Asian Social Science; Vol. 11, No. 9; 2015
ISSN 1911-2017 E-ISSN 1911-2025
Published by Canadian Center of Science and Education

Spatial Differentiation and Market Potential of the Regions: the Case of Russia

Tatiana Miroliubova[1] & Alexander Biryukov[2]

[1] Department of Economics, Perm State National Research University, Perm, Russian Federation

[2] Department of Economic Theory and Analysis, Bashkir State University, Sterlitamak, Republic of Bashkortostan, Russian Federation

Correspondence: Tatiana Miroliubova, Department of Economics, Perm State National Research University, 614990 Perm, Bukireva str. 15, Russian Federation. E-mail: mirolubov@list.ru

Received: September 2 2014 Accepted: October 18, 2014 Online Published: April 2, 2015

doi:10.5539/ass.v11n9p96 URL: http://dx.doi.org/10.5539/ass.v11n9p96

Abstract

This paper investigates spatial differentiation between Russian regions in the context of business location factors. First, we selected a number of variables to describe key factors of business location in the regions. They include market potential of the region's retail markets, fixed asset investments, the number of economically active population, and average nominal monthly wage in the region. Segmentation of Russian regions on the basis of these variables allows comparison and selection of the regions from investors' standpoint. To segment Russian regions on the basis of the selected variables we use self-learning neural networks allowing assessment of several variables with the lack of some input data. Second, we classified Russian regions based on their market potential indicators and represented the results on the map of Russia. We presented a structure of Russian regions which accounts for spatial differentiation of the market potential.

Keywords: spatial differentiation, factors of business location, market potential, Kohonen's self-organizing maps, Russian regions

1. Introduction

Russia has been transforming into a market economy since the early 1990-s. These changes have had different impacts on the socio-economic development of Russian regions. Some of them have successfully adjusted to new conditions and are experiencing economic growth and gain in living standards. Other regions still suffer economic stagnation and decline in their living standards.

As a result modern Russia is characterized by increased spatial differentiation and regional inequalities. This leads to such problems as economic slowdown, considerable outflow of population from unsuccessful regions to successful ones, growing separatist sentiment, disintegration processes, etc. To solve these problems we need to study spatial differentiation in modern Russia, to determine its features and sources. The results of this study can provide the basis for an effective economic policy both at the federal and regional levels.

Economic heterogeneity of territories, characteristic of the modern world, is an integral part of the economic area and the result of regional diversity. Spatial differentiation of economic development is an objective reality that exists both between countries and regions within one country. This is especially true for countries with a large area. The study of spatial differentiation in Russia's economic development has become very acute, as Russia is the world's largest country by area.

A lot of works within the framework of new economic geography have been devoted to the theoretical analysis of spatial economic development (Krugman, 1991; Matsuyama, 1991; Venables, 1996; Fujita et al., 1998; Krugman & Venables, 1995, 1996; Puga, 1999; Martin & Ottaviano, 1996, 1999; Baldwin, 1998; Markusen & Venables, 1997; Baldwin et al., 2003). Their conceptions are based on the Dixit-Stiglitz model of monopolistic competition (Dixit & Stiglitz, 1977).

In conditions of imperfect competition firms' decisions on geographical (territorial) location of a business are becoming particularly important. Under otherwise equal conditions firms, trying to reduce transport costs, choose locations closer to major markets with high potential demand for their products. Market potential plays a key role in the investor's decision making about locating production in this or that region.

Market potential (Harris, 1954) characterizes the level of regional market accessibility to businesses, consumers and other economic agents. Harris found out that, on the one hand, some industrialized regions of the USA had extremely high market potential. But on the other hand, not only regions with good market access were chosen for production location; concentration of production also improved access to the market. On this basis C. Harris deduced that market potential of a region is the main factor in production location.

According to the Keynesian approach to economic development, the relationship between economic growth and investment is explained with the help of Harrod-Domar model (Harrod, 1939; Domar, 1946). Central to the model is positive correlation between the rate of investment and economic growth.

If a decision on business location and investment in a region is made by a firm, but not by the state, the level of the economic development of the region will depend on the business investment. This is the principal difference between the market economy of modern Russia and the command-administrative socialist economy. Under socialism all production location decisions in Russia were made centrally by the State Planning Commission, a special state body.

Choosing a region to invest in, the investor will compare regions on a number of parameters. This requires selection of Russian regions where a business can achieve maximum return on investment.

In order to do this, it is necessary to segment all Russian regions in groups according to several features. To evaluate a region from different perspectives, it is necessary to conduct comparative analysis of regional economies based on a number of features. It should be emphasized, that one or two features are not enough and a thorough analysis can require three, four or even more features. Thus, application of the multivariate analysis methods, allowing simultaneous use of several variables to segment selected objects, is needed for research.

Segmentation allows to select regions with similar characteristics for the analysis and to solve several problems. Firstly, investors can compare and select regions more accurately. First of all, it is necessary to group all the regions, select the most attractive group of regions and then compare different regions within each group depending on the investor requirements for natural and labor resources, tax, infrastructure, etc. This will allow to select the most attractive regions.

Secondly, this can help the government bodies of regions within one group set clear goals and performance measures to create strategies of socio-economic development of the regions, as these particular regions, which are very similar and members of one group, have to compete with each other for capital resources.

Our research has the following objectives:

– create a set of indicators (factors) $\{X_j\}$, representing regional specific features for investors and their transformation in one composite index F (X), where X = (X,.., X_j ,… X_n), all of them should account for the regional specificity of the clustering model;

– apply the clustering model of Russian regions to the neural network using Kohonen's self-organizing maps;

– to conduct empirical analysis using real statistics for Russia's regions in order to test the hypotheses put forward in this study.

In our research we intend to test the following hypotheses:

1) according to the systemic analysis, assessment of a region in terms of business location should be systemic, but not for each individual region. This means that it is necessary to compare parameters of the analyzed region with other regions.

2) business location in Russian regions depends on its market potential, the number of economically active population, and the average nominal monthly wage. A quantitative indicator characterizing a region is the volume of fixed asset investments.

3) Russia's economy is characterized by spatial differentiation of business locations in the regions.

4) Russian regions are characterized by spatial differentiation of the retail market potential.

This research aims at contributing to the study of spatial differentiation between Russian regions and conducting empirical estimation of market potential and other factors of business location in Russian regions. We use self-learning neural networks which allow assessment of several variables with the lack of some input data. The research will result in a structure of Russian regions accounting for special differentiation of market potential as well as other business location factors.

2. Methodology and Data

2.1 Key Characteristics of a Region

A business, investing into production of goods in a region, wants to maximize its profit. Therefore, the business is particularly interested in the quantity demanded of the product in this and nearby regions as well as in those regions, transportation costs to which and the price level of which allow profit.

In our research we apply Harris's formula (Harris, 1954) defining the market potential of a region as the inverse distance-weighted sum of the purchasing power of all regions:

$$MP_i=\Sigma\ (\frac{Mj}{Dij})$$

where:

MP_i is the market potential of county *i*;

Mj is the market of county *j*;

Mij is the distance from county *i* to county *j*.

To make necessary calculations with the help of this formula, it is crucial to select empirical data: what data to use in the calculation?

Let us refer to the first necessary variable – the market size of a region.

According to the classical macroeconomic approach, the market size can be calculated by the value of sales to a market in a given period. It is based on the assumption that theoretically any Russian region can be a potential market for other regions of the country.

In the calculations we will use the retail turnover indicator for Russian regions in 2005 and 2010. Our information source is the Central statistical database of the Federal State Statistics Service of the Russian Federation. In this case we will be able to assess the regional market potential from a consumer demand perspective.

Retail markets, with total sales of 635833 million dollars (19075 billion rubles) and 2436.6 thousand people in 2011, are an important part of Russia's economy. 57% of goods sold at these markets are produced in Russia and 43% of goods are imported (Russia-2012, pp. 33-34). These particular markets allow producers to sell their products.

The main problem with calculating the market potential of Russian regions is the lack and poor quality of information, or incompleteness of information. Another limitation for this research is that the Federal State Statistics Service of the Russian Federation can not provide information on all indicators or all 83 Russian regions. To overcome this limitation we need to select appropriate research methods.

A second variable needed for the calculation is the distance between the region under consideration and other regions of the country.

To assess the market potential of a region we will use the shortest railway route between the administrative center of the region under consideration and those of other regions of the country. For regions with no train service modified data on driving, river and sea distances will be used. Thus, we will use not just a geographical straight line distance, but a so called "economic" distance, which depends on economic people's activities including availability of road/rail/sea/ river transport links. The information on distances between the main cities of Russian regions is taken from calculations of Russian scientists (Abramov & Gluschenko, 2000).

Besides the market potential, we will need some other parameters characterizing the regions.

In modern economy an investor first of all needs qualified workforce to build a globally competitive business. A business should be able to recruit personnel with good job skills. That is why such a characteristic of regional economy as "the number of economically active population" is very important for an investor.

From an investor's perspective, to maximize profit it is necessary to evaluate factors affecting the production costs. It is important to know the cost of labor in the region, which is characterized by the average monthly nominal wage index.

To make the right choice an investor should also know the general economic activity of business in the region. Therefore, we will use such an indicator as "fixed assets investment" in the region.

Thus, for our research we have selected the following variables: market potential of a region, fixed asset investment, economically active population, and average monthly nominal wages in a region.

Information on the variables is taken from the Central statistical database of the Federal State Statistics Service of the Russian Federation for the years 2005 and 2010.

2.2 Neural Network Approach to Data Classification

Studies on spatial differentiation generally use traditional methods of econometric modeling. As it has been stated, we will do our research with incomplete information. Thus, to overcome this limitation we will use artificial neural networks. They can be more effective than traditional research methods. Compared to traditional methods, the main advantage of the artificial neural networks is that they are not programmed but trained.

Theoretical and practical aspects of using artificial neural networks are discussed in many scientific works.

McCulloch W. S., Pitts W. in their work (McCulloch & Pitts, 1943) first suggested a mathematical model of the biological neural network, and later Hebb D. O. (1949) formulated basic rules of learning a neural network.

Rosenblatt F. (1958) was one of the first to suggest a mathematical representation of the living neuron to recognize data patterns. He also conducted a series of experiments proving the possibility of such applications.

Minsky M. L. and Papert S. A. (1969) conducted a detailed mathematical analysis of Rosenblatt perceptron properties and, in particular, proved that existing learning algorithms do not allow the use of perceptron to solve n-separable problems. This work significantly declined interest in artificial neural networks for more than a decade.

Rumelhart D. E., Hinton G. E. and Williams R. J. (1986) suggested a method for training artificial neural networks with a nonlinear activation function and a hidden layer, which solved the issue of n-separable problems and renewed interest in artificial neural networks.

Kohonen T. (1982) suggested a structure of the neural network capable of self-learning through clustering the input data space. It is T. Kohonen's work that initiated a widespread use of artificial neural networks in scientific research.

Hopfield J. J. (1982) developed a fundamentally new architecture of the artificial neural network with self-feedback (recurrent network). Unlike previous artificial neural networks, Hopfield recurrent networks are models of physical, not biological processes allowing to solve problems using associative memory.

Haykin S. (1999) summarized about 1200 most important works on neural network theory. His work is still considered the most comprehensive study in the field of neural network modeling.

Using neural networks allows a principally new level of creating algorithms to solve many complex problems with incomplete information, which is especially important for solving economic problems. Economic, financial and social systems result from actions and reactions of both objective reality and individuals. This makes it difficult to create a complete mathematical model with account for all possible actions and reactions. It is almost impossible to get a detailed approximation of the model based on such traditional parameters as utility and profit maximization.

Models directly imitating social and economic behavior are more effective to use in such complex systems. This is what the neural network methodology allows to do.

In this study we suggest segmentation of the regions on the basis of the market potential and other selected parameters using the Kohonen layer and Kohonen's self-organizing networks (sometimes called maps) (Kohonen, 1982).

According to different authors, Kohonen's neural networks, or Kohonen's self-organizing maps (SOM), are used for automated classification with no training sequence of patterns, i.e. when there is no a priori information of the desired output (Kruglov & Borisov, 2001). Consequently, there is no knowledge of the error between the network's and some desired outputs and no need to minimize this error like in the back propagation algorithm.

Using Kohonen's self-organizing maps – one of the neural network algorithms – for analysis allows the automation of pattern discovery.

The main advantage of this method is that the result of the training process depends only on the input data structure. In this method an artificial network of connected neurons during its unsupervised training process tries to understand the relationship between input data and to visualize it on the map.

In this research we used the following methodology. First, we figured out the factors characterizing regional economy from different perspectives. These factors affect the location of a business in Russian regions and include market potential of a region, fixed asset investment, economically active population, and average monthly nominal wage in a region.

Second, we calculated retail market potential for Russian regions using Harris's equation. We also formed generalized indicator $F(X_j)$ based on the selected factors and created generalized production function $F(\vec{X}(t), t)$ using Zwicky's morphological approach (*see:* Odrin & Kartavov, 1977). Zwicky suggested the idea of defining additive sets of values (conditions), shown at the axes of the morphological box, and "reducing" all mutually contradictory conditions with the help of the cross-consistency assessment. Specifically, in our task of clustering Russian regions the main useful function F((t), t) is written as:

$$F(\vec{X},t) = F_1(\vec{X},t) \cdot F_2(\vec{X},t) \cdot F_3(\vec{X},t) \cdot F_4(\vec{X},t), \quad (2)$$

where t is the time; $F_1(\vec{X},t)$ is the indicator of a region's market potential; $F_2(\vec{X},t)$ is the indicator of fixed asset investments; $F_3(\vec{X},t)$ is the indicator of the number of economically active population; and $F_4(\vec{X},t)$ is the indicator of the average nominal monthly wage in the region.

Multiplication of partial criteria $\{F_k\}$ in (2) represents the interrelationship of all indicators in the overall assessment F of a region: this indicator will reach its maximum value in case of simultaneously maximum values of all aggregates $F_1, \ldots F_p$.

To explore causal relationship between the selected factors of business location in Russian regions, we carried out correlation and regression analysis. It was found out that a quantitative indicator characterizing the location of a business is fixed asset investment in a region.

Next, we use Kohonen's method of self-organizing maps to calculate the selected factors across Russian regions. After that we rate the regions based on the selected indicators, sum up rating positions for every region and classify the regions.

Finally, we classify Russian regions based on the market potential of their retail markets.

3. Calculation Results

3.1 Spatial Differentiation of Market Potential in Russian Regions

Retail market potential in Russian regions was calculated based on the above mentioned methodology. Retail trade turnover across Russian regions from 2005 to 2010 was chosen as input data. The central statistical database of the Federal State Statistics Service was chosen as the source of information. Another indicator used for the calculation was the shortest railway between the administrative centre of the region under consideration and other regions.

The results of the calculation of market potential for Russian regions in 2005 and 2010 are given in Table 1.

Table 1. Market potential of Russian regions (across retail markets)

Subject of the RF	Administrative center	2005	2010
Belgorod Oblast	Belgorod	9556,54	16213,29
Bryansk Oblast	Bryansk	12737,3	20912,07
Vladimir Oblast	Vladimir	20725,56	33215,92
Voronezh Oblast	Voronezh	11668,5	19827,63
Ivanovo Oblast	Ivanovo	16134,2	26435,47
Kaluga Oblast	Kaluga	21042,77	33629,99
Kostroma Oblast	Kostroma	14849,04	24462,92
Kursk oblast	Kursk	11159,82	18829,39
Lipetsk Oblast	Lipetsk	13379,11	22371,65
Moscow		28605,01	53282,77
Moscow oblast	Krasnogorsk	96288,87	138294,28
Orlov Oblast	Orel	13868,06	22980,86
Ryazan Oblast	Ryazan	20400,17	32634,79
Smolensk Oblast	Smolensk	12007,03	19641,63
Tambov Oblast	Tambov	12822,67	21524,79
Tver Oblast	Tver	22014,98	34879,38
Tula Oblast	Tula	21361,93	34011,31
Yaroslavl Oblast	Yaroslavl	16681,06	26984,95
Arkhangelsk Oblast	Arkhangelsk	5620,66	9515,3
Vologda Oblast	Vologda	11396,72	18846,63
Kaliningrad Oblast	Kaliningrad	5169,76	8714,21

Subject of the RF	Administrative center	2005	2010
Republic of Kareliya	Petrozavodsk	7121,04	11999,9
Komi Republic	Syktyvkar	10055,86	10735,51
Leningrad Oblast	Gatchina	12181,62	21749,09
Murmansk Oblast	Murmansk	3959,94	6729,2
Nenets Autonomous Okrug	Naryan-Mar	2962,55	5068,64
Novgorod Oblast	Veliky Novgorod	11657,59	19242,07
Pskov Oblast	Pskov	8985,06	14985,42
Saint-Petersburg		9810,83	16611,34
Republic of Adygeya	Maikop	7305,93	15499,47
Astrakhan Oblast	Astrakhan	6213,36	11021,25
Volgograd Oblast	Волгоград	8044,42	14289,65
Kalmykia	Elista	7618,19	13741,54
Krasnodar Krai	Krasnodar	6733,23	11419,34
Rostov Oblast	Rostov-on-Don	7213,25	13527,84
Republic of Daghestan	Makhachkala	5012,89	9010,09
Ingush Republic	Magas	6785,55	12653,21
Kabarda-Balkar Republic	Nalchik	6256,9	11627,94
Karachai-Cherkes Republic	Cherkessk	7385,94	13798,48
Republic of North Ossetia – Alania	Vladikavkaz	6071,59	11320,24
Stavropol Krai	Stavropol	6663,91	12547,52
The Chechen Republic	Grozny	6045,21	11256,22
Republic of Bashkortostan	Ufa	8001,02	14042,53
Kirov Oblast	Kirov	8780,56	15257,94
Republic of Mari El	Yoshkar-Ola	11203,48	19340,53
Republic of Mordovia	Saransk	11250,9	19255,25
Nyzhniy Novgorod Oblast	Nyzhniy Novgorod	12414,56	20770,28
Orenburg Oblast	Orenburg	12385,03	12578,36
Penza Oblast	Penza	11152,67	18927,08
Perm Krai	Perm	7943,13	14239,7
Samara Oblast	samara	8351,68	14730,65
Saratov Oblast	Saratov	9471,22	16310,02
Republic of Tatarstan	Kazan	10109,97	17453,66
Republic of Udmurtiya	Izhevsk	8604,84	14819,23
Ulyanovsk Oblast	Ulyanovsk	10556,82	18200,19
Republic of Chuvashia	Cheboksary	11761,70	20295,48
Kurgan Oblast	Kurgan	7891,99	13827,73
Sverdlov Oblast	Ekaterinburg	7614,25	13423,27
Tyumen Oblast	Tyumen	6301,72	11092,14
Khanty-Mansi Autonomous Okrug – Yugra	Khanty-Mansiysk	3676,5	6384,37
Chelyabinsk Oblast	Chelyabinsk	7932,14	14009,34
Altai Republic	Gorno-Altaisk	4117,20	6996,31
Altai Krai	Barnaul	4549,30	7687,91
Republic of Buryatia	Ulan-Ude	2470,17	4185,81
Trans-Baikal Krai	Chita	2046,63	3492,3
Irkutsk Oblast	Irkutsk	2489,15	4273,89
Kemerovo Oblast	Kemerovo	4639,63	8214,47
Krasnoyarsk Krai	Krasnoyarsk	3411,88	5792,6
Novosibirsk Oblast	Novosibirsk	4909,79	8321,87
Omsk Oblast	Omsk	5043,87	8732,45
Tomsk Oblast	Tomsk	5022,46	8471,95
Republic of Tyva	Kyzyl	2888,14	4938,67
Republic of Khakassia	Abakan	3569,80	6081,1
Amur Oblast	Blagoveshchensk	1695,48	2886,84
Jewish Autonomous Region	Birobidzhan	2124,59	3542,96

Subject of the RF	Administrative center	2005	2010
Magadan Oblast	Magadan	1135,37	1944,95
Primorskiy Krai	Vladivostok	1350,58	2310,81
Republic of Sakha/Yakutiya	Yakutsk	1407,25	2414,46
Sakhalin Oblast	Yuzhno-Sakhalinsk	1998,58	2284,5
Khabarovsk Krai	Khabarovsk	1608,58	2739,14

Russian regions were also classified by their market potential (for retail sales) based on the data for 2005 and 2010 respectively.

For this purpose the market potential of Moscow and Moscow Oblast was taken as 100% since, according to our calculations, it is the maximum value. Relative values of the market potential of other regions were calculated as the ratio of the market potential of a region under consideration to the value of Moscow Oblast and Moscow's market potential. We introduced the following parameters of grouping regions based on their market potential value: 0-10%, 10-20%, 20-40%, 60-80% and 80–100%.

The results are presented on the maps of Russia (Figures 1 & 2).

Figure 1. Market potential of Russian regions (retail markets), 2005

Figure 2. Market potential of Russian regions (retail markets), 2010

The maps (Figures 1 & 2) show an inverse relationship between the market potential of Russia's regions and their proximity to the central region: the farther from Moscow a region is, the lower market potential it has. It proves our hypothesis of a high level of spatial differentiation of Russia's economic development. This puts bounds to comprehensive socio-economic development of the country.

Classification of Russian regions by their market potential resulted in 4 groups of regions (Tables 2 & 3).

Table 2. Classification of Russian regions by retail market potential, 2005

IV group 0–20%	III group 20–60%	II group 60–80%	I group 80–100%
Republic of Sakha (Yakutiya)	Arkhangelsk Oblast	Leningrad Oblast	Moscow
Nenets Autonomous Okrug	Ivanovo Oblast		Moscow Oblast
Chukchi Autonomous Okrug	Kaliningrad Oblast		Tver Oblast
Yamalo-Nenetskiy Avtonomnyy Okrug	Yaroslavl Oblast	Saint-Petersburg	Vladimir Oblast
Magadan Oblast	Pskov Oblast	Novgorod Oblast	Kaluga Oblast
Jewish Autonomous Oblast			
Kamchatka Krai	Republic of Karelia	Vologda Oblast	Tula Oblast
Trans-Baikal Krai			
Khabarovsk Krai	Kirov Oblast	Republic of Komi	7. Ryazan Oblast
Republic of Buryatiya			
Sakhalin Oblast	Republic of Udmurtiya	Smolensk Oblast	
Republic of Tyva			
Amur Oblast	Perm Krai	Kostroma Oblast	
Irkutsk Oblast			
Primorskiy Krai	Republic of Bashkortostan	Nyzhniy Novgorod Oblast	
Krasnoyarsk Krai			
Khanty-Mansi Autonomous Okrug	Chelyabinsk Oblast	Respublika Mariy El	
Novosibirsk Oblast	Sverdlov Oblast	Republic of Chuvashia	
Altai Krai	Kurgan Oblast	Republic of Tatarstan	
Republic of Altay	Tyumen Oblast	Orenburg Oblast	
Republic of Khakasiya	Omsk Oblast	Ulyanovsk Oblast	
Kemerovo Oblast	Tomsk Oblast	Respublika Mordoviya	
23. Murmansk Oblast	Samara Oblast	Penza Oblast	
	Saratov Oblast	Tambov Oblast	
	Volgograd Oblast	Lipetsk Oblast	
	Rostov Oblast	Orel Oblast	
	Republic of Kalmykia	Bryansk Oblast	
	Astrakhan Oblast	Kursk Oblast	
	Krasnodar Krai	Belgorod Oblast	
	Stavropol Krai	22. Voronezh Oblast	
	Republic of Adygea		
	Karachay-Cherkess Republic		
	Kabardino-Balkaria		
	Republic of North Ossetia-Alania		
	Republic of Ingushetia		
	Chechen Republic		
	31. Republic of Dagestan		

Table 3. Classification of Russian regions by retail market potential, 2010

IV group 0 – 20%	III group 20 – 60%	II group 60 – 80%	I group 80 – 100%
Republic of Sakha (Yakutiya)	Perm Krai	Leningrad Oblast	Moscow
Nenets Autonomous Okrug	Respublika Karelia		Moscow Oblast
Chukchi Autonomous Okru			Saint-Petersburg
Yamalo-Nenetskiy Avtonomnyy Okrug	Respublika Komi	Kostroma Oblast	Tver Oblast
Magadan Oblast	Sverdlov Oblast	Yaroslavl Oblast	Vladimir Oblast
Krasnoyarsk Krai			
Kamchatka Krai	Tyumen Oblast	Ivanovo Oblast	Ryazan Oblast
Republic of Khakasiya			
Khabarovsk Krai	Kurgan Oblast	Nyzhniy Novgorod Oblast	Tula Oblast
Republic of Altay			
Sakhalin Oblast	Chelyabinsk Oblast	Republic of Chuvashia	8. Kaluga oblast
Altai Krai			
Primorskiy Krai	Orenburg Oblast	Tambov Oblast	
Kemerovo Oblast			
Jewish Autonomous Oblast	Republic of Bashkortostan	Lipetsk Oblast	
Novosibirsk Oblast			
Amur Oblast	Republic of Udmurtiya	Orel Oblast	
Tomsk Oblast			
Trans-Baikal Krai	Kirov Oblast	10.Bryansk Oblast	
Omsk Oblast			
Republic of Buryatiya			
Khanty-Mansi Autonomous Okrug	Volgograd Oblast		
Irkutsk Oblast	Respublika Mariy El		
Arkhangelsk Oblast			
Republic of Tyva	Respublika Tatarstan		
Republic of Dagestan			
Murmansk Oblast	Samara Oblast		
28. Kaliningrad Oblast	Ulyanovsk Oblast		
	Republic of Mordoviya		
	Penza Oblast		
	Saratov Oblast		
	Vologda Oblast		
	Voronezh Oblast		
	Belgorod Oblast		
	Kursk Oblast		
	Smolensk Oblast		
	Pskov Oblast		
	Novgorod Oblast		
	Rostov Oblast		
	Republic of Kalmykiya		
	Astrakhan Oblast		
	Krasnodar Krai		
	Stavropol Krai		
	Republic of Adygeya		
	Karachai-Cherkes Republic		
	Kabarda-Balkar Republic		
	Republic of Severnaya Osetiya-Alaniya		
	Republic of Ingushetiya		
	37. Chechen Republic		

Tables 2 and 3 show that Russian regions are characterized by a significant spatial differentiation of the market potential: the maximum market potential concentrates in few regions, while the majority of the regions are characterized by a far less market potential. The 3rd group of the regions (from 20 to 60%) is the most numerous: it included 31 regions in 2005 and 37 in 2010. At the same time, the group with the maximum market potential (from 80 to 100%) is the smallest in quantity: it included only 7 regions in 2005, and 8 regions in 2010 as Saint Petersburg moved from the 2nd group to the leader group. The number of the regions in the 2nd group (from 60 to 80%) reduced from 22 in 2005 to 10 in 2010, as the rating positions of 11 regions became worse and they moved to the 3rd and even 4th groups. These results once again prove our hypothesis of a high and increasing level of spatial differentiation of Russia's economic development.

Based on the data of tables 2 and 3, we classified Russians regions by the dynamics of their market potential. We obtained three groups of regions: 1) regions with a stable market potential; 2) regions with an improved market potential; 3) regions with a decreased market potential. The results of the classification are presented in Table 4.

Table 4. Classification of Russian regions by retail market potential dynamics

Regions with a stable market potential	Regions with an improved market potential	Regions with an aggravated market potential
The Republic of Sakha (Yakutia)	Pskov Oblast	Jewish Autonomous Oblast
Chukchi Autonomous Okrug	Kirov Oblast	Trans-Baikal Krai
Magadan Oblast	Republic of Kareliya	Republic of Buryatiya
Kamchatka Krai	Republic of Udmurtiya	Republic of Tuva
Khabarovsk Krai	Republic of Bashkortostan	Irkutsk Oblast
Sakhalin Oblast	Chelyabinsk Oblast	Arkhangelsk Oblast
Amur Oblast	Sverdlov Oblast	Kaliningrad Oblast
Primorsky Krai	Kurgan Oblast	Pskov Oblast
Nenets Autonomous Okrug	Tyumen Oblast	Omsk Oblast
Yamalo-Nenets Autonomous Okrug	Samara Oblast	Tomsk Oblast
Krasnoyarsk Krai	Saratov Oblast	Republic of Dagestan
Khanty-Mansi Autonomous Okrug	Volgograd Oblast	Novgorod Oblast
Novosibirsk Oblast	Rostov Oblast	Vologda Oblast
Altai Krai	Republic of Kalmykiya	Republic of Komi
Republic of Altay	Astrakhan Oblast	Smolensk Oblast
Republic of Khakasiya	Krasnodar Krai	Respublika Mariy El
Kemerovo Oblast	Stavropol Krai	Respublika Tatarstan
Murmansk Oblast	Republic of Adygeya	Orenburg Oblast
Perm Krai	Karachai-Cherkes Republic	Ulyanovsk Oblast
Leningrad Oblast	Kabarda-Balkar Republic	Republic of Mordoviya
Kostroma Oblast	Republic of Severnaya Osetiya-Alaniya	Penza Oblast
Nizhny Novgorod Oblast	Republic of Ingushetiya	Kursk Oblast
Republic of Chuvashia	Chechen Republic	Belgorod Oblast
Tambov Oblast	Ivanovo Oblast	24.Voronezh Oblast
Lipetsk Oblast	Yaroslavl Oblast	
Orel Oblast	26. Saint-Petersburg	
Bryansk Oblast		
Tver Oblast		
Vladimir Oblast		
Kaluga Oblast		
Tula Oblast		
32.Ryazan Oblast		

Table 4 shows change in the market potential of Russian regions over the indicated period of time: 24 regions are characterized by decrease in their market potential, 26 regions are marked by the market potential growth, and

the market potential did not change in 32 regions. This says about slow positive dynamics of economic development in most regions of Russia.

3.2 Casual Relationship between Factors of Business Location in Russian Regions

Casual relationships between the selected factors of business location in Russian regions were established with the help of the correlation-regression analysis. The volume of fixed asset investment in a region was taken as an explained variable Y, characterizing business location in a region. Explaining variables include:

X1 – the retail market potential;

X2 – the number of economically active population in the regions;

X3 – the average nominal monthly wage in the regions.

The correlation-regression analysis was based on the data on Russian regions for 2005 and 2010 from the Central statistical database of the Federal State Statistics Service of the Russian Federation.

We created pairwise comparison matrices of correlation between the values of the selected factors in 2005 and 2010 (Tables 5, 6).

Table 5. Correlation pairwise comparison matrix (2005)

	Y	X1	X2	X3
Y	1	0.2629	0.7601	0.5683
X1	0.2629	1	0.4379	-0.0844
X2	0.7601	0.4379	1	0.1569
X3	0.5683	-0.0844	0.1569	1

Table 6. Correlation pairwise comparison matrix (2010)

	Y	X1	X2	X3
Y	1	0.2164	0.7209	0.5401
X1	0.2164	1	0.4721	-0.0296
X2	0.7209	0.4721	1	0.2544
X3	0.5401	-0.0296	0.2544	1

These correlation matrices show that factors X2 and X3 are significant both in 2005 and 2010, which means a strong linear relationship between the volume of fixed asset investment, the number of economically active population and the average nominal monthly wage. At the same time factor X1 turned out to be insignificant meaning the absence of correlation between the volume of fixed asset investment and the region's market potential. As correlation between the factors is not very high, the problem of multicollinearity should not arise.

The multiple regression equation in a linear form is written as:

1) based on data for 2005:

$$Y = -80823.36 + 0.0049 * X1 + 59.439 * X2 + 9.351 * X3$$

General characteristics of the obtained model:

Regression statistics	
Multiple R	0.8857
R-squared	0.7845
Normalized R-squared	0.7760
Standard error	35588.14
Observation	80

Variance analysis

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	3.505E+11	1.17E+11	92.2455	2.91E-25
Excess	76	9.626E+10	1.27E+09		
Total	79	4.467E+11			

	Coefficients	Standard error	*t-statistics*	*P-Value*
Y-intersection	-80823.36	10354.61	-7.806	2.59E-11
Variable X1	0.0049	0.403	0.012	0.990
Variable X2	59.439	5.244	11.334	5.32E-18
Variable X3	9.351	1.111	8.414	1.77E-12

The obtained model is characterized by a rather high value of determination coefficient (R^2=0.7845), which means that the model is reliable enough. The model is also significant, since F-statistic has a large value. However, according to t-test results, factor X1 is not significant (P-value is close to 1).

Figure 3 shows a graph of the explained value (the volume of fixed asset investment) and values obtained from the model.

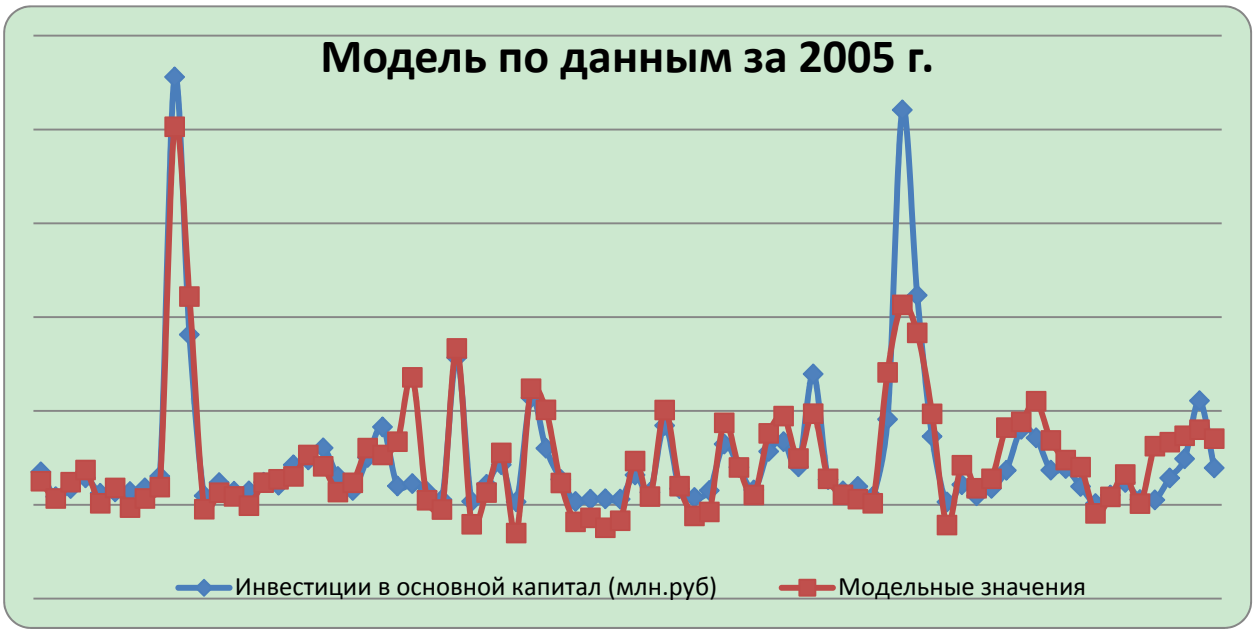

Figure 3. A model of fixed asset investment based on data for 2005

2) Based on data for 2010:

$$Y = -136312.96 - 0.898 * X1 + 123.83 * X2 + 8.355 * X3$$

General characteristics of the obtained model:

Regression statistics	
Multiple R	0.8135
R-squared	0.6617
Normalized R-squared	0.6484
Standard error	99340.48
Observation	80

Variance analysis

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1.467E+12	4.89E+11	49.5523	7.46E-18
Excess	76	7.5E+11	9.87E+09		
Total	79	2.217E+12			

	Coefficients	Standard error	*t-statistics*	*P-Value*
Y-intersection	-136312.96	32320.6	-4.218	6.75E-05
Variable X1	-0.898	0.779	-1.154	0.252
Variable X2	123.83	14.699	8.424	1.69E-12
VariableX3	8.355	1.595	5.240	1.39E-06

As compared to the model obtained for 2005, the model for 2010 has smaller values of R^2 and *F*-statistics, but it is well significant. Similar to the model obtained for 2005, the model for 2010 has significant factors X2 and X3 and insignificant factor X1. Nevertheless, P-value of factor X1 is much less in the second model than in the first one.

Figure 4 shows a graph of the fixed asset investment and model values for 2010.

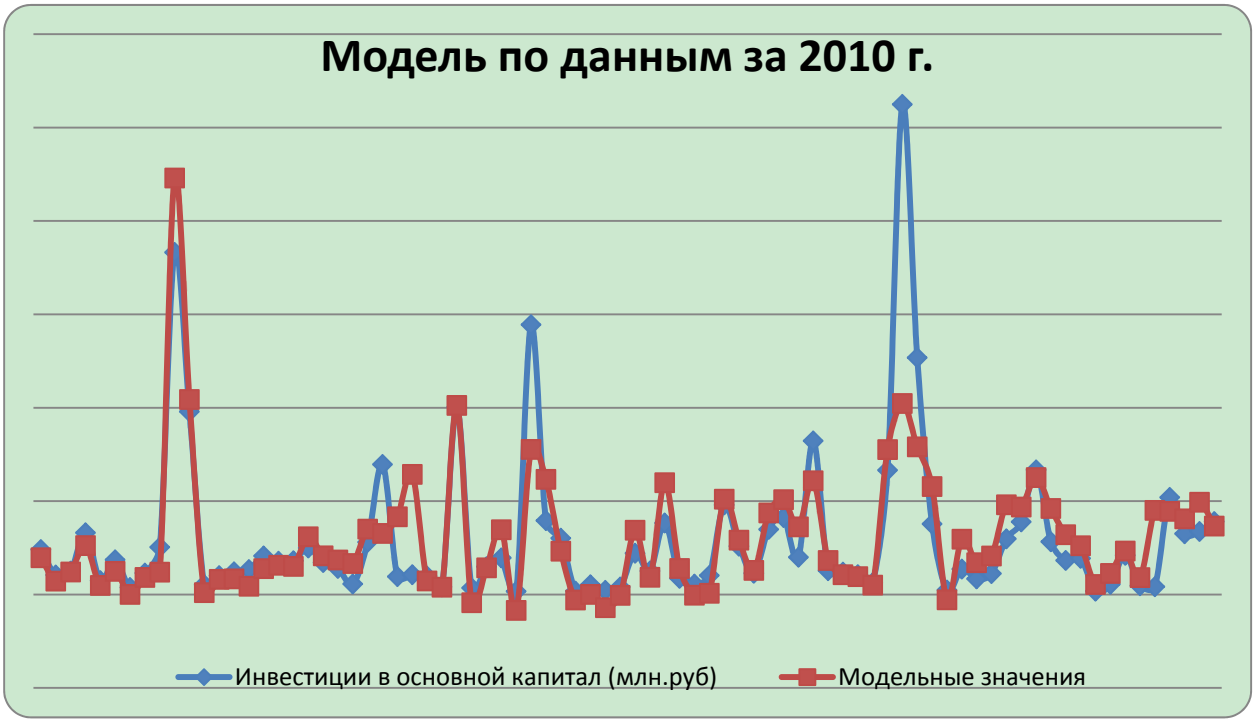

Figure 4. A model of fixed asset investment based on data for 2010

So, correlation-regression analysis showed that our hypothesis that business location in Russian regions is determined by such factors as the market potential, the number of economically active population and the average nominal monthly wage is partially true. According to the obtained results, there is a strong linear relationship between the volume of fixed asset investment and such factors as the number of economically active population and the average nominal monthly wage while the amount of fixed asset investment does not correlate with the retail market potential.

3.3 Classification of the Regions

Russian regions were clustered on the basis of 5 variables: aggregates and the main useful function F. The latter allows a clear and simple interpretation of calculation results.

Using the initial values of parameters, we rated each region of the Russian Federation based on the selected indicators by means of the Kohonen layer and self-organizing net. Further we summed up rating positions of every region and grouped the regions.

The calculation results for the selected variables in Russian regions for 2005 and 2010 are given in Tables 7 and 8, where column *A* is the classification of regions by their retail market potential, *B* is the classification of regions with the help of the Kohonen layer, column *C* is the classification of regions by means of the

self-organizing net, x_1 is the classification by fixed capital investment, x_2 is the classification by economically active population, x_3 is the classification by the average monthly nominal wage, and column *D* is the total rating of a region.

Table 7. Ratings of Russian regions, 2005

Subject of the Federation	A	B			C			Total places
		x1	x2	X3	x1	x2	x3	D
1	4	5	6	7	8	9	10	11
Belgorod Oblast	2	1	1	3	1	1	3	14
Bryansk Oblast	2	1	1	2	1	1	2	12
Vladimir Oblast	3	1	1	2	1	1	2	15
Voronezh Oblast	2	1	2	2	1	2	2	14
Ivanovo Oblast	3	1	1	2	1	1	2	14
Kaluga Oblast	3	1	1	3	1	1	3	17
Kostroma Oblast	2	1	1	2	1	1	2	13
Kursk Oblast	2	1	1	2	1	1	2	12
Lipetsk Oblast	2	1	2	3	1	1	3	15
Moscow	4	4	4	4	4	4	4	32
Moscow Oblast	4	3	3	4	2	3	4	27
Orel Oblast	2	1	1	2	1	1	3	14
Ryazan Oblast	3	1	1	2	1	1	2	15
Smolensk Oblast	2	1	1	3	1	1	3	14
Tambov Oblast	2	1	2	2	1	1	2	13
Tver Oblast	3	1	1	3	1	1	3	17
Tula Oblast	3	1	1	3	1	1	3	17
Yaroslavl Oblast	3	1	1	3	1	1	3	16
Arkhangelsk Oblast	1	1	1	4	1	1	4	14
Vologda Oblast	2	1	2	1	1	2	2	13
Kaliningrad Oblast	1	1	1	3	1	1	3	12
Republic of Kareliya	1	1	2	3	1	1	3	13
Komi Republic	2	1	2	4	1	1	4	16
Leningrad Oblast	2	1	2	3	1	1	3	15
Murmansk Oblast	1	1	1	4	1	1	3	13
Nenets Autonomous Okrug	1	1	1	4	1	1	4	14
Novgorod Oblast	2	1	1	3	1	1	3	14
Pskov Oblast	2	1	1	2	1	1	2	12
Saint-Petersburg	2	2	3	4	2	3	4	22
Republic of Adygeya	2	1	1	2	1	1	2	11
Astrakhan Oblast	1	1	2	3	1	1	3	13
Volgograd Oblast	2	1	2	3	1	2	3	16
Kalmykia	2	1	1	2	1	1	1	11
Krasnodar Krai	2	2	3	3	2	3	3	19
Rostov Oblast	2	1	3	2	1	3	2	16

Republic of Daghestan	1	1	1	2	1	2	2	11
Ingush Republic	1	1	1	2	1	1	2	10
Kabarda-Balkar Republic	1	1	1	2	1	1	2	10
Karachai-Cherkes Republic	1	1	1	2	1	1	2	10
Republic of North Ossetia – Alania	1	1	1	2	1	1	2	10
Stavropol Krai	1	1	2	1	1	2	2	11
Republic of Bashkortostan	2	1	2	3	1	2	3	16
Kirov Oblast	2	1	1	2	1	1	2	12
Republic of Mari El	2	1	1	2	1	1	2	12
Republic of Mordovia	2	1	1	2	1	1	2	12
Nyzhniy Novgorod Oblast	2	1	2	3	1	2	3	16
Orenburg Oblast	2	1	2	3	1	2	3	15
Penza Oblast	2	1	1	2	1	1	1	11
Perm Krai	2	1	2	3	1	2	2	15
Samara Oblast	2	1	2	3	1	2	2	15
Saratov Oblast	2	1	2	2	1	2	3	15
Republic of Tatarstan	2	2	2	3	2	2	3	18
Republic of Udmurtiya	2	1	1	3	1	1	3	14
Ulyanovsk Oblast	2	1	1	2	1	1	2	12
Republic of Chuvashia	2	1	1	2	1	1	3	13
Kurgan Oblast	2	1	1	2	1	1	2	12
Sverdlov Oblast	2	1	3	3	1	3	3	18
Tyumen Oblast	1	4	2	4	4	2	4	22
Chelyabinsk Oblast	2	1	2	3	1	2	3	16
Altai Republic	1	1	1	2	1	1	2	10
Altai Krai	1	1	1	2	1	2	3	12
Republic of Buryatia	1	1	1	3	1	1	3	12
Trans-Baikal Krai	1	1	1	1	1	1	2	9
Irkutsk Oblast	1	1	2	4	1	2	4	16
Kemerovo Oblast	1	1	1	3	1	1	3	12
Krasnoyarsk Krai	1	4	2	4	4	2	4	22
Novosibirsk Oblast	1	1	2	3	1	2	3	14
Omsk Oblast	1	1	2	3	1	2	3	14
Tomsk Oblast	1	1	2	4	1	1	4	15
Republic of Tyva	1	1	1	3	1	1	3	12
Republic of Khakassia	1	1	1	3	1	1	3	12
Amur Oblast	1	1	1	3	1	1	2	11
Jewish Autonomous Region	1	1	1	1	1	1	2	9
Magadan Oblast	1	1	1	4	1	1	4	14
Primorskiy Krai	1	1	1	3	1	2	3	13
Republic of Sakha/Yakutiya	1	1	2	1	1	1	2	10
Sakhalin Oblast	1	1	1	4	1	1	4	14
Khabarovsk Krai	1	1	1	4	1	1	4	14

Table 8. Ratings of Russian regions, 2010

Subject of the Federation	A	B			C			Total places
		x1	x2	x3	x1	x2	x3	D
1	4	5	6	7	8	9	10	11
Belgorod Oblast	2	1	1	2	1	1	2	12
Bryansk Oblast	2	1	1	2	1	1	2	13
Vladimir Oblast	4	1	2	2	1	2	2	18
Voronezh Oblast	2	2	2	2	3	2	2	18
Ivanovo Oblast	3	1	1	2	1	1	2	15
Kaluga Oblast	4	1	1	3	1	1	2	17
Kostroma Oblast	3	1	1	2	1	1	2	15
Kursk Oblast	2	1	1	2	1	1	2	13
Lipetsk Oblast	3	2	1	2	2	1	3	17
Moscow	4	4	4	4	4	4	4	32
Moscow Oblast	4	3	3	3	4	3	3	27
Orel Oblast	3	1	1	2	1	1	2	14
Ryazan Oblast	4	1	1	2	1	1	2	13
Smolensk Oblast	2	1	1	2	1	1	2	13
Tambov Oblast	3	1	1	2	1	1	2	14
Tver Oblast	4	1	1	2	1	1	2	16
Tula Oblast	4	1	1	2	1	1	2	16
Yaroslavl Oblast	3	1	1	2	1	2	2	16
Arkhangelsk Oblast	1	1	1	3	1	2	3	14
Vologda Oblast	2	1	2	2	1	2	3	15
Kaliningrad Oblast	1	1	1	3	1	1	3	13
Republic of Kareliya	2	1	1	3	1	1	3	14
Komi Republic	1	2	1	4	1	1	4	16
Leningrad Oblast	3	3	1	3	3	1	3	20
Murmansk Oblast	1	1	1	4	1	1	4	14
Nenets Autonomous Okrug	1	1	1	4	1	1	4	14
Novgorod Oblast	2	1	1	3	1	1	3	15
Pskov Oblast	2	1	1	2	1	1	2	12
Saint-Petersburg	2	4	3	4	4	3	4	26
Republic of Adygeya	2	1	1	2	1	1	2	12
Astrakhan Oblast	2	1	1	3	1	1	2	13
Volgograd Oblast	2	1	1	3	1	1	3	15
Kalmykia	2	1	1	2	1	1	1	11
Krasnodar Krai	2	4	3	2	4	2	3	22
Rostov Oblast	2	2	2	2	2	1	2	15
Republic of Daghestan	1	2	2	2	2	2	2	14
Ingush Republic	2	1	1	2	1	1	2	12
Kabarda-Balkar Republic	2	1	1	2	1	1	2	12
Karachai-Cherkes Republic	2	1	1	2	1	1	2	12

Republic of North Ossetia – Alania	2	1	1	2	1	1	1	11
Stavropol Krai	2	1	2	2	1	2	2	14
Republic of Bashkortostan	2	2	2	3	2	2	3	18
Kirov Oblast	2	1	1	2	1	1	2	12
Republic of Mari El	2	1	1	2	1	1	2	13
Republic of Mordovia	2	1	1	2	1	2	2	14
Nyzhniy Novgorod Oblast	2	2	2	3	2	2	3	19
Orenburg Oblast	2	2	2	2	1	2	3	16
Penza Oblast	2	1	1	2	1	1	1	12
Perm Krai	2	2	2	3	3	2	3	18
Samara Oblast	2	2	2	3	2	2	3	17
Saratov Oblast	2	1	2	2	1	2	3	14
Republic of Tatarstan	2	3	2	3	3	2	3	19
Republic of Udmurtiya	2	1	1	2	1	1	2	11
Ulyanovsk Oblast	2	1	1	2	1	1	1	10
Republic of Chuvashia	2	1	1	2	1	1	2	13
Kurgan Oblast	2	1	1	2	1	1	2	12
Sverdlov Oblast	2	3	3	3	2	2	3	20
Tyumen Oblast	2	4	2	4	4	2	4	24
Chelyabinsk Oblast	2	2	2	3	2	2	3	18
Altai Republic	1	1	1	2	1	1	2	10
Altai Krai	1	1	2	2	1	2	2	12
Republic of Buryatia	1	1	1	3	1	1	3	12
Trans-Baikal Krai	1	1	1	3	1	1	3	12
Irkutsk Oblast	1	2	1	3	2	1	2	13
Kemerovo Oblast	1	2	2	3	2	2	3	16
Krasnoyarsk Krai	1	4	2	4	4	2	3	21
Novosibirsk Oblast	1	2	2	3	2	2	3	16
Omsk Oblast	1	1	2	3	1	2	3	14
Tomsk Oblast	1	1	1	3	1	1	3	12
Republic of Tyva	1	1	1	3	1	1	3	12
Republic of Khakassia	1	1	1	3	1	1	3	12
Amur Oblast	1	1	1	3	1	1	3	12
Jewish Autonomous Region	1	1	2	1	1	1	1	9
Magadan Oblast	1	1	1	4	1	1	4	14
Primorskiy Krai	1	2	2	3	2	2	3	16
Republic of Sakha/Yakutiya	1	2	1	4	2	1	4	16
Sakhalin Oblast	1	2	1	4	2	1	3	15
Khabarovsk Krai	1	2	1	3	2	2	3	15

The comparative analysis of the calculation results using the Kohonen layer and self-organizing net (Tables 7, 8, Columns A and B) reveals that the work of the Kohonen layer slightly differs from the work of the self-organizing network. In some cases the self-organizing network omitted one group while classifying the

regions. That is why it is useful to apply both the Kohonen layer and the self-organizing network in order to improve accuracy of the calculation.

The calculation results in tables 7 and 8 allow to segment the regions. In our research we identified 4 groups of regions from the most attractive to the least attractive for investors to locate a business in accordance with the criterion in column D: the first group includes the most attractive regions and the forth one – the least attractive (Tables 9, 10).

Table 9. Classification of Russian regions by attractiveness for investors to locate a business, 2005

I group (28-23)	II group (22-18)	III group (17-13)	IV group (12-8)
Moscow	Saint-Petersburg	Kaluga Oblast	Belgorod Oblast
Moscow Oblast	Krasnodar Krai	Lipetsk Oblast	Bryansk Oblast
	Tyumen Oblast	Tver Oblast	Tver Oblast
	Krasnoyarsk Krai	Tula Oblast	Tula Oblast
		Yaroslavl Oblast	Yaroslavl Oblast
		Arkhangelsk Oblast	Arkhangelsk Oblast
		Republic of Komi	Kursk Oblast
		Leningrad Oblast	Orel Oblast
		Nenets Autonomous Okrug	Ryazan Oblast
		Volgograd Oblast	Smolensk Oblast
		Rostov Oblast	Tambov Oblast
		Republic of Bashkortostan	Vologda Oblast
		Nyzhniy Novgorod Oblast	Kaliningrad Oblast
		Orenburg Oblast	Respublika Kareliya
		Perm Krai	Murmansk Oblast
		Samara Oblast	Novgorod Oblast
		Saratov Oblast	Pskov Oblast
		Republic of Tatarstan	Respublika Adygeya
		Sverdlov Oblast	Astrakhan Oblast
		Chelyabinsk Oblast	Respublika Kalmykiya
		Irkutsk Oblast	Respublika Dagestan
		Novosibirsk Oblast	Respublika Ingushetiya
		Omsk Oblast	Kabarda-Balkar Republic
		Tomsk Oblast	Karachai-Cherkes Republic
		Magadan Oblast	Republic of North Ossetia - Alania
		Sakhalin Oblast	Stavropol Krai
		Khabarovsk Krai	Kirov Oblast
			Republic of Mariy El
			Republic of Mordoviya
			Penza Oblast
			Republic of Udmurtiya
			Ulyanovsk Oblast
			Republic of Chuvashia
			Kurgan Oblast
			Republic of Altay
			Altai Krai
			Republic of Buryatiya
			Trans-Baikal Krai
			Kemerovo Oblast
			Republic of Tyva
			Republic of Khakasiya
			Amur Oblast
			Jewish Autonomous Oblast
			Primorskiy Krai
			Republic of Sakha (Yakutiya)

Table 10. Classification of Russian regions by attractiveness for investors to locate a business, 2010

I group (28-23)	II group (22-18)	III group (17-13)	IV group (12-8)
Moscow	Krasnodar Krai	Vladimir Oblast	Belgorod Oblast
Moscow Oblast	Republic of Tatarstan	Voronezh Oblast	Bryansk Oblast
Saint-Petersburg	Sverdlov Oblast	Kaluga Oblast	Ivanovo Oblast
	Krasnoyarsk Krai	Lipetsk Oblast	Kostroma Oblast
	Tyumen Oblast	Vologda Oblast	Kursk Oblast
		Republic of Komi	Orel Oblast
		Leningrad Oblast	Ryazan Oblast
		Murmansk Oblast	Smolensk Oblast
		Nenets Autonomous Okrug	Tambov Oblast
		Rostov Oblast	Tver Oblast
		Republic of Dagestan	Tula Oblast
		Republic of Bashkortostan	Yaroslavl Oblast
		Nyzhniy Novgorod Oblast	Arkhangelsk Oblast
		Orenburg Oblast	Kaliningrad Oblast
		Perm Krai	Republic of Kareliya
		Samara Oblast	Novgorod Oblast
		Saratov Oblast	Pskov Oblast
		Chelyabinsk Oblast	Respublika Adygeya
		Kemerovo Oblast	Astrakhan Oblast
		Novosibirsk Oblast	Volgograd Oblast
		Omsk Oblast	Republic of Kalmykiya
		Magadan Oblast	Republic of Ingushetiya
		Primorskiy Krai	Kabarda-Balkar Republic
		Republic of Sakha (Yakutiya)	Karachai-Cherkes Republic
		Sakhalin Oblast	Republic of North Ossetia - Alania
		Khabarovsk Territory	Stavropol Krai
			Kirov Oblast
			Republic of Mariy El
			Republic of Mordoviya
			Penza Oblast
			Republic of Udmurtiya
			Ulyanovsk Oblast
			Republic of Chuvashia
			Kurgan Oblast
			Republic of Altay
			Altai Krai
			Republic of Buryatiya
			Trans-Baikal Krai
			Irkutsk Oblast
			Tomsk Oblast
			Republic of Tyva
			Republic of Khakasiya
			Amur Oblast
			Jewish Autonomous Oblast

Tables 9 and 10 show that Moscow and Moscow Oblast are the absolute leaders by all parameters; these regions are included into the first group. The group is the smallest and includes only two regions. The second group includes slightly more regions – in 2010 it included 6 regions attractive for investors. Groups 3 and 4 are the most numerous and unattractive for economic activity, in 2010 group 4 (the most unattractive) was bigger that group 3 by 14 regions. Some regions of Russia, such as Krasnodar Krai, Republic of Bashkortostan and Sverdlovsk Oblast had improved their positions over 5 years, and moved from group 3 into group 2 thus having increased their attractive force.

Tables 9 and 10 prove spatial differentiation of Russia's economy by means of spatial differentiation of factors affecting business location in regions. It is obvious that modern Russia has a very high level of spatial differentiation – most regions are the most unattractive for business location, and vice versa, only few regions are the most attractive for business location.

So, applying the neural networks to assess factors affecting the location of a business in Russian regions allows to identify regions with similar features in terms of basic factors of business location in conditions of incomplete information.

4. Conclusions

The results of the research are the following:

1. To investigate spatial differentiation of the regions' economic development, it is necessary to carry out analysis of regional economies based on numerous parameters affecting the attractiveness of a region for business location. In the context of incomplete information, applying self-learning neural networks gives good results. Neural networks, alternatively to the traditional methods of data processing operations, help to solve problems without preliminary hypotheses and theoretical conclusions (for example, to state that the desired value is linear or one variable has normal distribution). The neural approach can be used both for linear and complex nonlinear relations, but it is especially effective while used in the exploratory data analysis aiming at finding out any relations between different variables. It should be noted that the data can be incomplete, controversial or even knowingly corrupted. If there is relation between input and output data, even non-discoverable by the traditional correlation methods, the neural network is able to automatically set itself up for that relation with a desired level of accuracy.

2. The empirical analysis proved the hypothesis that Russia is characterized by a significant spatial differentiation of the market potential: only few Russian regions have the biggest market potential, whereas a large majority of the regions have small market potential. The obtained results emphasize spatial differentiation of Russia's economic development.

3. Segmentation of Russian regions based on the market potential and other multidimensional data allowed to group regions with similar features in terms of basic factors of business location. The obtained results prove the hypothesis about spatial differentiation of Russia's economy through spatial differentiation of factors of business location in Russian regions. Russia is characterized by a high and growing level of spatial differentiation: a large majority of the regions are the least attractive for business location and only few Russian regions are attractive for business location.

4. The results of Russia' regions segmentation allow to select the most attractive regions to locate a business. Thus, methods of "new economic geography" help to find patterns of business location in modern market economy of Russia.

5. Correlation-regression analysis helped to establish casual relationship between the fixed asset investment on the one hand and the number of economically active population and average nominal monthly wage on the other hand. However, there is no relationship between the fixed asset investment and retail market potential of a region.

6. The results of our research allow to determine the most important task of public authorities, both at the federal level and at the regional level, which is to reduce spatial differentiation of Russia's economic development. Normal economic development of the country is impossible in a situation where the capital and nearby regions are the only regions characterized by the maximum values.

7. The obtained results also allow to assess the effectiveness of the regional development policy and to find ways of increasing its effectiveness. To reduce the level of spatial differentiation it is proposed to take into account the specificity of certain groups of the regions, as well as to use the policy of selective impact on growth points in the regions, on key industries of economic growth. The transition of the regions from groups with low rates into groups with higher rates can indicate correct management decisions of public authorities in the sphere of economic policy.

References

Abramov, A., & Gluschenko, K. (2000). *The Shortest Distances between Capital Cities of Russian Regions (km).* Novosibirsk, RF: Novosibirsk State University. Retrieved from http://econom.nsu.ru/staff/chair_et/gluschenko/Research/Data/Distances.xls

Baldwin, R. E. (1998). Agglomeration and endogenous capital. *NBER Working Paper*, 6459.

Baldwin, R., Forslid, R., Martin, P., Ottaviano, G., & Robert-Nicound, F. (2003). *Economic geography and public policy.* Princeton, USA*:* Princeton University Press.

Dixit, A., & Stiglitz, J. (1977). Monopolistic competition and optimum product diversity. *American Economic Review, 67*, 297-308.

Domar, E. D. (1946, April). Capital Expansion, Rate of Growth, and Employment. *Econometrica, 14*(2), 137-147. http://dx.doi.org/10.2307/1905364

Federal State Statistics Service. (2012). *Central database of statistical information.* Retrieved August 25, 2012, from http://www.gks.ru/dbscripts/Cbsd/DBInet.cgi

Fujita, M., Krugman, P., & Venables, A. (1998). *The spatial economy: cities, regions and international trade.* Manuscript.

Harris, C. D. (1954). The market as a factor in the localization of industry in the United States. *Annals of the Association of American Geographers, 44*(4), 315-348.

Harrod, R. (1939). An Essay in Dynamic Theory. *Economic Journal, 49,* 14-33. http://dx.doi.org/10.2307/2225181

Haykin, S. (1999). *Neural Networks: A Comprehensive Foundation* (2nd ed.). New Jersey: Prentice-Hall.

Hebb, D. O. (1949). *The organization of Behavior: A Neuropsychological Theory.* New York: Wiley.

Hopfield, J. J. (1982, April). Neural networks and physical systems with emergent collective computational abilities. *Proceedings of National Academy of Sciences, 79*(8), 2554-2558. http://dx.doi.org/10.1073/pnas.79.8.2554

Kohonen, T. (1982). Self-Organized Formation of Topologically Correct Feature Maps. *Biological Cybernetics, 43,* 59-69. http://dx.doi.org/10.1007/BF00337288

Kruglov, V. V., & Borisov, V. V. (2001). *Artificial Neural Networks. Theory and practice.* Moscow: Hot line - Telecom.

Krugman, P. (1991a). *Geography and trade.* Cambridge, MA: MIT Press.

Krugman, P. (1991b). History versus expectations. *Quarterly Journal of Economics, 106*(2)*,* 651-667. http://dx.doi.org/10.2307/2937950

Krugman, P. (1991c). Increasing returns and economic geography. *Journal of Political Economy, 99,* 483-499. http://dx.doi.org/10.1086/261763

Krugman, P., & Venables, A. (1995). Globalization and the inequality of nations. *Quarterly Journal of Economics, 60,* 857-880. http://dx.doi.org/10.2307/2946642

Krugman, P., & Venables, A. (1996). Integration, specialization, and adjustment. *European Economics Review, 40,* 959-967. http://dx.doi.org/10.1016/0014-2921(95)00104-2

Lysenko, Y. G., Mints, A. Y., & Stasyuk, V. G. (2002). *A search for effective solutions to economic problems*. Donetsk: Donetsk National University, Yugo-Vostok, Ltd.

Markusen, J. R., & Venables, A. J. (1997). Foreign direct investment as a catalyst for industrial development. *NBER Working Paper, 6241*.

Martin, P., & Ottaviano, G. I. (1996). Growth and agglomeration. *Center for Economic Policy Research (CEPR), Discussion Paper, 1529*.

Martin, P., & Ottaviano, G. I. (1999). Growing location: Industry location in a model of endogenous growth. *European Economics Review, 43,* 281-302. http://dx.doi.org/10.1016/S0014-2921(98)00031-2

Matsuyama, K. (1991). Increasing returns, Industrialization and indeterminacy of equilibrium. *Quarterly Journal of Economics, 106*(2), 617-650. http://dx.doi.org/10.2307/2937949

McCulloch, W. S., & Pitts, W. (1943). A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematical Biophysics, 5,* 115-133. http://dx.doi.org/10.1007/BF02478259

Minsky, M. L., & Papert, S. A. (1969). *Perceptions.* Cambridge, MA: MIT Press.

Odrin, V. M., & Kartavov, S. S. (1977). *Morphological analysis of systems*. Kiev, Ukraine: Naukova Dumka.

Puga, D. (1999). The rise and fall of regional inequalities. *European Economics Review, 43*(2), 303-334. http://dx.doi.org/10.1016/S0014-2921(98)00061-0

Rosenblatt, F. (1958). The perceptron: A probabilistic model for information storage and organization in the brain. *Psychological Review, 65,* 386-407. http://dx.doi.org/10.1037/h0042519

Rumelhart, D. E., Hinton, G. E., & Williams R. J. (1986). Learning internal representations by error propagation. In J. L. McClelland, & D. E. Rumelhart (Eds.), *Parallel Distributed Processing: Explorations in the Microstructure of Cognition* (Vol. 1, pp. 318-362). Cambridge MA: MIT Press.

Russia-2012. *Statistical Handbook, 2012* (pp. 33-34). Moscow, RF: Rosstat.

Venables, A. (1996). Equilibrium location with vertically linked industries. *International Economics Review, 37,* 341-359. http://dx.doi.org/10.2307/2527327