REGIONAL SPECIALIZATION AND GEOGRAPHICAL CONCENTRATION OF INDUSTRY IN RUSSIA

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Abstract
The goal of the research is to analyze spatial economic dynamics by evaluating specialization of the Russian regions and concentration of production in our country. In this article the theoretical basis of the scientific problem is represented for this purpose, the methodical evaluation tools are shaped, the manufacturing industry concentration and specialization of the Russia regions are analyzed. Concentration was estimated as the dynamics of Herfindahl-Hirschman index on the industrial output, capital stock investments, the employment and GDP of regions, the dynamics of Gini index and Krugman concentration index by 12 subsectors of the processing industry. The production concentration which depends on the degree of manifestation of scale effect was analyzed by 97 industrial groups, and indexes CR3 and CR4 were calculated. The regional specialization of Russian industry was estimated through the dynamics of Krugman specialization index. The groups of the most and least specialized regions were defined, where the additional analysis was made.
Keywords: New Economic Geography, industrial concentration, Russian regions
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1. Introduction.

Inequality of Russian regions in terms of social and economic development in recent years has a tendency to strengthening. For example, the Gini index for the GRP in 1995 was 0.517, in 2000 – 0.594, reached its maximum value in 2007 – 0.628 - and in 2012 amounted to 0.612 (authors' calculations). If we analyze the Gini index in terms of employment, in 1995 the figure was 0.422, in 2000 – 0.425 in 2005 – 0.439 and peaked in 2012 – 0.449 (authors' calculations). Increasing differentiation of regions of Russia is largely due to intense competition for limited resources. 24.14% of the labour resources of the country are concentrated in five regions (in 2002 the share of these same regions in total employment was 22.14% - authors' calculations). In the five regions - the leader in terms of attracting foreign direct investment in 2012 was concentrated 48.45% of such investments (for comparison, in 2002, the top five in terms of regions was concentrated 74.77% of direct foreign investment - the authors' calculations). Thus, we can suppose a high concentration of resources and economic activities in some selected regions of the country.

Growth of differentiation of regions in terms of social and economic development requires effective policy, which should be formed as a basis of the results of empirical research using economic-mathematical methods and theoretical positions of the leading world scientific schools. The aim of our study is to analyze the spatial economic dynamics by evaluating specialization of Russian regions and concentration of production in the country, as well as analysis of factors of such concentration.

We formulate the main hypotheses of the study. Hypothesis 1: selected centres where economic activities are formed historically; during the analyzed period and in the future there are preconditions to their economic leadership. Hypothesis 2: the global economic crisis has affected the concentration of economic activities in the Russian regions insignificantly and, to a greater extent, in the direction of dispersion.

2. Theoretical background and bibliography.

Issues of specialization and concentration of spatial economy were considered in three scientific courses: neoclassical theory, new trade theory and New Economic Geography. Let us consider some of the approaches to the study of regional specialization and geographical concentration in economics (table 1).

Table 1. Basic economics approaches deals with spatial economics specialization and concentration

	Neoclassical theory	New trade theory	New Economical Geography
Main references	Ricardo, Heckscher, Ohlin (1933), Balassa (1964, 1985), Samuelson (1948, 1964)	Krugman (1980), Helpman & Krugman (1985), Grubel & Lloyd (1975), Brülhart & Torstensson (1998)	Krugman (1991a, 1991b, 1992, 1993, 1994), Venables (1996), Krugman & Venables (1996), Puga (1999), Head & Mayer (2004), Fujita & Thisse (2002)
Type of market competition	Perfect competition in all markets	Monopolistic competition	Monopolistic competition in industrial markets
Other admissions	Constant economies of scale, homogeneous products, full rent for the owners of factors of production, growth through capital accumulation, intra-branch trade	New: intra-and interbranch trade (globalization and integration), the aggregated economies of scale due to external effects of localization, endogenous size of the market	New: the existence of transport costs (costs of shipping, transaction facilities, trading costs, non-tariff barriers), internal economies of scale, good's differentiation, direct and reverse connections
The determinants of placement	Provision of natural resources or factors of production, the differences in technological development	The level of the growing production return, the degree of substitutability of dissimilar goods	The level of transport costs, financial externalities (labour market, input-output connection, demand, stimulating migration), the tension between centrifugal and centripetal forces, technological externalities in some models.
Effect on welfare from trade liberalization	Net welfare gain, owners of factors of production lose	Net welfare gain, large countries benefit more than smaller ones, possibility of winning for the owners of factors of production	Net welfare gain, U-shaped relation in real wages of two regions at the time of the reducing of transport costs, the interconnection "core-periphery" can be destroyed in the middle or final stage of integration

Source[20]

The factors that explain regional specialization of production can be divided into two groups: primary (physical geography and natural resources) and secondary (geographical distance between economical agents) [18]. The neoclassical theory emphasizes on the role of primary factors. Economical activity is concentrated in the regions in accordance with the presence of production factors, natural resources and technologies. These types of economy specialize in manufacturing products based on their comparative advantages (Ricardo) or availability of production factors (*Heckscher-Ohlin*). However, the growth theory predicts a lesser specialization in the long-term period due to tendency of narrowing the profits via alignment of the factor productivity. The postulates of economic theory in this sphere became significantly more complicated in 1980s, when the model of monopolistic competition was applied to the theory of trade and economic geography.

The new theory of trade unites such primary factors of regional specialization as market size (size of work force in the country), if the immobility of labour is suggested; and the secondary factor is the geographical distance between economical agents. If the trade expenses decrease, the industry aims to concentrate in the region with the high market potential ("core") in order to realize manufactured goods to other regions in the future ("periphery"). The new trade theory, where at construction of models the externals from the technological development and human capital are taken into account, explains the specialization by the self-intensifying effects from the externals. In these models the trade integration leads to exchange of knowledge and technologies.

The New Economic Geography evaluates the allocation of production based on the ratio of two powers: agglomeration ones (such as the scale effect and direct and reverse connections) and de-agglomeration ones (such as trade expenses and difference in prices for the production factors) [8]. The differences in the interregional demand are considered as endogenous [5]. If there is a growing return and trade expenses the companies and workers are trying to concentrate in the vicinity of major markets. In its turn, the major market is the market on which a large number of companies and workers operate [7, 13]. The New Economic Geography models the agglomeration processes based upon the interregional mobility of the workforce [11] and the mobility of the companies having demand for the intermediate goods [19].

The absolute and relative concentration should be discerned. The sector of industry is absolutely concentrated, if several countries regardless of their sizes have large enough shares in the total amount of the given production [12]. The sector of industry is relatively concentrated, if any one type of activity differs from those that are averagely widespread within the amount of production in the countries. The neoclassical theory usually deals with the relative concentration, the New Economic Geography deals with the absolute concentration, the new trade theory considers both types mentioned above [10]. In table 2 we can see factors of regional specialization and geographical concentration in economics.

Table 2. Factors of regional specialization and geographical concentration in economics

Factors of spatial concentration	Reference
Regions will specialise in areas in which they have a comparative advantage	Traditional trade theory
Depending on the level of trade costs, economic activities will either cluster or disperse	Newer trade theories
Access to raw materials or more generally industries (extractive industries), historically from the industrial revolution (traditional industries (textile and leather), knowledge spillovers (high technology industries).	[9]
Increasing regional integration may lead export-oriented industries to locate at greater distance from each other in order to enjoy benefits from locations with lower factor costs	[6]
Primate cities and ports, historical legacy, physical geography	[15]
FDI acts as a centrifugal force for technology-intensive industries while it operates as a centripetal force on labour-intensive ones. It is due to the different nature of investments in these two distinct groupings. Technology-intensive industries have been more	[1]

Factors of spatial concentration	Reference
geographically concentrated compared to the non-technology intensive ones.	
Geographic clustering is most prevalent in the mining sector, less so, but still significant, in the agriculture and manufacturing industries, and not very evident in the services sector. Manufacturing industries that are intensively involved in international trade, either as importers or as exporters, are significantly more geographically concentrated than manufacturing industries with less involvement in trade.	[14]

3. Methodology and Data.

Prior to starting the analysis let us introduce the main notions. The concentration is defined in relation to the kind of economic activities, a sector, a subsector, a production group and so on and means the degree of concentration or sparseness of industrial production within the specific territory. Specialization is considered in relation to the region, namely, its occupational structure, and reveals the situation, when some kinds of production in the region dominate, or the production equals to diversification.

To analyze the concentration of industrial production we are going to use Herfindahl-Hirschman index, Gini index, Krugman and CR_3 and CR_4 concentration indices. The regional specialization will be evaluated by calculation of Krugman index (table 3).

Table 3. Methodological tools for assessment of the geographic concentration and regional industry specialization

Index	Calculation	Notation conventions
	Evaluation indicators of the geographic concentration	
Herfindahl–Hirschman Index of industrial concentration (HHI)	$$HHI = \sum_{i=1}^{n} x_i^2$$	x_i - share of region i in total population size
Gini coefficient (G)	$$G = 1 - 2\sum_{i=1}^{k} dx_i dy_i^n + \sum_{i=1}^{k} dx_i dy_i$$	dx_i – share of group i in total population size; dy_i - share of group i in total feature size; dy_i^n - accumulated share of group i in total feature size.
Krugman Concentration index $CONC_i$	$$CONC_i = \sum_j \left| s^C_{ij} - s_j \right|$$ где $$s^C_{ij} = \frac{E_{ij}}{E_i} = \frac{E_{ij}}{\sum_j E_{ij}},$$ $$s_j = \frac{E_j}{E} = \frac{\sum_i E_{ij}}{\sum_i \sum_j E_{ij}}$$	E - the number of employed in the economy; s^C_{ij} - the share of employed in the industrial sector in the region j in the total number of employed in the industrial sector in the country i; s_j - the share of total employed in the economy in the region i among the employed in the economy; i - the industrial sector; j - region.
Concentration index CR_3	$$CR_{3i} = \sum_{j=1}^{3} s_{ij}$$	i – the industrial sector; j – region (one of three or four) with the highest

Index	Calculation	Notation conventions
Evaluation indicators of the geographic concentration		
Concentration index CR_4	$$CR_{3i} = \sum_{j=1}^{4} s_{ij}$$	share of employed in the sector i; s_{ij} – the share of employed in the region j in the total number of employed in the sector i.
Evaluation indicators of regional specialization		
Krugman specialization index ($SPEC_j$)	$$SPEC_j = \sum_i \left| s^S_{ij} - s_i \right|$$ где $$s^S_{ij} = \frac{E_{ij}}{E_j} = \frac{E_{ij}}{\sum_i E_{ij}},$$ $$s_i = \frac{E_j}{E} = \frac{\sum_j E_{ij}}{\sum_i \sum_j E_{ij}}$$	E – the number of employed in the economy; s^S_{ij} - - the share of employed in the industrial sector in the region j in the total number of employed in the industrial sector in the country i; s_j - the share of employed in the industrial sector i in the total number of employed in the country's economy i - the industrial sector; j - region.

Source: Amity 1998; Traistaru, Nijkamp, Resmini 2002; Wandel 2009

4. Results and Discussion.

For calculation of Herfindahl-Hirschman index as initial indicators, which will be used for evaluation of concentration, let us define the volume of industrial production, amount of capital stock investments, the employment (number of workers) and GDP of regions (fig. 1).
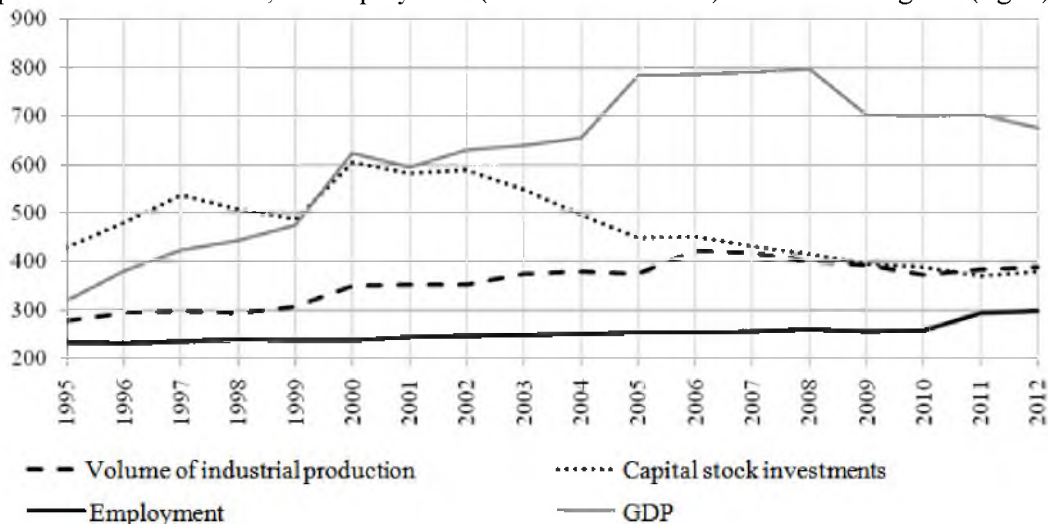

Fig. 1 Dynamics of Herfindahl-Hirschman index calculated by volume of industrial production, amount of capital stock investments and number of employed ones in economy in 1990 – 2012

The concentration of industrial production by output volume and number of workers is stably increasing, while the capital stock investments become more diversified. GDP is increasing to 2008 and then it becomes more diversified.

Gini index, calculated for the analyzed period (by the number of workers in the industrial production), shows the growth of concentration up to 2008 (from 48.18% to 50.29%) and further stable decrease to 48.95%. In our opinion, this proves that the crisis phenomena enhance the production diversification among the Russian regions.

The Krugman index provides evaluation of concentration by certain types of the processing industry. Concentration in certain sectors can be discussed, when the significant part of production is realized in a small number of regions. The higher is the index, the higher is the level of concentration in the given sector of industry [20].

Then we will try to answer the following questions. How are the Russian regions specialized or diversified? What changes in the regional specialization took place during the period analyzed? Is there a connection between specialization of the region and economic efficiency?

In general, for the analyzed period the reduction of specialization index took place in 78.5% of regions, in three regions there were no changes, in the remaining regions the growth is observed. Averagely the highest level of specialization was noticed in 2003 (0.61), and the lowest one – in 2008 and 2010 (0.55).

Among all the regions let us highlight two groups with the highest index (over 0.75 for 5 years and over) and the lowest index (less than 0.35 during 5 years and over). Attributed to the group of more specialized regions can be 14 regions, and to the group of less specialized regions – only 11. Therefore, the remaining 53 regions have an average level of specialization. Let us calculate by two groups such indicators as the Gross Regional Product (GRP) calculated per capita, labour efficiency (as ratio of GRP to the number of workers), the average nominal wages and the unemployment rate.

We found out, that in the regions with a high degree of specialization such indicators and GRP per capita, wages and unemployment rate slightly exceed the average values in the country, and the labour efficiency is close to the average level in Russia. Thereby, we know that out of 14 regions of this group in seven regions the mining industry is actively developing[1]. Based on this fact we guess that the group with high index of specialization should be divided into two subgroups: regions with the strongest mining sector of economy (I subgroup) and other regions (II subgroup). The results of analysis are represented in table 4.

Table 4. –Average indicators of the most and least specialized Russian regions during the years 2003-2012

№	Region	Krugman specialization index, index	Average GRP per capita, rub. per person	Economic growth, index	Labour productivity, rub. per person	Average monthly nominal wages, thousand rub.	Export to GDP, %
1	2	3	4	5	6	7	8
	Russian Federation	0.60	204398	1.18	431513	15190	0.16
Regions with the highest level of specialization							
I subgroup - regions with a strong mining sector							
1	Chukotka Autonomous Okrug	1.41	576465	1.19	816967	35766	0.61
2	Arkhangelsk Region	1.11	222861	1.19	455979	16389	0.27
3	Sakhalin Region	1.03	631688	1.30	1108868	25999	0.56
4	Magadan Region	0.91	272393	1.14	479790	26395	0.06
5	Komi Republic	0.90	294024	1.18	585792	19366	0.15
6	Karelia Republic	0.86	154544	1.15	308599	14771	0.37
7	Sakha Republic (Yakutia)	0.78	311657	1.17	619176	22305	0.28
8	Samara Region	0.76	182268	1.16	376739	12619	0.41
Average value of the subgroup I		0,97	330738	1.19	593989	21701	0.34

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[1] It should be noted, that the Krugman specialization index used in grouping the regions was calculated only based on the mining industry data. The conclusions on significant influence of the mining sector in these regions were made by us based on the structure analysis of their GRP.

№	Region	Krugman specialization index, index	Average GRP per capita, rub. per person	Economic growth, index	Labour productivity, rub. per person	Average monthly nominal wages, thousand rub.	Export to GDP, %
1	2	3	4	5	6	7	8
	Russian Federation	0.60	204398	1.18	431513	15190	0.16
Regions with the highest level of specialization							
Subgroup II – other regions							
9	Kamchatka Krai	1.12	223689	1.17	402236	25590	0.13
10	Ivanovo Region	1.1	73522	1.17	160848	9327	0.06
11	Tyva Republic	1.06	69773	1.19	205294	12503	0.01
12	Jewish Autonomous Region	0.94	132720	1.21	297238	14125	0.02
13	Republic of Ingushetia, Chechnya	0.93	99422	1.55	707045	9229	0.39
14	Altai Republic	0.92	80867	1.17	184927	10343	0.07
15	Adygea Republic	0.89	75804	1.23	219688	9267	0.03
16	Kalmykia Republic	0.86	66415	1.15	166274	8286	0.14
17	Lipetsk Region	0.83	179229	1.16	383749	11545	0,55
Average value of the subgroup II		0.96	111271	1.22	303033	12246	0.15
Average value of the group		0.97	221004	1.20	448511	16974	0.25
Regions with the lowest level of specialization							
1	Rostov Region	0.24	113192	1.19	253306	10970	0.20
2	Moscow Region	0.25	196352	1.22	470929	18268	0.09
3	Bryansk Region	0.27	87700	1.18	194248	9141	0.10
4	St. Petersburg	0.28	263936	1.20	507076	19112	0.33
5	Novosibirsk Region	0.29	145324	1.18	304379	13320	0.11
6	Bashkortostan Republic	0.3	155249	1.19	350520	12018	0.37
7	Nizhny Novgorod Region	0.33	149847	1.17	289886	11840	0.18
8	Smolensk Region	0.33	114383	1.17	230636	10613	0.22
9	Kaluga Region	0.35	138349	1.22	289492	12761	0.07
10	Chuvash Republic	0.37	98478	1.19	213555	9524	0.06
11	Orel Region	0.37	105996	1.14	212752	9637	0.11
Average value		0,31	142619	1.19	301525	12473	0.17

* Regions referred to a subgroup with a strong mining sector and the other in terms of the share of mining in GRP in 2012 (over 14.1%).

Thus we can see that in the group "regions with a strong extractive sector," the average value of the index of specialization P. Krugman is 0.97, which is 0.37 (or 1.62 times) higher than the average national value. GRP per capita exceeds the national average in 1.62 times, the dynamics of economic growth is virtually identical (1.19 vs. 1.18 – in the Russian Federation). Labour productivity are also higher in these regions in 1.38 times, and wages - 1.43 times. It is logical to suggest that the economy of regions with a strong extractive sector is export-oriented. This is confirmed by the export quota, value of which in the group is much higher than national average (0.34 vs. 0.16).

The average value of the index of specialization P.Krugman in the group "other regions" is 0.96. We must note that GRP per capita is almost two times lower than the national average, with more confident dynamics of economic growth (index - 1.22). Productivity is also lower in this group of regions, it is 303 033 rubles/ per person (the national average - 431513 rubles), salary - 12 246 rubles (the national average - 15 190 rubles). These regions can not be considered as export oriented (with the exception of the Republic of Ingushetia and the

Chechen Republic, the export quota where is 0.39% of the GRP and the Lipetsk region (0.55%)). Average export quota in the group is 0.15%.

The third group - the regions with the lowest level of specialization - has a median P.Krugman 0.31. GRP per capita below the national average, but a few higher than the previous group. The rate of economic growth has national average value. Labour productivity (as well as the export quota) is two times lower than in the group with a strong extractive sector. Average monthly wage in the regions of this group are comparable with the group "other regions" (average for the period under review - 12473 rub.).

5. Conclusions.

Thus, we see that the most important factors of economic development of the region by a number of indicators becomes its endowment (and extraction) minerals, as well as export-oriented economy. We can draw attention, that the narrow specialization in any sector of the industry "can afford" themselves only regions, providing development of their economies due to mining production. In other cases, a profound specialization of Russian regions are ineffective.

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"A methodological approach to identifying potential clusters in regional economy" is an other article which deals with the cluster approach as one of the most effective ways of development of the regions and the national economy as a whole. The goal of the study is to develop a methodological approach to identifying potential clusters in the regional economy.

"To the question about factors of the regional development efficiency increasing", in Newsletter of Tomsk State University. The article deals with economic and social efficiency conception of the regional development, the main factors of its formation are explored.

"Theoretical bases of regional development efficiency management" The article deals with theoretical problems of region efficiency managements.

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