ESTIMATION OF FACTORS FOR SOCIAL AND ECONOMIC INEQUALITY OF RUSSIA'S TOWNS

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Abstract

At the present-day stage of economics development the issue of productive power arrangement over the Russia's territory is being intensively researched due to ever growing differentiation of social and economic state of towns. The goal is to identify factors and estimate their impact on the social and economic inequality of Russia's towns. The key factors under consideration include the size of engaged population, investment in a town budget, population density, density of hard-surface roads, distance along motor roads to the town center. The factor model is constructed by a least-square method. The authors made use of the data from the Federal State Statistics Service as of 2003, 2009, 2014, the research covered the populated areas having a town status with the population size over 100 thous. people.

It has been proven empirically that positive impact on the social and economic inequality of Russia's towns is the most significant from volume of investments in a town budget and level of transport infrastructure development. Such factor as geographic arrangement of the towns has a noticeable negative influence on the social and economic inequality of towns. However, in the Siberian Federal district, a factor of distance along motor roads to the nearest major town correlates with the industrial output, thus demonstrating that trade in the towns of this Federal District is aimed at the foreign market. In Southern, North Caucasian, Ural, Siberian and Far Eastern Federal Districts the inflow of labor resources to a town exceeds demand thereof, thus confirming migration of engaged population to big towns. Research outcomes may be utilized in creation of procedural aids for development of mechanisms to level out interregional inequalities, social and economic development programs of a town.

Keywords: town, social and economic inequality, inequality factors, interregional differentiation, production output, engaged population, investment, salary, density population, least-square method.

JEL classification:

1. Introduction

Russia holds the first line in the territory size and the 181th line in population density in the world, which determines its unique pattern of towns and economic activity distribution over the territory and differences between the regions that pose a number of problems at the current stage of development. High income differences, concentration of competitive advantages in some areas and deficiency thereof in others are worsened by social inequality. Issues of unequal access to the labour market, education, health service are aggravating, thus threatening the state integrity and politico-social stability. Various mechanisms of levelling out differences between the regions are actually used: budget transfers between regions, support of "advanced development areas", implementation of one-factory town renewal programs. In taking the above measures, high emphasis is put on understanding the processes of concentration of resources, population, enterprises in towns as economic growth sources.

An issue of production power arrangement over the Russia's territory at the current stage of economics development is a subject of systematic and dynamic research, which is caused by ever growing differences between the towns: maximum production output per capita in

2003 was noted in Norilsk, equalling to 823 thous. RUB, minimum one in Gorno-Altaysk, equaling to 2 thous. RUB (411 times as low), maximum one in 2009 – in Achinsk, equaling to 1,570 thous. RUB, minimum one – in Nazran, equaling to 2.17 thous. RUB (723 times as low), maximum one in 2014 – Almetyevsk, equaling to 2,831 thous. RUB, minimum one – in Nazran, equaling to 11.5 thous. RUB (246 times as low) . Maximum population density in 2003 was noted in Lubertsy, equaling to 12,320 people per km2 , minimum one – in Ukhta, equaling to 9.6 people per km2 (1,283 times as low); maximum one in 2009 – in Lubertsy, equaling to 12,354 people per km2 , minimum one – in Ukhta, equaling to 9.5 people per km2 (1,300 times as low); maximum one in 2014 – in Odintsovo, equaling to 7,163.3 people per km2 , minimum one – in Yelets, equaling to 1.49 people per km2 (4,800 times as low).

The goal of research, which outcomes are presented here, is to identify factors and estimate their impact on social and economic inequality of Russia's tows.

2. Review of the research

Spatial distribution of towns and development of social and economic inequality among them are impacted by numerous factors. A theory of changing over from one spatial pattern of country development to another one is supported by a concept of spatial equilibrium plurality, which has a theoretical justification in agglomeration economics [1]. While studying specific features of territorial distribution of towns by an example of France, P.-P. Combe et al. identified factors of spatial inequality: size of a local market; localization effects; urbanization effects; market potential [2].

R. Arenda uses political, institutional, structural and geographical characteristics to explain differences in growth rates of country regions [3]. Researchers emphasize significance of the town size (size of population) in formation of urban stability and population's quality of life, thus providing economic reasons for town dynamics. Urban stability correlates with size of a town, with change in house price in future periods depending on demographic data [4]. The research cannot ignore the role of geography of markets and neighbours in hierarchy of towns. A growth rate of neighbouring towns has a direct influence on a town [5]. Socio-economic activity in a town is determined not only by internal production factors but also by effects generated by neighbouring towns and territories. S. Harris used market potential for measurement of territory accessibility in domestic markets. Market potential of a region is measured as distance of weighted total of economic activities in other territories [6].

A role of geographic factors ("primary factors") in estimation of urban inequality needs to be determined. Within a territory, distribution of town sizes follows the Pareto distribution with index equalling to one [7]. Zipf's law as applied to towns is an example of agglomeration law that expresses the most precise relationship in economics. Demographic distribution of individuals over the Earth's surface with sharp peaks of population concentration in towns alternating with relatively long spans where population density is much lower follows a power law of standard dynamics typical of complicated systems [8]. Zipf's law must be used as background for the local-wise town growth law [9]. According to the research, distribution of town sizes requires considering impact of international relationships on the economic growth process [10].

Specific features of town start and end were considered by L. Dobkins, U. Ioannidis, A. Anas and others [11, 12].

Though issues of urban inequality are mostly dealt with by foreign scientists, some aspects have been studied in Russian papers as well. Certain fields were studied by: A. Aleksandrova, Ye. Grishina (estimation of intraregional inequality) [10], O. S. Balash (spatial modeling of towns) [11], A. N. Bufetova (trends in "center-periphery" system development) [12], K. P. Glushchenko (estimation of interregional inequality) [13], Zh. Zayonchkovskaya, N. Nozdrina (migration flows, attractiveness radius of cities on the basis of social studies) [14]; N. V. Zubarevich (regional and urban inequality) [15], E.A. Kolomak (spatial development inequality, town agglomerations) [16], M. Yu. Malkina (inequality of regional income) [17], A. Treyvish, T. Nefedova (state estimation of country's towns, forecast of their response to financial crisis) [18]; I. E. Trubekhina (spatial inequality of Russia's regions) [19]; A. Yu. Shevyakov (social inequality and economic growth) [20].

## 3.   Specific features of socio-economic inequality of Russia's towns

The territory of Russia accommodates fifteen million-plus cities: in the Central Federal District: Moscow and Voronezh; North-Western Federal District - Saint Petersburg; Southern Federal District - Rostov-on-Don, Volgograd; Privolzhsky Federal District - Ufa, Kazan, Perm, Nizhni Novgorod, Samara; Ural Federal District - Ekaterinburg, Chelyabinsk; Siberian Federal District - Krasnoyarsk, Novosibirsk, Omsk. North Caucasian and Far Eastern Federal Districts do not have towns with million-plus population. Figure 1 shows results of analysis of Russian towns distribution, density and urbanization level within a federal district.
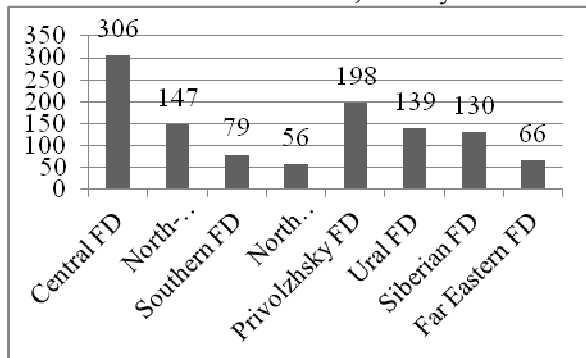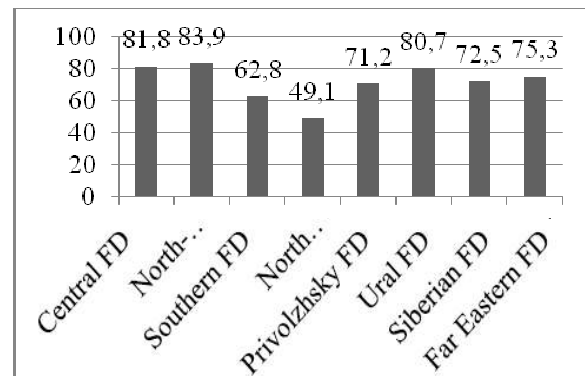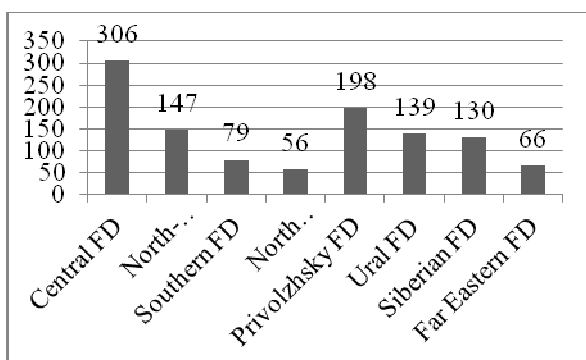

a) number of towns, units
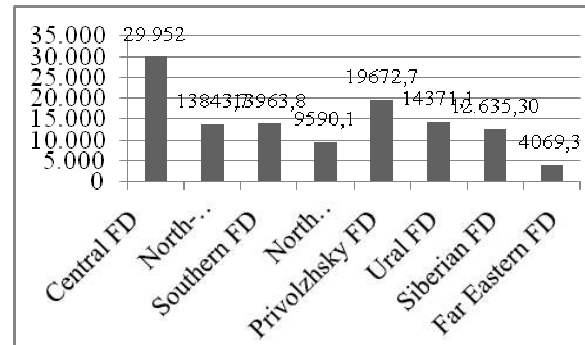
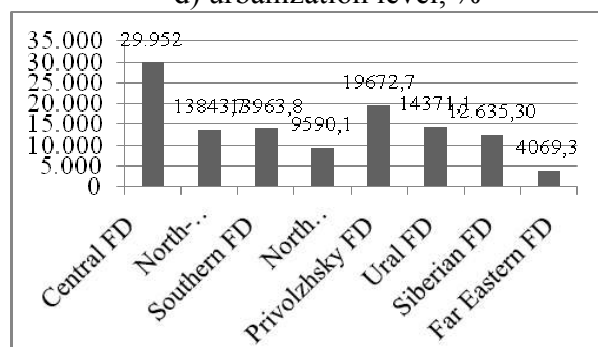b) size of town population, thous. people
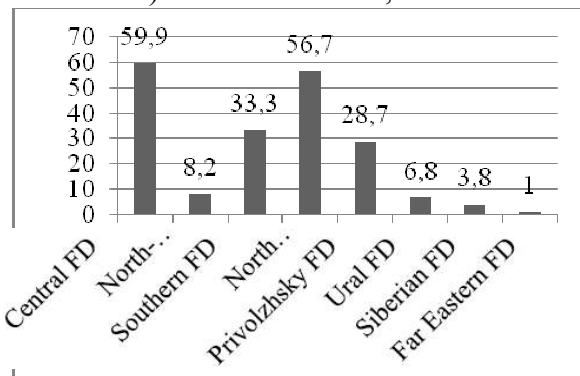
c) population density, people per m^2
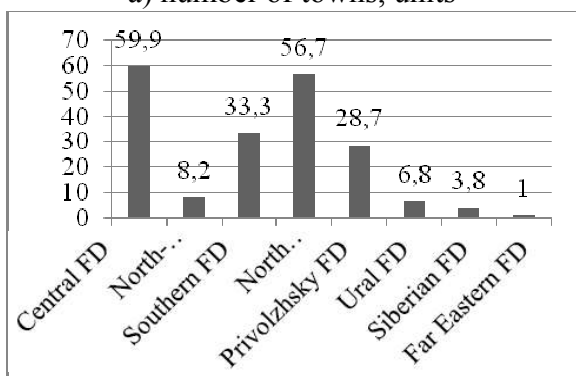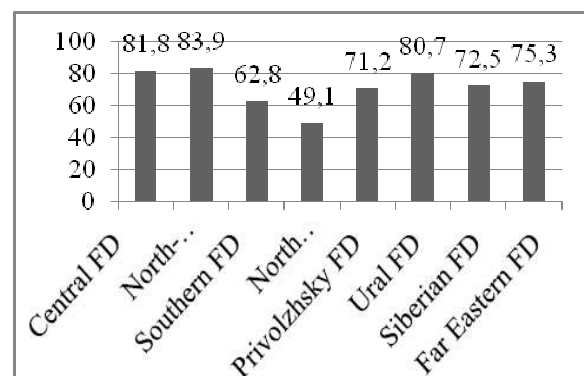

d) urbanization level, %

a) number of towns, units

b) size of town population, thous. people

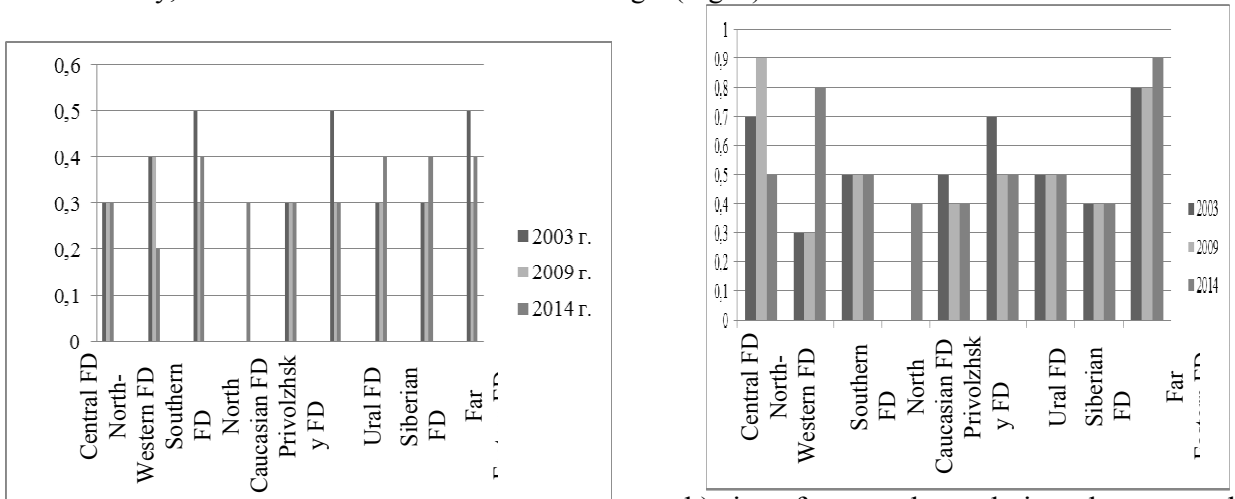c) population density, people per m^2

d) urbanization level, %

Fig. 1 Distribution of towns over the territory of Russia in 2014 [123].

The Central Federal District is a leader in number of towns and urban population size. It should be noted that Moscow population size equals to 12,108 thous. people, with 17,844 thous. people living in 305 towns. The same situation is observed in the North-Western Federal District: population size of Saint Petersburg is 5,132 thous. people, with 8.711.7 thous. people living in the rest 146 towns. Population concentration in Moscow and Saint Petersburg determines the high inequality level of the towns in terms of population size. Low figures of the population size parameter in towns of North-Western, Ural, Siberian and Far Eastern Federal Districts result from climatic conditions of these areas.

To analyse the socio-economic inequality of towns in Russia, we find it necessary to calculate the Gini coefficient for such parameters as size of engaged population, population density, volume of investment in the town budget (Fig. 2).

a) population density, people per km^2

b) size of engaged population, thous. people
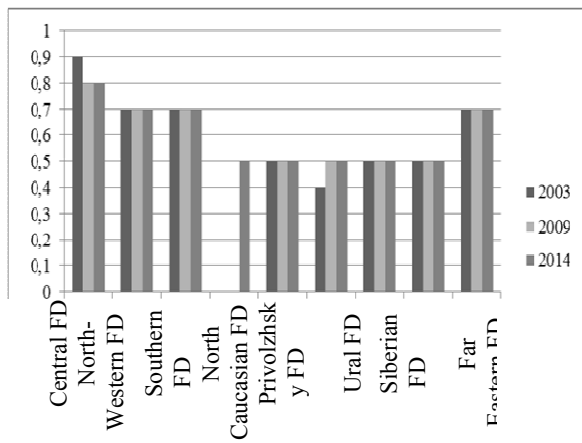
c) volume of investment in the town budget

Calculated from data: [1,14, 15]

Fig. 2 Dynamics of Gini coefficient in the towns of Russia in 2003-2014[456].

Population density. During the period from 2003 to 2014, along with high values of the coefficient, its negative growth takes place in North-Western, Southern, Ural Federal Districts and over Russia as a whole, which is a result of decrease in population size of small towns. In Central and Privolzhsky Federal Districts the Gini coefficient as applied to the parameter has not changed, moreover its value (0.3) proves a low level on inequality for the parameter under analysis.
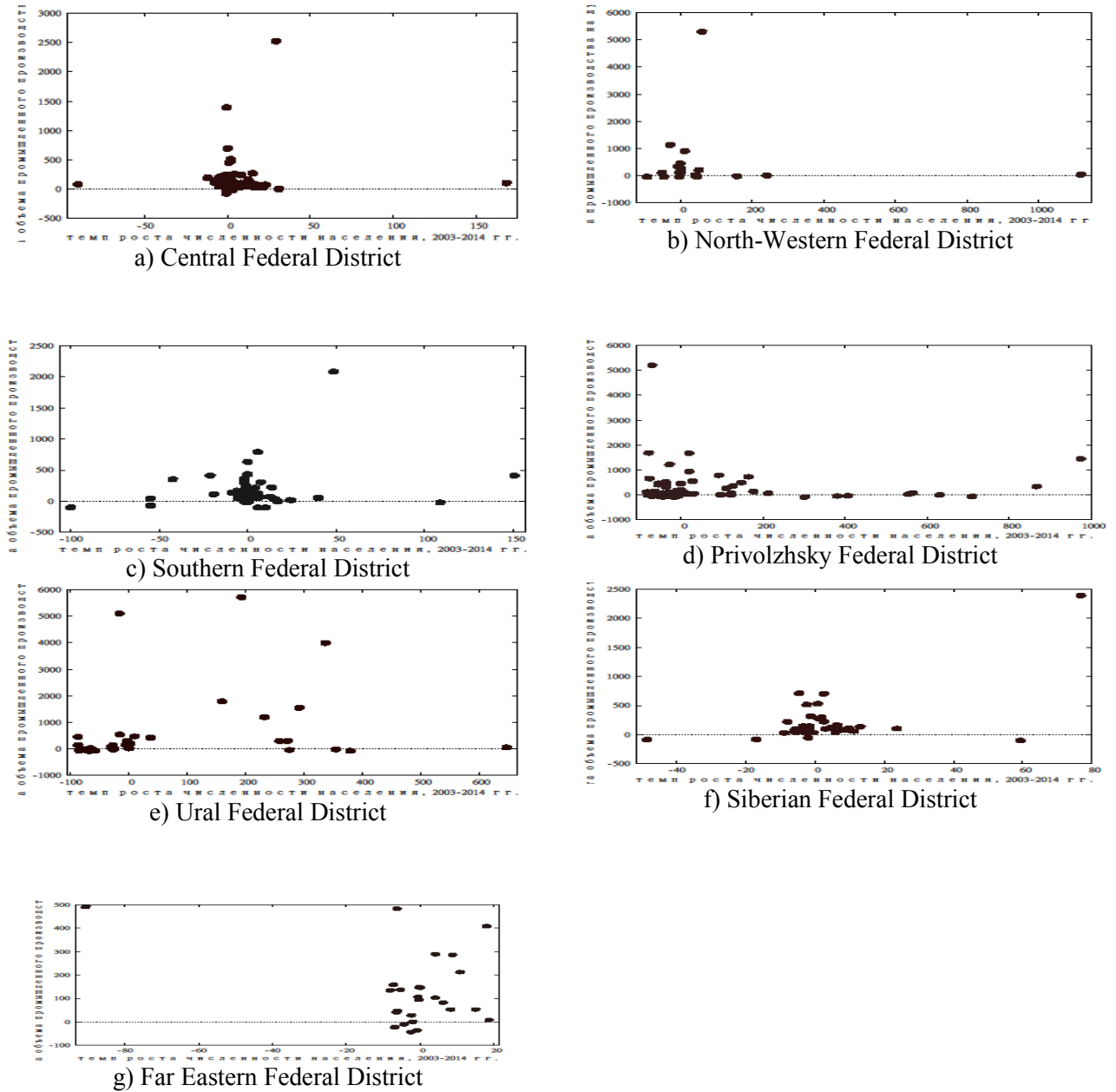
Size of engaged population. As for the given parameter, the high level of inequality can be seen in towns of the Central Federal District in 2009 while its negative growth suggests dispersion of engaged population. Positive growth of the Gini coefficient is present in the North-Western Federal District, which means concentration of engaged population in big towns. No changes occurred during the analyzed period in Southern, Siberian and Far Eastern Federal Districts.

High inequality of towns as far as volume of fixed capital expenditure is concerned can be seen in the Central Federal District (exceeding the overall Russian level), thus emphasizing the high level of inequality between Central Federal District towns. For example, in 2003 the volume of investments in Moscow's budget amounted to 263,797 mln RUB, in that of Orekhovo-Zuevo (minimum values in the District) – to 136.3 mln RUB. A steadily low Gini coefficient is typical for Privolzhsky, Ural, Siberian and Far Eastern Federal Districts.

Another by no means unimportant factor contributing to inequality of Russian towns is the level of transport infrastructure development, access of this or that market participant to sale markets. It should be noted that the traffic infrastructure is better developed in Saint Petersburg (2,156 km of roads per 1,000 sq m of territory), Moscow (2,114 km of roads per 1,000 sq m of territory), Moscow Region (695 km of roads per 1,000 sq m of territory), Republic of North Ossetia – Alaniya (633 km of roads per 1,000 sq m of territory), Belgorod Region (600 km of roads per 1,000 sq m of territory), and Republic of Adygeya (526 km of roads per 1,000 sq m of territory). The lowest values of this parameter are exhibited by the Chukotka Autonomous District (0.9 km of roads per 1,000 sq m of territory), Republic of Sakha (Yakutia) (3.3 km of roads per 1,000 sq m of territory), Kamchatka Region (3.9 km of roads per 1,000 sq m of territory), Magadan Region (5.3 km of roads per 1,000 sq m of territory), Khabarovsk Region (8 km of roads per 1,000 sq m of territory), and Krasnoyarsk Region (11 km of roads per 1,000 sq m of territory).

An indicator of town's economic inequality is industrial output per capita. Since positive growth rate of this parameter may be caused by decrease of population size in a town, let's analyze any relationship between growth rate of urban population and growth rates of industrial output per capita, with a breakdown into Federal Districts (Fig. 3).

a) Central Federal District

b) North-Western Federal District

c) Southern Federal District

d) Privolzhsky Federal District

e) Ural Federal District

f) Siberian Federal District

g) Far Eastern Federal District
Calculated from data: [1, 14,15]

Fig. 3 Relationship of population size growth rate and growth of industrial output per capita in the towns of Russia , 2003-2014[7].

The derived plots show mixed and inhomogeneous situation, which means that the "population reduction effect" is not determinant for growth of industrial output per capita in the towns of Russia.

An important criterion of social inequality between towns is salary level. According to some researchers [16;17], high contrast of salaries in towns is caused by influence of labour resources skill level. The higher the share of low-skilled employees is, the less significant is the difference in salaries between a major town and surrounding territory. A quality of life indicator is minimum cost of living vs. average monthly salary (Table 3).

Table 3 Analysis of salaries in the towns of Russia, 2014[8910].

Federal District	Average monthly salary, RUB			Share of minimum cost of living in average monthly salary, %		
	Max	Min	Gini coef.	Max	Min	Gini coef.
Central FD	55,485 Moscow	20,085 Elets	0.5	36 Murom	17 Khimki	0.15
North-Western FD	46,350 Murmansk	22,979 Petrozavodsk	0.05	31 Pskov	22 Cherepovets	0.1
Southern FD	36,311 Sochi	17,580 Novoshakhtinsk	0.1	42 Novoshakhtinsk	21 Sochi	0.1
North Caucasian FD	26,835 Stavropol	16,111 Derbent	0.08	44 Derbent	26 Stavropol, Pyatigorsk	0.07
Privolzhsky FD	32,801 Perm	20,077 Orsk	0.07	38 Syzran	21 Ufa	0.08
Ural FD	79,466 Novy Urengoy	21,693 Zlatoust	0.12	34 Zlatoust	16 Novy Urengoy	0.2
Siberian	66,584 Norilsk	18,918 Rubtsovsk	0.1	37 Rubtsovsk	13 Norilsk	0.1
Far Eastern FD	81,533 Anadyr	31,435 Birobidjan	0.01	32 Komsomosk-on-Amur	18 Yuzhno-Sakhalinsk	0.2
Russia	81,533 Anadyr	16,111 Derbent	0.1	44 Derbent	17 Khimki	0.2

Maximum values (Anadyr) of the parameter under analysis are 5 times as high as minimum ones (Derbent). Within the Federal Districts, the highest difference can be seen in Ural and Siberian Federal Districts. The derived Gini coefficient allows to conclude the following: the highest difference between the towns is exhibited by the Central Federal District, because salaries exceeding the average level are concentrated in the Moscow Region. However, Gini coefficient of the parameter, the share of minimum cost of living in the average monthly salary, is low in the Central Federal District. It is worth noting that difference between towns in other Federal Districts and Russian Federation as a whole is low.

4. Constructing a model.

Lets' assume the following factors as the key ones influencing the level of socio-economic inequality of Russian towns:

1. Size of engaged population of a town (engaged¬_prod) – this parameter reflects influence of "human capital assets" factor. An important role in estimation of labour resources

measure shall be played by employees' skill level but lack of statistical data for Russian towns prevent it from including into a model.

    2.   Investment in the town budget (fdi). We believe that volume of investments in the town budget correlates with parameters of socio-economic inequality of the town.

    3.   Population density (population density). It is supposed that industrial output per capita be higher in densely populated towns.

    4.   Density of hard-surfaced public roads in a town (road). Including the variable in a model results from provisions of neoclassical theory of growth. The parameter is treated as physical infrastructure. We believe that the transport infrastructure development level is quite an important factor adding to socio-economic inequality of towns.

    5.   Distance along motor roads to the center (dist) – the factor of geographic arrangement of towns. Considering its vast territory, we applied to Russia the distance to the nearest big town with population size above 1 mln of people, which we assumed to be an economically isolated industrial center.

As a resulting parameter of urban economic inequality, the industrial output per capita (vip) was determined, of social inequality – salary level (msl).

To construct a model of influence on socio-economic inequality of towns from the factors, let's use panel data of 186 towns (with population sixe over 100 thous. people) in 2003-2014. Calculation will be made by a combined least-square method.

5.   <u>Analysis results.</u>

$Ln_{i,t}(vip)= 1.12 + 0.1 Ln_{i,t}(engaged\_prod) + 0.5\ Ln_{i,t}(fdi) + 0.01\ Ln_{i,t}(population\ density) + 0.09\ Ln_{i,t}(road) - 0.2\ Ln_{i,t}(dist) + \varepsilon;$

$R^2 = 0.54$

$Ln_{i,t}(msl)= 6.9 - 0.1 Ln_{i,t}(engaged\_prod) + 0.4\ Ln_{i,t}(fdi) - 0.03\ Ln_{i,t}(population\ density) + 0.05\ Ln_{i,t}(road) - 0.1\ Ln_{i,t}(dist) + \varepsilon;$

$R^2 = 0.67$

where

i– town;

t– year;

ε– mean-square error of the model.

Thus, a system of models describing influence of the factors on the socio-economic inequality that was constructed for Russian towns allows making some conclusions.

Size of engaged population (0.1) and density of hard-surfaced motor roads (0.09) have virtually equal positive influence on economic inequality of a town. The derived coefficient of the model (0.5) shows that increase of investments in a town's budget gives a significant impetus to the industrial output.

Growth of engaged population has a negative influence on an average monthly salary in Russian towns (-0.1). We may suggest that inflow of labour resources to a town grows faster than demand thereof, thus contributing to reduction of a relative salary. We believe that it is reasonable to research these results additionally.

Growth of investments to a town's budget (0.4) and density of motor roads (0.05) are directly correlated with salary growth in Russia's towns.

More densely populated towns do not exhibit apparent advantage in terms of socio-economical efficiency. Distance to the nearest major town has a negative influence on economic (-0.2) and social (-0.1) state. We believe the obtained results to be consistent because a factor of geographic arrangement of a town plays a key role in this case. The farther the town from major markets is, the lower is the probability of positive correlation between the relative industrial output and an average monthly salary.

Determination coefficients 0.54 and 0.67 point to a number of factors ignored in this system of the model.

For the purpose of a more detailed analysis, the developed model describing influence of the factors on socio-economic inequality of towns was constructed for each Federal District (Tables 3, 4).

Table 4 Coefficients of the model describing influence of the factors on economic state of towns within Federal Districts of Russia 2003-2014

Factor	Central FD	North-Western FD	Southern FD	North Caucasian FD	Privolzhsky FD	Ural FD	Siberian	Far Eastern FD
Constant	1.14	–1.5	1.5	16	2.9	0.9	-1.6	-0.5
Size of engaged population in town (*engaged-_prod*)	0.12 **	-0.02	-0.04	0.01	0.01	-0.1	0.3*	-0.1
Investment in the town budget (*fdi*)	0.35 ***	1.2***	0.4***	0.07	0.4***	0.6***	0.7***	0.7***
Population density (*population density*)	0.01	-0.2	0.2	-0.2	-0.06	0.1	0.1	-0.04
Density of hard-surfaced public roads in a town (*road*)	0.2**	0.09*	0.1	0.08	0.2*	0.08	0.09*	0.06
Distance along motor roads to the nearest major town *(dist)*	-0.3	-0.5**	-0.33***	-1.9**	-0.2***	-0.2	0.2	-0.1
Mean-square error of the model	0.73	0.77	0.91	1.4	0.8	1	1	0.6
Determination coefficient	0.51	0.73	0.45	0.38	0.52	0.54	0.62	0.72
Number of observations	**133**	**39**	**54**	**45**	**96**	**57**	**69**	**38**

Table 5 Coefficients of the model describing influence of the factors on social state of towns within Federal Districts of Russia 2003-2014

Factor	Central FD	North-Western FD	Southern FD	North Caucasian FD	Privolzhsky FD	Ural FD	Siberian	Far Eastern FD
Constant	7.6	5.6	7.8	2.4	6.8	8	7.7	7.2
Size of engaged population in town (*engaged_prod*)	0.21***	-0.04	-0.6***	-0.5***	0.1***	-0.5***	-0.8***	-0.2**
Investment in the town budget (*fdi*)	0.3***	0.5***	0.5***	0.7***	0.4***	0.4***	0.6***	0.6***
Population density (*population density*)	0.03	-0.1	0.1	0.1	-0.1	0.01	-0.1	-0.3**
Density of hard-surfaced public roads in	0.1**	0.07**	0.09	0.04	0.1*	0.06*	0.04	0.03

a town (*road*)								
Distance along motor roads to the nearest major town *(dist)*	-0.4***	0.02	-0.1*	0.4	-0.12*	0.1	0.02	0.03
Mean-square error of the model	0.5	0.5	0.4	0.5	0.4	0.5	0.4	0.5
Determination coefficient	0.72	0.59	0.85	0.80	0.76	0.82	0.85	0.79
Number of observations	133	39	54	45	96	57	69	38

Prepared by the authors.

*** – significance level mistake of error - 1%; **– significance level mistake of error – 5%; * – significance level mistake of error – 10%

Growth of engaged population has a significant positive influence on economic inequality in towns of the Central and Siberian Federal Districts. Impact of this factor is noticeable on social state throughout the territory of Russia, the exception being the North Caucasian Federal District. In Southern (-0.6), North Caucasian (-0.5), Ural (-0.5), Siberian (-0.8) and Far Eastern (-0.2) Federal Districts the inflow of labour resources grows faster than demand thereof. We may suggest that migration of engaged population to major towns happens in these Federal Districts.

Consistent results were obtained for such parameters as volume of investments in the town's budget - throughout the territory of Russia this parameter correlates well with an average monthly salary and industrial output in a town (an exception being the North Caucasian Federal District).

As we can see, population density is not a probably significant factor of urban socio-economic inequality in Russia. The Far Eastern Federal District (-0.3) is worth distinguishing since this parameter has a negative impact on an average monthly salary here, which is also explained by the inflow of labour resources to major towns.

The transport infrastructure development level has a positive influence on the socio-economic state of a town, being noticeable in Central, North-Western, Privolzhsky, Ural and Siberian Federal Districts.

Uncertain results are suggested by estimation of geographical arrangement of a town (distance to the nearest major town). Significant negative influence of this factor takes place in the territory of the North-Western (-0.5), Southern, North Caucasian (-1.9), Privolzhsky (-0.2) Federal Districts. The derived results suggest that trade development in towns of these Federal Districts is mainly directed towards domestic markets. An opposite situation can be observed in the Siberian Federal District: such parameter as distance along motor roads to the nearest major town correlates with industrial output. Thus, trade development in towns of the Siberian Federal District is aimed at the foreign market.

Significant negative influence of distance along motor roads to the nearest major town is exercised on the social state of towns in Central (-0.4), Southern (-0.1), and Privolzhsky (-0.12) Federal Districts. It is worth noting that the high coefficient was obtained for towns of the Central Federal District, which is explained by high difference in salaries between Moscow and peripheral towns. For example, in 2003 an average monthly salary in Moscow equaled to 8,511.6 RUB, in Belgorod (the most distant town from the center in the Central Federal District) –5,239.5 RUB (61 %), in 2009 in Moscow – 23,623.3 RUB, in Belgorod– 12,734.5 RUB (54 %), in 2014 in Moscow –55,485 RUB, in Belgorod – 26,423.9 RUB (47 %) [14].

It should be emphasized that determination coefficients in all models are quite high. It is beneficial for the derived system of models

6. **Conclusion.**

Estimation of factors of socio-economic inequality of Russia's towns allows making the following conclusions.

1.   While implementing the regional policy, it is important to understand that towns behave as individual parties to economic relations, being competitors in most cases due to limited production factors.

2.   Modelling the influence of factors on the social-economic inequality of towns has shown that the most significant influence is exercised by volume of investments in a budget and level of transport infrastructure development.

3.   Population density is not a probably significant factor of urban socio-economic inequality in Russia.

4.   Such factor as geographic arrangement of towns has a noticeable negative influence on the social and economic state of towns. However, in the Siberian Federal district, a factor of distance along motor roads to the nearest major town correlates with the industrial output, thus demonstrating that trade in the towns of this Federal District is aimed at the foreign market.

5.   In Southern, North Caucasian, Ural, Siberian and Far Eastern Federal Districts the inflow of labour resources grows faster than demand thereof. Migration of engaged population to major towns happens in these Federal Districts.

6.   The calculations made within the Federal Districts allowed supplementing the available conclusions.

7.   Theoretical significance of the research performed is in supplementing fundamental procedures of estimating factors of socio-economic inequality on Russia's towns.

8.   From practical point of view, the results derived may be used in activities of regional and municipal authorities and will enable scientific justification for programs and strategies of social and economic development of towns in Russia.

7. Links

2, 5, 8, 9,12 – Regions of Russia. Basic social and economic indices of cities 2014 // Federal State Statistics Service. [Electronic resource]
URL:http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1138631758656 (accessed date 07.06.2017).
3, 6, 10 – Regions of Russia. Basic social and economic indices of cities 2003 // Federal State Statistics Service. [Electronic resource]
URL:http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1138631758656 (accessed date 07.06.2017).
4, 7, 11 – Regions of Russia. Basic social and economic indices of cities 2014 // Federal State Statistics Service. [Electronic resource]
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