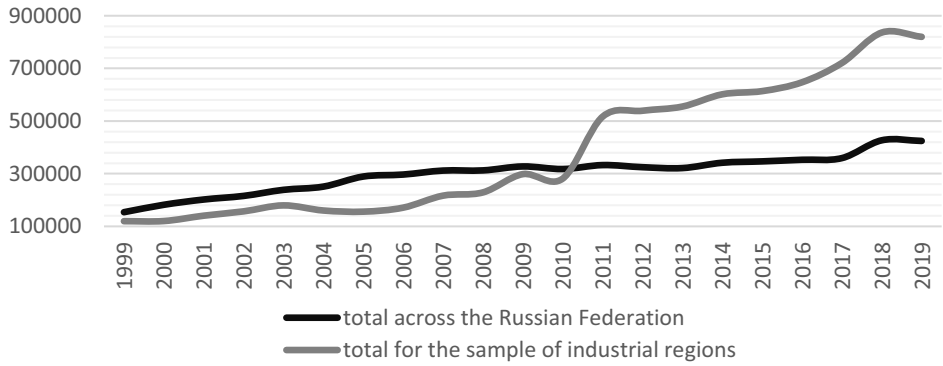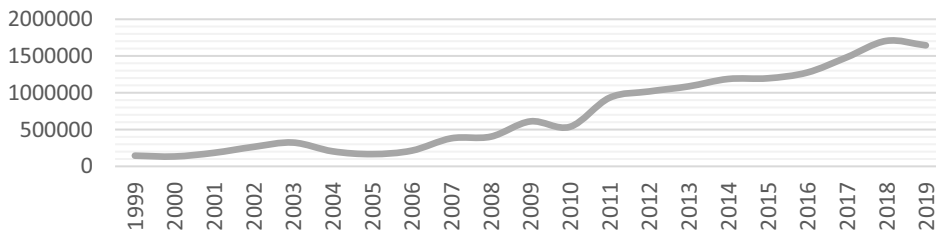

a. Sample from all regions of the Russian Federation and industrial regions
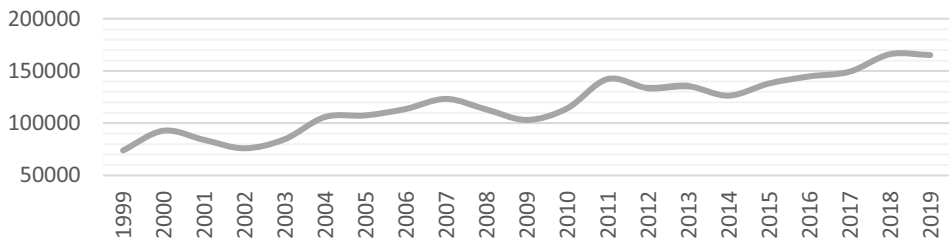
b. Sample from regions with specialization in the manufacturing industry

c. Sample from regions with specialization in agriculture

d. Sample from regions with a specialization in the extractive industry

Fig. 1. Dynamics of the coefficient of variation of the adjusted GRP per capita by regions of the Russian Federation for 1999-2019 (σ-convergence).

Manufacturing regions have the most uneven convergence / divergence trend (Figure 1b). Even though the variance for these regions increased by 2.2 times, the ratio of the average to the median over 20 years decreased by 3.3% for them, that is, these regions can be considered for the presence of convergence processes. The graph shows that special attention in the study should be paid to the following periods of convergence of regions: 2000-2002, 2007-2009, 2011-2013.

Regions with a specialization in agriculture have the smoothest growth trend in the dispersion indicator with the lowest growth rate of 2.1 times over 20 years. In these regions, there was an increase in the ratio of the average value to the median by 4.7%. However, it is impossible to clearly distinguish the periods of convergence of the regions. The period after 2014, when agriculture received a state development program, deserves special attention. Uneven distribution of financing of the state program led to economic growth in a number of regions, which influenced the diverging trend.

Consequently, in the aggregate of regions, there is an unconditional β-convergence if β is a negative and statistically significant value. An analysis of the unconditional β-convergence of industrial regions (Table 2) demonstrates the presence of catching-up development of industrial regions in the pre- and post-crisis years, but the R2 indicator is so small that it is impossible to conclude about the significance of the identified relationships.

Table 2. Estimation results of models of absolute β-convergence.

Indicator	1999-2001	2002-2004	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019
In all industrial regions of Russia							
β_0	0.784 (0.055)	0.265 (0.5757)	0.802 (0.0341)**	-0.219 (0.5807)	0.654 (0.0028)**	0.529 (0.0371)	-0.715 (0.0002)**
β_1	-0.053 (0.11)	-0.011 (0.7747)	-0.048 (0.1063)*	0.017 (0.5724)	-0.047 (0.0050)**	-0.031 (0.1149)	0.058 (0.0001)**
Stand error	0.3996	0.4704	0.3689	0.3932	0.2090	0.2477	0.1568
R^2	0.046	0.002	0.048	0.006	0.130	0.043	0.289
Extractive Industries Specialized Regions							
β_0	0.051 (0.9846)	4.695 (0.082)	-4.567 (0.358)	-1.930 (0.2314)	-1.368 (0.231)	1.129 (0.3345)	-0.951 (0.2429)
β_1	0.008 (0.9681)	-0.349 (0.0860)	0.357 (0.3404)	0.150 (0.2101)	0.096 (0.2365)	-0.073 (0.3789)	0.075 (0.1977)
Stand error	2.4996	2.0323	4.4008	1.3686	1.0261	1.0759	0.7342
R^2	0.000	0.562	0.226	0.357	0.224	0.131	0.259
Regions with a specialization in the manufacturing industry							
β_0	0.659 (0.1865)	-1.365 (0.0681)	1.165 (0.0266)**	1.352 (0.0748)	1.079 (0.022)**	0.429 (0.3071)	-0.334 (0.3125)
β_1	-0.043 (0.2904)	0.121 (0.0458)**	-0.078 (0.0576)*	-0.108 (0.0694)	-0.081 (0.003)**	-0.022 (0.4965)	0.028 (0.2681)
Stand error	0.4870	0.7205	0.4984	0.7316	0.3231	0.4132	0.3253
R^2	0.038	0.131	0.119	0.109	0.259	0.016	0.041
Regions with specialization in agriculture							
β_0	3.166 (0.006)**	-0.705 (0.5703)	1.369 (0.0178)**	0.293 (0.6151)	1.218 (0.0143)**	0.470 (0.6290)	-0.142 (0.755)
β_1	-0.254 (0.0079)**	0.069 (0.5024)	-0.093 (0.0426)**	-0.022 (0.6424)	-0.090 (0.0216)**	-0.027 (0.7197)	0.013 (0.721)
Stand error	1.0085	1.2180	0.5215	0.5725	0.4465	0.9556	0.4476
R^2	0.348	0.027	0.220	0.013	0.274	0.008	0.008

Notes: ** the coefficient is significant at the level 0.05; * the coefficient is significant at the level 0.1.

Regression models for commodity regions show absolute divergence within a given club of regions. In the club of regions with a specialization in the manufacturing industry, one can

distinguish one period - 2011-2013, when after the 2008 crisis and before the imposition of US sanctions, the development of these regions had a certain trend towards convergence for the accelerated growth of less developed regions. In other periods, there is also a lack of such growth. Among agricultural regions, there are 3 periods with accelerated growth of lagging regions: 1999-2001, 2005-2007 and 2011-2013.

5 Conclusion

The analysis of the convergence of the industrial regions of Russia makes allows partially refute the hypothesis of club convergence according to the sectoral principle. The conducted research allows us to confirm that the level of convergence of regions specializing in the manufacturing industry is indeed the highest than in regions specializing in other industries. The revealed differences in the rates of development of the regions make it possible to recommend further research of the factors of convergence in the regions with specialization in the manufacturing industry and in agriculture. The presence of a number of short periods, when both σ- and β-convergence are observed, makes it possible to carry out additional studies more precisely, which would make it possible to identify which external influences the economic regional system reacted by the process of convergence. This will make it possible to more effectively develop new approaches to the management and regulation of the development of the regions.

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