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SPATIAL CONFIGURATION OF GROSS REGIONAL PRODUCT OF RUSSIAN REGIONS: ESTIMATION AND FORECAST

The relation between Russia's macroeconomic growth and its regional components for the period of 1990–2013 is considered in the paper. The goal is to estimate this ratio depending on the phase (stage) of development. The hypothesis is that the increase in regional disparities within the post-Soviet period, picked up by standard measures and noted by many authors, is not connected with the systemic removal of regional indicators from each other. The Russian regional space is considered to have specific forms of convergence-divergence, required to be identified. The dynamics of regional space configuration in Russia is considered from a new point of view – as a distribution of mass (volume) of the gross regional product (GRP) over the growth rates. The estimation and forecast of the structural characteristics of GRP mass distribution are made on the basis of the “distribution dynamics” approach. Using this approach, the forecast of the GRP dynamics and structure until 2025 is made. The average annual growth rate is expected to be around 104,5 % by 2025, while differentiation of growth rates significantly increases. The phase of macroeconomic growth over the last 15 years is reflected on its regional components: GRP growth in Russia in general, both before and after the crisis of 2009, creates a denser distribution than in 2009. The general trend of the 2000s and subsequent years is characterized by a certain decline in the differentiation of GRP per capita relating to the main regional space of Russia (74 regions). The results of this research may be useful for regional regulation policy purposes. A significant part of the Russian regions in 2009–2013, in spite of the dominant trend, provides dynamics not worse than that of the number of countries with a developed market. It seems that there is an urgent need to create a special scientific and practical project to study this phenomenon.

Keywords: spatial configuration, convergence-divergence of regional space, regional differentiation, economic growth, distribution dynamics, coefficient of variation, gross regional product, the Russian regions, forecast of regional growth

Introduction

A considerable literature is devoted to the issues of convergence-divergence (catch-up effect and variance) in regional space as a whole and in Russian regions, in particular, it even has a special name of “the convergence literature” [1–3].

In our opinion, in the world economic literature, there are two contradictory points of view on the relationship between economic growth and spatial differences. Some of the theories are based on the fact that there are no significant barriers for market forces in regional space. In accordance with the market laws, in the case of most important factor mobility, the factor prices in different regions tend to equalize what creates conditions for regional productivity convergence [4, 5].

It is claimed in other concepts that there are no significant reasons (conditions, factors) to form a convergence of regional growth and regional incomes even in the long term. This is due to the fact that market forces, if they are not corrected, result in a cumulative concentration of capital, labor and, consequently, the output in certain regions, other territories getting relatively impoverished (depleted). The main reasons for strengthening some areas and weakening others are scale effects and agglomeration reasons. In other words, the disparate regional development is likely to be self-reproduced (self-sustained) than self-correcting. Compensative forces are not enough to bring the regional system to a new quality – regional convergence. According to these concepts, the vector of economic development is directed exactly towards the divergence.

The justification of possibilities to change the differentiation tendency is described in the works of S. Kuznets and J. Williamson [6].

The emergence of available statistical data on the economic development of many countries over a sufficiently long period of time (for example, see Penn World Table [7]¹) made it possible to conduct

¹ Retrieved from: <http://www.rug.nl/research/ggdc/data/pwt/> (date of access: 05.10.2015).

an empirical analysis of cross-country differentiation and to test the theories of economic growth. It turned out that in the empirical literature on inter-regional and cross-country differentiation, there is no similar notion of the regional differences dynamics, but there is a large variety of the patterns of the regional development of economic area [1, 8–10].

After the beginning of market reforms, an interregional differentiation in Russia was not left without the attention of researchers.² In the literature, in particular, the attention is paid to the fact that "the differentiation process development is due to increasing the distance between the most successful group and the others regions" [11, p. 50]. However, this important fact and the distribution pattern peculiarity in work mentioned above (in other authors' ones too) are not emphasized: first, statistically are not illustrated (not confirmed) and, second, are not considered specifically in the analysis.

Many authors investigated problems of the relation between macroeconomic growth in Russia and its regional proportions, but the specific characteristics of growth, resulting ultimately in some estimates of the spatial regional structure, were studied only in a very limited number of works.

Statement of the Problem

The central question regarding the regional differentiation is the configuration of economic space, how the position of the regions changes to each other over time, which factors (sources) change the integral evaluation of differentiation. It is one thing when in the "range of regions" each subsequent item is markedly different from the previous one, and quite another thing, when in a large number of regions approximately equal in economic power or economic productivity, there are a few abnormally strong or weak. However, these a few regions mainly form an integral estimation of differentiation.

The characteristic of the dynamics of inter-regional differences only as the growth or decline defines some generalized trend of the change of inter-regional relations. However, this characterizing is not quite adequate and does not reflect the whole variety of regional development patterns. Along with generalized characteristics both from the theoretical point of view and to determine the activities of regional policy, of great importance is the differentiation structure taken into account. It is about the nature and patterns of the change of distribution form.

It is important not to follow a priori judgments and incorrect interpretations. The point is that the growth of inter-regional differentiation picked up by standard measures is not necessarily characterized by the systemic remote of regional indicators from each other, other forms of its development are also possible. And these other forms of convergence-divergence over times, which are specific to the Russian regional space including the most recent years, are the subject of the study in this paper.

The study is undertaken using data of 79 regions of the Russian Federation from 1990 to 2013. The data of Russian Federal State Statistics Service on regional GRP both in the constant and current prices is used, as well as GRP estimations from 1990 to 1993, published by N. Miheeva [11].

Stages of Development and the Nature of Regional Differentiation

The quarter-century period of post-Soviet economic development under consideration is clearly divided into three fundamentally different stages. The first of them — an internal system crisis of 1991–1998, accompanied by almost continuous production decrease, in some sense ended in the August 1998 default, the devaluation of the national currency at the same time and the world oil prices increase as well. The second stage of sustainable economic growth is the period of 1999–2008, ended in a sharp drop in world oil prices in the second half of 2008. Finally, the third stage, which began in 2009 and continues until now, is characterized by instability and a significant downward trend of GRP growth rates.³

The characteristics of the macroeconomic growth in the post-Soviet period are shown in Fig. 1.

Our task does not include any further in-depth discussion of the macroeconomic post-Soviet period trend. The above well-known periodization was necessary for us only for the identification of the regional component of economic growth at its different stages.

² Diversified description and analysis of inter-regional differences are presented in the works of V.N. Leksin, A.N. Shvetsov, O.N. Pchelintsev, A.G. Granberg, Yu. M. Zaitseva, N.V. Zubarevich, N.N. Mikheeva, I. Dolinskaya, R.M. Melnikov, V.I. Suslov, S.A. Suspitzin, E.V. Seliverstov, O.V. Kuznetsova, V.V. Klimanov, S. Drobyshevsky, O. Lugovoi, E. Astafyeva, D. Polevaya, A. Kozlovskaya, A. Trunin, L. Lederman et al.

³ The total volume of GRP of Russian regions in the article is referred to as "Russia's GRP" or, in appropriate context, "GRP".

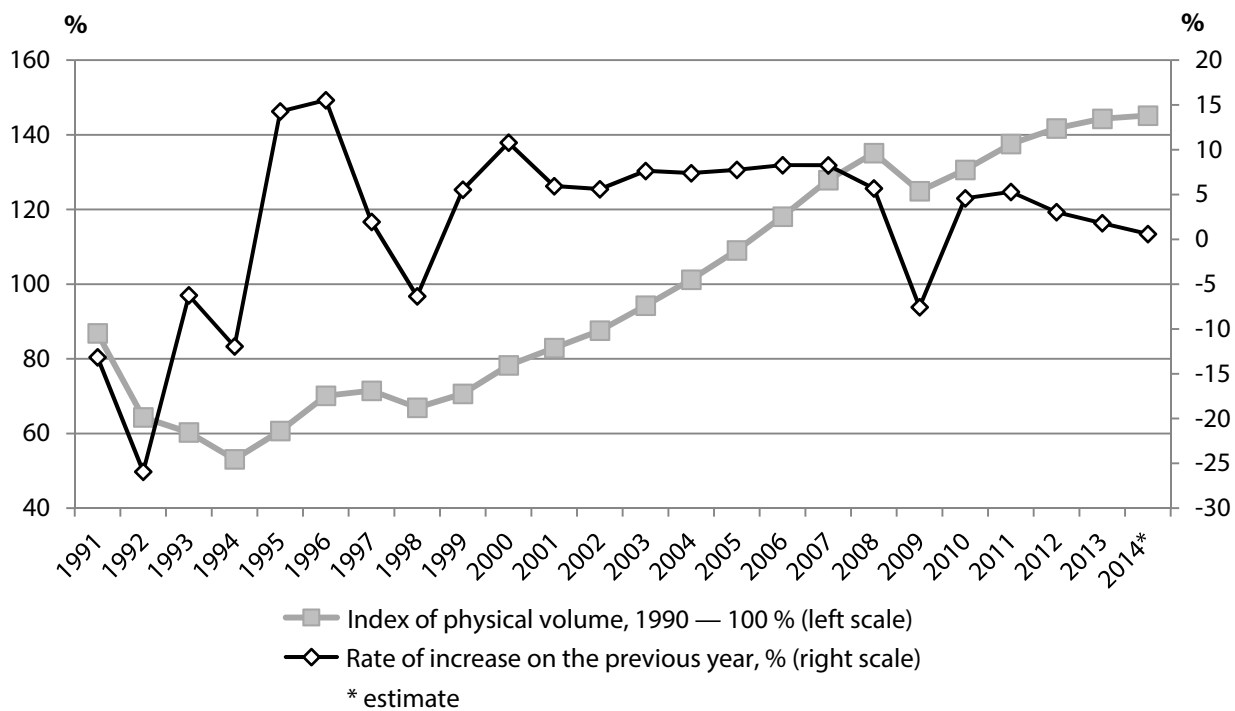


Fig. 1. Characteristics of Russia's GRP dynamics

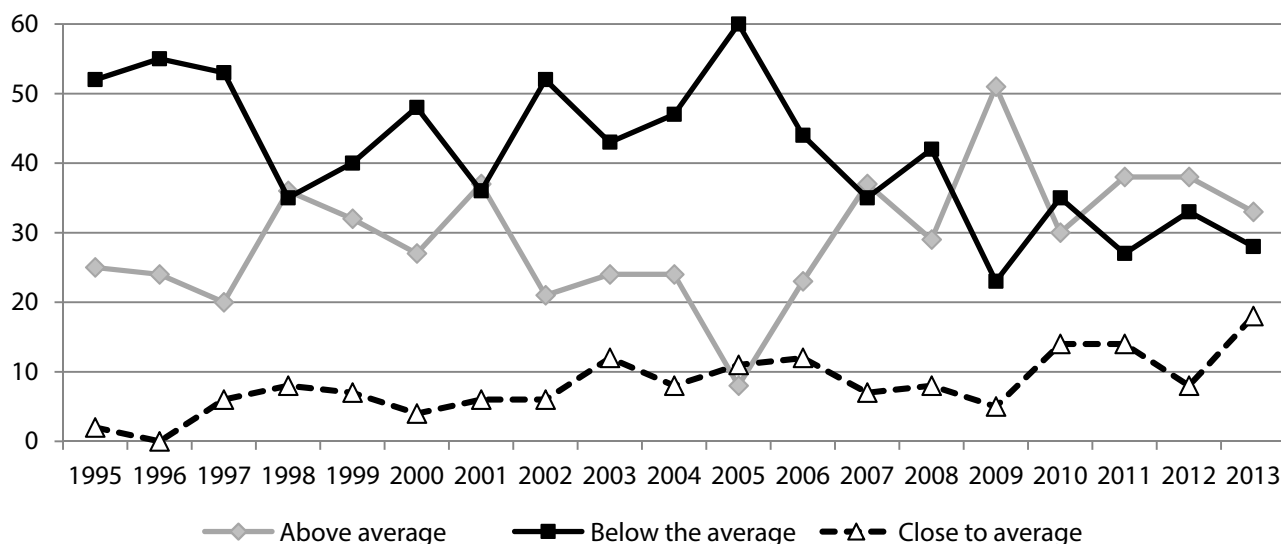


Fig. 2. The number of regions with a different (towards average) growth rate, units

The first thing that distinguishes the stages is the correspondence of the subjects of the Federation with different dynamics (towards national average), as well as a measure of regional growth rate variation. Over most of the period under review, until recent times (2009 exactly), the national average annual dynamics figures reflect slightly the regional picture. This includes a significant differentiation of dynamics by regions. Furthermore, the number of regions with a rate close to the national average (the difference is within $\pm 0,5$ %) is small, usually no more than 10. Usually, more than half the subjects of the Federation has a growth rate below the national average. Only one third and less of regions generally refer to areas of advanced development, having preferential growth rate (Fig. 2).

Though not quite typical, but very striking example related to 2005 can be given as an illustration: 11 regions have a growth rate close to the national average, 60 – below average and only 8 regions – above average. It is important to emphasize that the number of regional leaders (the subjects of the Federation), which set relatively high standards of development, although is relatively small, but still higher than expected (for example, basing on the degree of subsidization of regional budgets).

Characterized by a notable weakening of the dynamics of development at the macro level current situation after 2008 is accompanied by the convergence of regional indicators in contrast to the previous

phases. The coefficient of the variation of annual growth rates over the period of 2010–2013 does not exceed 4 %, while it is more than 5–6 percent over the period of 1991–2003. Thereafter, the number of regions with the high and low (towards average) growth rate equalizes, the number of subjects with an average one grows.

The 1990s crisis overcoming proved to be much more prolonged and difficult for many regions than it follows from the dynamics of macroeconomic indicator. Russia approached its 1990 level of GRP in the middle of the 2000s. By 2005 Russia's GRP increased rapidly, becoming 9,1 % higher than in 1990.

60 (3/4) regions have not yet reached their 1990 level of GRP by 2005. Thus, Russia's GRP increase for the period of 1991–2005, which is equal to about 1,5 trillion rubles, consists of 19 positive values and 60 negative. In this period, Moscow played the decisive role securing economic growth. Moscow's GRP increase turned out to be 30 % larger than GRP increase of the whole country. A major contribution to growth was made by the Tyumen region (79,6 % of Russia's GRP increase), Moscow region (15,5 %), the Republic of Tatarstan (11,5 %), Leningrad region (5,2 %), the Republic of Bashkortostan (4,8 %). Thus due to the capital and the oil and gas regions mainly the country managed to obtain a positive product growth over 15 years.

In the next three years over the period of 2006–2008, none of the 79 regions did not show a negative trend. As a result, such bright distortions in the structure of Russia's GRP increase are no longer observed. For example, the share of Moscow in these three years was 28 %, of the Tyumen region – 6,9 %, etc.

The change of macroeconomic trend on the stage of 2009–2013 due to the exhaustion of the potential sources of foreign economic development suggests a need to switch to domestic investment and innovative development factors mainly, sectorial and regional structural changes. In this connection, it may be important to identify areas that, contrary to the dominant tendencies, could provide today's tangible dynamics.

Table 1 presents the Russian regions with more than 4 % average annual rate of GRP growth for the period of 2009–2013. There are 10 such regions from different federal districts. Not all of them can be referred to as the territories determining macroeconomic dynamics.

Table 1

The dynamics of the rapidly developing regions for period of 2009–2013

Region	The average annual rate of increase, %		The rate of increase per year, %				
	1999–2008	2009–2013	2009	2010	2011	2012	2013
Russia, total	7,3	1,3	-7,6	4,6	5,3	3,0	1,8
Belgorod region	8,8	6,1	1,5	9,8	11,0	5,5	3,0
Kaluga region	7,3	4,4	-6,4	10,1	12,9	9,6	-2,8
Tambov Region	7,5	5,3	-0,4	-3,0	12,8	8,9	9,2
Republic of Adygea	7,1	4,9	6,1	4,4	5,6	5,9	2,7
Astrakhan region	7,3	4,9	-10,6	2,1	7,8	11,3	16,2
The Republic of Dagestan	12,9	6,3	8,9	3,6	8,0	4,6	6,3
The Republic of Ingushetia	4,6	5,2	-12,1	1,9	9,4	15,3	14,2
Mari El Republic	4,4	4,6	0,0	5,6	6,0	9,8	1,9
Irkutsk region	5,4	4,5	0,1	6,8	4,5	9,4	2,0
Sakhalin region	9,7	4,3	10,9	8,0	4,3	-2,5	1,4

Source: Calculated by the authors basing on the data of Russian Federal State Statistics Service.

There is quite a large group of the subjects of the Russian Federation (14) with an average annual rate from 3 % to 4 %, including the Leningrad region, Krasnodar Territory, the Republic of Bashkortostan, Sverdlovsk region, Krasnoyarsk Territory. So, in 2010–2013, about the third part of Russian regions provide the dynamics at least equal to the worldwide average.

The Spatial Growth of the Gross Product – A New Sight

The dynamics of the entire mass of national economy's gross product is defined by regional growth rates as well as by indicators of region's relative economic strength. In this regard, the question of the structural characteristics of the change in gross product of the Russian regions can be put forward in

a new way. The distribution of the regions over growth rates is usually (traditionally) considered in the literature. A feature of the proposed approach is the distribution of gross product mass (volume) considered over growth rates. In this case, the economic power difference between regions is also taken into account.

To illustrate approach we only compare the distribution built in the traditional way with one distribution of GRP-mass (volume), for example, in 2002 (Fig. 3).

As can be seen, the distribution of mass is more right shifted than the distribution of regions. The growth rate is higher than average (about 109 %) demonstrated by a significant GRP share (more than 1/5), which belongs to only 5 of 79 regions (right highest peak).

Since the beginning of the 2000s from period to period the nature of structural dynamics differs significantly (Fig. 4).

In the period of 2001–2008, the vast majority of the value added was growing at a rate of from 103 to 110 %. A quarter of the gross regional product of the country (right peak) was growing at a rate of

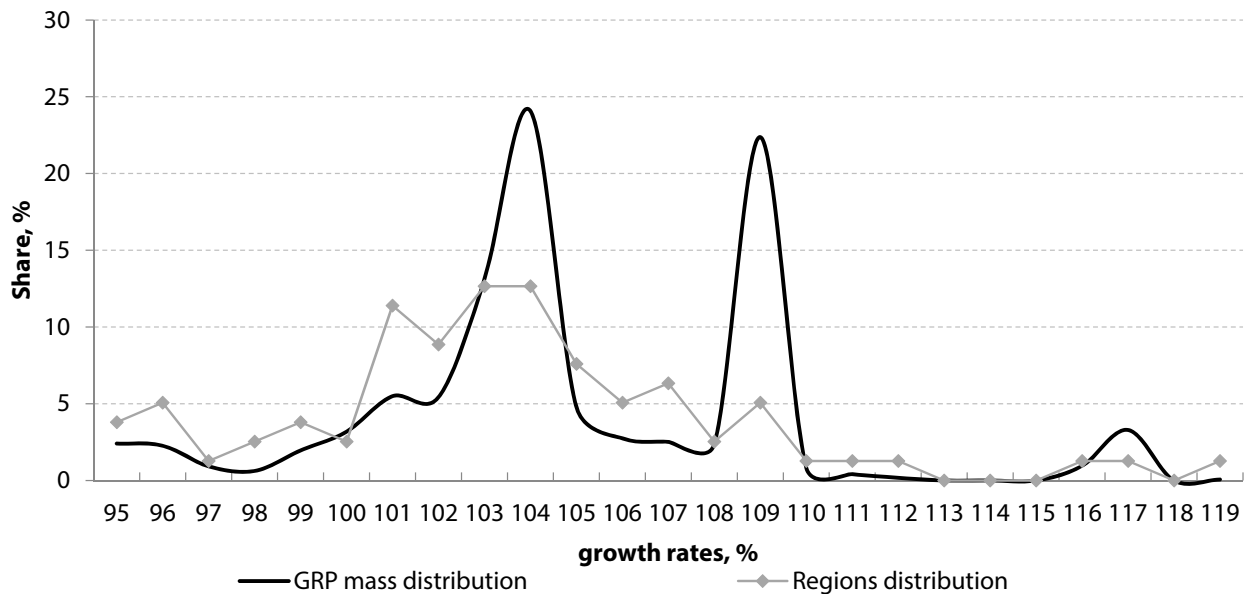


Fig. 3. Distribution of the regions and GRP mass (volume) over growth rates in 2002

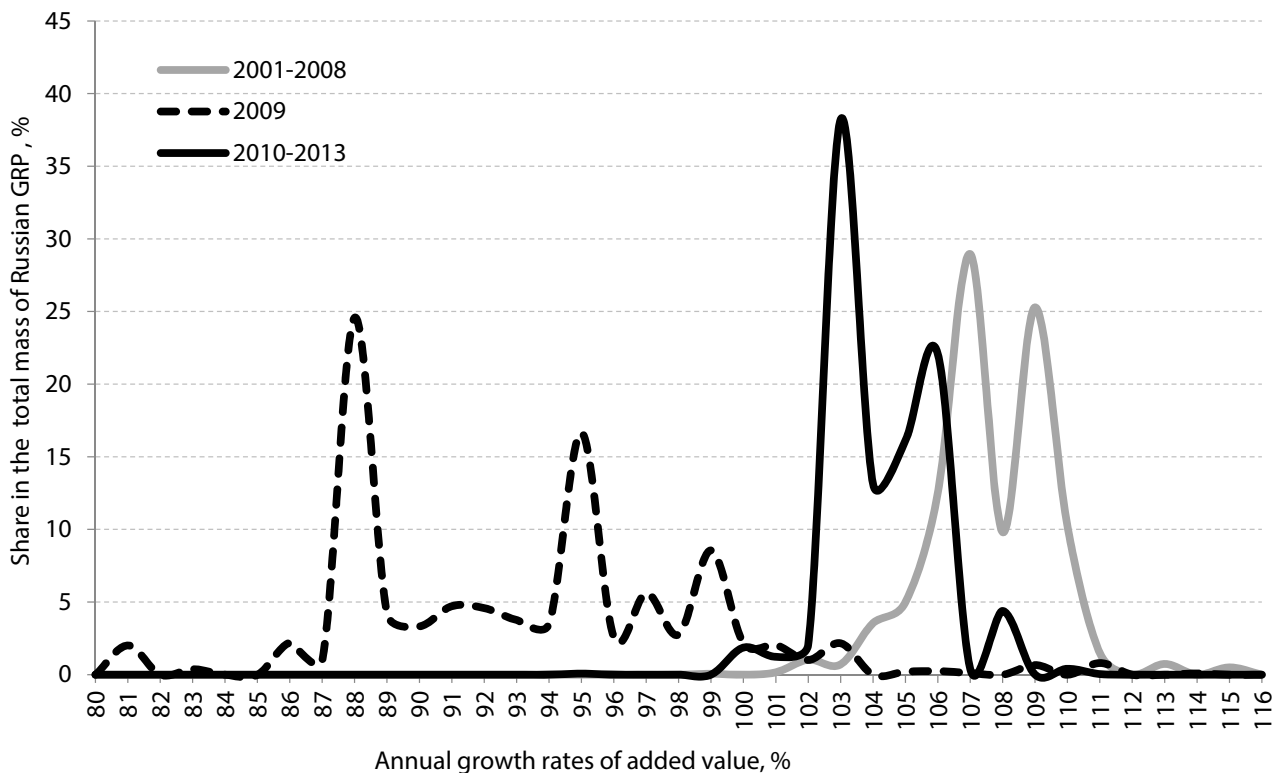


Fig. 4. The distribution of GRP mass over growth rates and periods

from 108 % to 109 % (this part of the product was given by 5 regions: Arkhangelsk, Kaluga, Novosibirsk regions, the Jewish Autonomous Region and Moscow), 29 % of GRP (left peak) was growing at a rate of from 106–107 % (it is 21 regions, including the Tyumen region).

In the 2009 crisis year, almost the entire mass of the GRP was shifted to the area of negative growth: 90 % of value added was stretched in a range of growth from 85 to 100 %. 15 regions had positive increase, but their share in the product of the country was only 7,6 %.

In the period of 2010–2013, the vast majority of the product was distributed in the range of 102–108 % of average annual growth rates. The main "investors" into Russia's product – Moscow and the Tyumen region – were growing at a rate of 102 % and 102,8 %, respectively, which were in total 33 % of the product. Together with other "contributors" it corresponds to the first (left) peak on the distribution density – 38 % (Fig/ 4).

The second density peak corresponded to 22 % of GRP mass formed by 17 regions with growth rate of 105–106 %. The largest of them – the Moscow region, Krasnodar Territory, the Republic of Bashkortostan, the Nizhny Novgorod and Samara regions, the Krasnoyarsk Territory and the Irkutsk region – together provided 16,8 % of the product.

The generalized characteristics of the product mass distribution in terms of growth rates are given below (Table 2).

Table 2

Generalized characteristics of the product mass distribution over the periods*

Period	The average growth rate of the product	The standard deviation of the product growth rate	The proportion of product mass in the corresponding growth intervals,%		
			<100	[100; 107]	>107
2001–2008	107,1	1,9	0,1	22,9	77,0
2009	92,7	5,4	92,7	5,7	1,7
2010–2013	103,8	1,7	1,9	92,8	5,2

Source: Calculated by the authors basing on data of Russian Federal State Statistics Service.

* All the characteristics of the distribution are calculated in this table according to the empirical distribution of frequencies.

It is evident that the crisis leads to a large differentiation of total product mass over growth rates: the average decrease of rates by 14,4 %, the standard deviation increases more than twice. Growth after 2009, vice versa, creates a denser distribution with an average growth rate still 3,3 % below pre-crisis one.

Processes of Convergence-Divergence

To make a more detailed estimation and prediction of regional differentiation we used GDP per capita. As can be seen in Fig. 5, any significant strengthening of differences in regional productivity in 2000–2013 is not observed.

Excluding the five leading regions (Moscow, Tyumen region, Yakutia, Sakhalin and Chukotka), whose average GRP per capita being significantly different from the average, makes a significant imbalance in the general indicator of variation [12], the differentiation even falls. For the period of 2000–2013, the average rate of decline was 1,8 % per year. The evaluation of convergence rate (differentiation decrease) over selected periods is shown in Table 3.

Table 3

The average rate of decrease of GRP per capita differentiation (74 regions)

Period	% per year
2001–2008	2,6
2009	-0,4
2010–2013	1

Source: Calculated by the authors basing on data of Russian Federal State Statistics Service.

Thus, the main regional space (74 regions) of Russia did not show a significantly increasing differentiation on the stage of growth [12, 13]. Even with a significant drop in production in 2009, the increase of the coefficient of variation observed is very small (0,4 %). Talking about main regional space of Russia the general trend of the 2000s and subsequent years is characterized by a certain decline in the regional differentiation of GRP per capita.

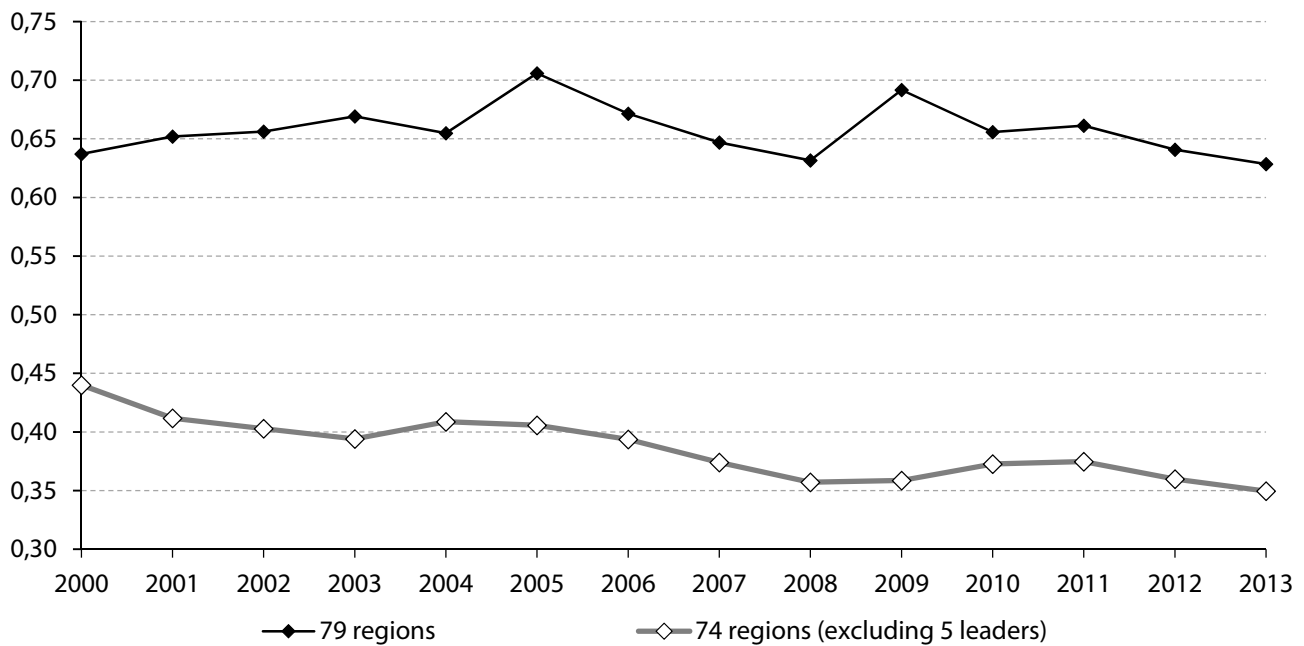


Fig. 5. The coefficient of variation of GDP per capita (in current prices)

Generalized differentiation characteristics need to be clarified. It is the differentiation structure and logic of its changes that provide an opportunity to understand the current processes better and to make the forecast.

The estimation and forecast of the structural characteristics of regional productivity distribution are based on the distribution dynamics approach. It is proposed by D. Quah's and S. Durlauf [14, 15] and is connected to the modeling of changes in indicator distribution over time. We have slightly modified the approach for the application to the distribution of gross product mass of the Russian regions over growth rates, maintaining its features and advantages.

In the dynamics, some regions increase growth rates, the others reduce, thus the configuration of growth changes, the distribution of the total mass of Russia's GRP over growth rates varies. Distribution varies significantly, if the growth rates of large regions or a large number of small GRP regions significantly change. For example, consider how the GRP mass distribution over growth rates in 2002 (already shown in Fig. 3) has evolved from the distribution in 2001 (Fig. 6).

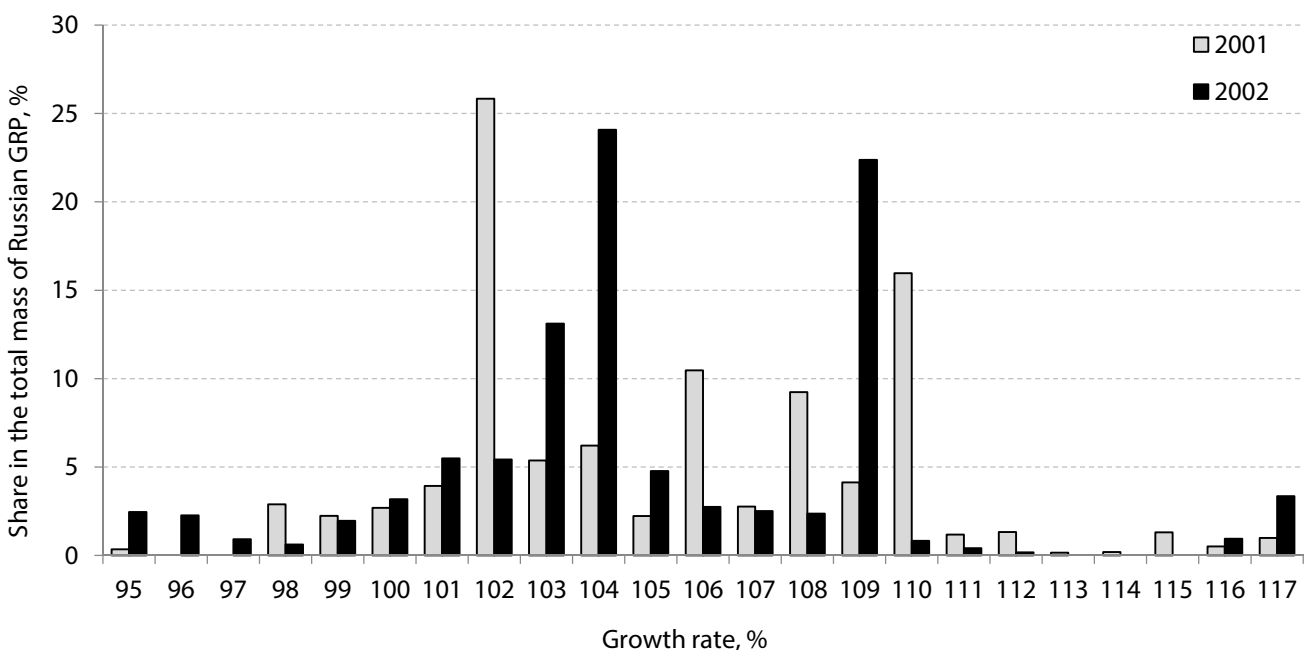


Fig. 6. Distribution of GRP mass over growth rates in 2001 and 2002

Only four regions (the Kirov and Kurgan regions, Buryatia and Chukotka) kept the same growth intervals in 2002 that were in the previous year, have not changed their relative positions. Other regions removed their GRP shares into other growth intervals. The largest movement touched Moscow and the Tyumen region. Moscow grew at the rate of 103 % in 2001 and 110 % in 2002, in other words, the capital shifted 21 % of Russia's GRP 7 intervals forward, while the Tyumen region, on the contrary, its 12 % of Russia's GRP dropped by 6 intervals down. It is shown up on the graph in the corresponding peaks. Other regions have also shifted between the intervals, "moving" a further 2/3 of Russia's GRP.

Writing down all such transfers for each year in the so-called transition matrix, we can clearly see the dynamics of changes of the GRP mass distribution from one year to the next.

A fragment of the transition matrix, estimated for the period of 2001–2002, is shown in Table 4.

Table 4

A fragment of the transition matrix

Transition matrix		2002					
		(99; 100]	(100; 101]	(101; 102]	(102; 103]	(103; 104]	(104; 105]
2001	(99; 100]	0,5 %	0	0	0	0	1,1 %
	(100; 101]	0	0	0,9 %	0,3 %	0	1,4 %
	(101; 102]	0	1,1 %	0,3 %	1,4 %	0	0
	(102; 103]	0	0	2,1 %	0	1,4 %	0
	(103; 104]	0	2,1 %	0	0,7 %	0	0
	(104; 105]	0,5 %	0	0	0	1,7 %	0

Source: Calculated by the authors basing on data of Russian Federal State Statistics Service

The matrix element shows what distribution share (of GRP mass) for the period of 2001–2002 moved from the interval corresponding to the row to the interval corresponding to the column. For example, according to data of Russian Federal State Statistics Service, Vologda and Kostroma regions increased growth rates from 101,5 % to 102,1 % and from 101,9 % to 102,5 % in 2001–2002, respectively. These two regions provided that time 1,4 % of Russia's GRP, which having shifted from growth interval (101; 102] in 2001 to the growth interval (102; 103] in 2002.

All the matrix elements are built in the same way. Row sum in the complete matrix gave the column of GRP mass distribution in 2001, and column sum gave the distribution row in 2002. Thus, the matrix provides an opportunity to estimate the density of joint distribution, to model the distribution change from year to year.

Formally mentioned movements are recorded as follows. Let fix growth intervals. In our case it is a set of intervals [80; 81], (81; 82], ..., (116;.. 117]. Suppose g_t to be a vector of GRP mass distribution over these intervals in year t . The matrix of transition from year t to year $t + 1$, we discussed above, we denote W_t . Normalization of transition matrix is written as follows:

$$m_{ij}^t = w_{ij}^t / g_i^t, \quad (1)$$

where g_i^t is i -th element of the vector g_t , w_{ij}^t is matrix element w_t in the i -th row and j -th column, m_{ij}^t is the corresponding element of the normalized transition matrix M_t . The sum of elements in any row of the matrix M_t is equal to one.

Then the distribution in the year $t + 1$ can be written as follows:

$$g_{t+1} = M_t' \cdot g_t, \quad (2)$$

where M_t is normalized matrix of transitions, sign ' denotes transposition.

Estimation of the average normalized matrix of transitions for the period (1 to t), \bar{M} , is obtained as the average of the matrixes on an annual basis:

$$\bar{m}_{ij} = \frac{\sum_{\tau=1}^t w_{ij}^{\tau}}{\sum_{\tau=1}^t g_i^{\tau}}, \quad (3)$$

where \bar{m}_{ij} is the corresponding element of the matrix \bar{M} . For this matrix the relation is valid:

$$g_t = (\bar{M}')^t \cdot g_0. \quad (4)$$

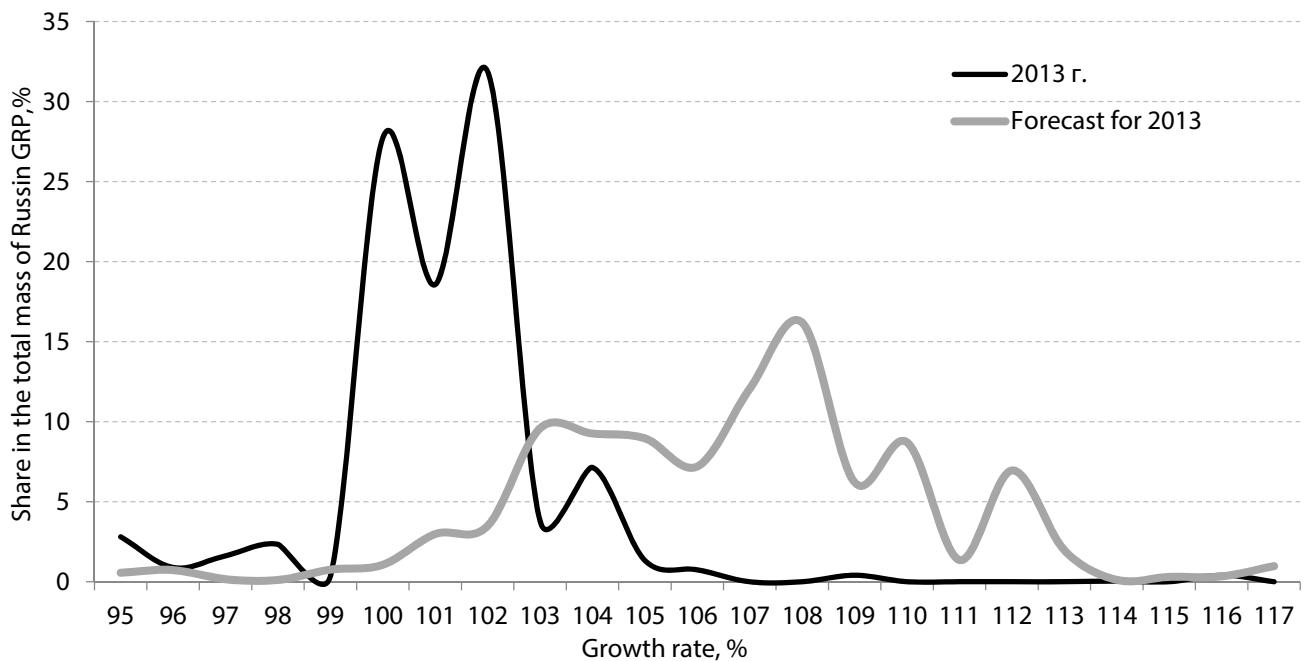


Fig. 7. Distribution of GRP mass over growth rates in 2013: the actual and predicted (based on the period of 2001–2008)
 Distribution of GRP mass over growth rates in 2013: the actual and predicted (based on the period of 2001–2008)

On the basis of the average matrix of transition the prediction of the distribution of GRP mass for any year ahead can be obtained, if the trends of spatial growth, recorded in the given period, stay the same.

For example, we assume the pattern of GRP mass redistribution over the period from 1 to T as a whole to stay the same, the prediction of GRP mass distribution τ steps forward is as follows:

$$g_{T+\tau} = (\bar{M}')^\tau \cdot g_T. \quad (5)$$

Two prediction calculations to be introduced:

1. Prediction for 2013 (based on the period of 2001–2008) and the actual distribution (Fig. 7).

The graph shows how lower (worse) the actual growth rates are than those could be if economic conditions of 2001–2008 stood the same. A significant GRP mass in 2013 grows at around 100–103 %, while it might grow at within 103–110 %, according to our estimate (under the assumption that the processes of change in the spatial configuration of the beginning of the 2000s remain unchanged).



Fig. 8. The GRP mass distribution for 2013 and forecast for 2025

The middle of the observed distribution is 5–6 % less. All of this is a consequence of macro-economic conditions of 2009–2013.

2. The forecast for 2025 on the basis of the period of 2001–2013 (Fig. 8).

The forecast for 2025 gives fairly modest estimates of GRP mass growth. Although approximately ¾ of regional product mass grows at a rate of from 100 to 109 %, high differentiation of growth rates still remains. A comparison of the main predictive and observed characteristics of growth of the regional mass of GRP is presented in Table 5.

Table 5

Generalized characteristics of the product mass distribution over periods and forecast *

Period	The average growth rate of the product	The standard deviation of the product growth rate	The proportion of product mass in the corresponding growth intervals,%		
			<100	[100; 107]	>107
2001–2008	107,1	1,9	0,1	22,9	77,0
2009	92,7	5,4	92,7	5,7	1,7
2010–2013	103,8	1,7	1,9	92,8	5,2
2013	101,6	2,3	8,0	91,1	0,9
2025 forecast	104,5	5,3	11,2	53,9	34,8

Source: Calculated by the authors basing on data of Russian Federal State Statistics Service.

* All characteristics are calculated by the empirical distribution of GRP mass.

Average growth by 2025 is predicted to be at around 104,5 % per year, 2,6 percentage points less than in 2001–2008, but 2,9 % higher than in 2013. In addition, the differentiation of the growth rates increases more than twice; more than 1/3 of the GRP mass is expected to grow at the rate over 107 %.

Coming into play is the situation prevailing in 2009 and subsequent years. However, the economic growth potential in the early and middle of the 2000s is turned out to be so strong that the situation in recent years, rather holding back, still cannot substantially reverse the positive changes in the spatial configuration of the long run.

Conclusions

The following can be noted as conclusions.

The ratio of macroeconomic growth and its regional components during the last 15 years varies depending on the phase of development. The crisis of 2009 leads to the increased differentiation of GRP mass over growth rates. The GRP growth in Russia in general, both before and after 2009, by contrast, creates a denser distribution, enables regional indicators of dynamics to converge.

The major regional space of Russia (74 regions) on the stage of growth does not show a significantly increased differentiation of GRP per capita. Its certain decline characterizes the general trend of the 2000s and subsequent years. Only in 2009, with a significant drop in production a slight increase of the coefficient of variation is observed.

According to the forecast, a 2,9 % increase of the average growth rate of Russia's GRP compared to 2013 is expected by 2025, differentiation of growth rates growing.

A significant part of the Russian regions in 2009–2013, in spite of the dominant trend, provides dynamics not worse than worldwide average and some of the countries with a developed market. It seems that there is an urgent need for the formation of a special scientific and practical project related to the study of this phenomenon. Its value may be much higher than that of similar projects of 1990s, performed in the framework of the TACIS program⁴.

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