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CLUSTERING OF RUSSIAN REGIONS ACCORDING TO INDICATORS OF SOCIO-ECONOMIC DEVELOPMENT

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Purpose: clustering the regions of Russia according to the indicators of socio-economic and environmental sustainability in order to identify the particular state and development of the regions of the country. *Discussion*: the development of the subjects of the Russian are important for the country. That`s why, the author decided to group objects into homogeneous groups on similar grounds, to identify and summarize the features of the situation of the subjects of Russia, to assess the trends in the development of groups of regions in the period 2012-2016. *Results*: socio-economic stability of the regions was assessed by seven indicators characterizing the level of development of the subjects of the Federation, environmental sustainability – by six indicators. The author performed cluster analysis by k-means method in Statistica software product. Analysis of the results showed that the most regions of Russia are not at the same time socio-economically and environmentally sustainable.

Keywords: subjects of the Russian Federation, socio-economic development, cluster analysis, indicators of socio-economic and environmental sustainability.

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Introduction

Building an effective socio-economic system of regional development is an important strategic task. This direction of research is devoted to the whole series of works [6, 8, 13, 9, 14, 3, 11, 15, 10]. Integrated assessments should take into account the socio-economic, geographical, environmental and other development characteristics of both regional actors and the country as a whole. The assessment of the group behavior of socio-economic objects [9, 17] is aimed at increasing the level of their development and is associated with the development of generalized (integral) indicators that characterize both the socio-economic development of objects and the standard of living of the population as a whole. This area of research is one of the most important in socio-economic statistics, and in General the strategic goal of a comprehensive assessment and forecasting of the development of territorial entities, an important result of the activities of state and municipal governments.

Methodology

Research methods such as cluster analysis, multidimensional scaling and event-driven evaluation allow to analyze the development of subjects of the Russian Federation, Federal districts and the country as a whole [17, 4, 12, 18, 2], where the cities will be presented as a group of objects defining the key development of the regions, and the regions, in turn, will determine the development of the districts and the country as a whole. With the help of event evaluation and multi-dimensional scaling, it is possible to measure the similarity of objects (object States) for several indicators comprehensively, if each assessment is considered as a joint event of observation of the values of indicators [17, 1]. Cluster analysis in this case is necessary to identify groups of objects with the highest (lowest) level of development, in relation to which a comprehensive assessment of the totality of the analyzed objects will be carried out.

Discussion

The Russian Federation, being the largest country in the world, has its own special features. Among its main problems are the following: uneven in the aspect of regional development, budgeting, resource supply, demographic and social and cultural characteristics, imperfection of legislation in the field of management [16]. Classification of regions on similar grounds allows for a preliminary examination of the relevant socio-economic objects, which, in turn, makes it possible to identify groups of similar regional objects, to study their characteristics and to develop for each group activities aimed at improving their socio-economic situation and improving the level of development of the territory as a whole.

Nowadays, for the analysis of the economic and social status of objects in the statistical monitoring of regional development of the Russian Federation are used a number of 400 indicators of the regional level and 25 indicators of the municipal level [5, 16]. In this regard, it is important to justify the choice of a limited group of indicators that can be used for a comprehensive assessment of the environmental and socio-economic situation of objects and determine the sustainability of their development.

To conduct a comparative analysis of the Russian regions on the basis of their clustering, control groups from the stable developed regions of the country were formed.

Nowadays, the issue of a comprehensive assessment of the level and sustainability of development of territories is poorly studied. The United Nations development program are employed almost 250 indicators, in turn, the world Bank is of the order of 50 indicators. In Russia, 35 indicators are used as national indicators of development [5, 7]. Taking into account the recommendations of the Russian Federal state statistics service, more than ten indicators were selected for analysis in this article, which are combined into a group of social and economic indicators of development and into a group of environmental indicators of development.

As indicators that characterize the level of socio-economic development of the regions were selected [5]:

• gross regional product per capita, RUB/person, z_{1y};

• per capita income of the population, RUB, z_{2y};

• average size of the assigned pensions, RUB, z_{3y};

• volume of freight traffic by the main modes of transport (railway, AV-mobile), thousand tons/person, z_{4y};

• the volume of exports, converted at the rate of the dollar, RUB/person, z_{5y};

• the volume of imports converted at the dollar exchange rate, RUB/person, z_{6y};

• the amount of work performed in construction, RUB/person, z_{7y}.

From the point of view of socio-economic development, the higher the values of the listed indicators, the higher the level of development of the analyzed territory. As indicators that characterize the level of environmental development of regions were selected [5]:

- investments in fixed capital, which are directly aimed at the additional protection activities, RUB/person, z_{8y};
- air emissions of pollutants from stationary and mobile sources, kg/person, z_{9y};
- fresh water intake from natural water bodies, m^3/person, z_{10y};
- discharge of contaminated wastewater to surface water bodies, m^3/person, z_{11y};
- power consumption of GRP, kg of conventional fuel/10 thousand rubles., z_{12y};
- infant mortality, which is determined by the number of children who die before the age of 1 year per 1,000 children born, z_{13y}.

From the point of view of environmental development, the lower the values of these indicators, the higher the level of development of the analyzed area, as the environmental situation is better.

The values of the above indicators for eighty regions of Russia in 2012–2016 were taken from the open database of the Federal service for state statistics [5]. Cluster analysis of regional development for the above groups of indicators was carried out by the method of k-means in the program Statistica [4, 1]. The clustering technique involved the use of the nearest neighbor method, where Euclidean distance was used as a measure of similarity of object States.

A comprehensive assessment of the level of socio-economic development of the regions was carried out by the values of seven standardized indicators $z_{1y},\ldots,z_{7y}$, in turn, environmental development – by the values of six standardized indicators $z_{8y},\ldots,z_{13y}$.

All analyzed indicators were standardized on the basis of the formula:

$$z_k^{st} = \left(z_k - z_k^{sr}\right) / \sigma_k , \quad (1)$$

where z_k^{st} – the average value of the k-th indicator, σ_k – standard deviation. The method of construction of dendrograms was used for reasonable determination of the number of clusters.

Cluster analysis of indicators of socio-economic development of the regions allowed to identify four interrelated groups of indicators: gross regional product per capita z_{1y} and the volume of work in construction z_{7y}; average per capita income z_{2y} and the average size of pensions z_{3y}; exports z_{5y} and imports z_{6y}; the volume of cargo transportation z_{4y}. Thus, in the construction of econometric models should be used one indicator from each of the above groups.

The analysis of the 80 regions by indicators of socio-economic development gave the opportunity to distinguish three groups of regions. The first group contained 7 regions, the second 26 and the third 47 regions. The most developed are: the city of Moscow, Tyumen, Magadan and Leningrad regions, the Republic of Sakha (Yakutia), the Sakhalin region and the Chukotka Autonomous district.

The cluster analysis of indicators of ecological development of regions allowed to reveal existence of only one closely interconnected group of variables $z_{8y},\ldots, z_{13y}$.

The analysis of 80 regions in terms of environmental development also made it possible to identify three groups of regions. The first and second groups contained 12 regions, the third – 56 regions [1]. The most developed regions by environmental indicators include: Belgorod, Kursk, Ivanovo, Tambov, Voronezh, Kirov, Penza, Kur-Ghana, Novosibirsk regions, the Republic of Mordovia, Udmurt Republic, Chuvash Republic.

In General, based on the results obtained, it can be concluded that virtually all regions are not both socio-economically and environmentally sustainable.

The analysis of regions by relative socio-economic indicators (related to the population) allowed to study the situation of the subjects of the Federation, which are included in the various Federal districts belonging to the European part of Russia.

The Central Federal district (CFA) includes 18 subjects of the Federation. With a population of 27% of the total population of Russia, the district accounts for 20% of industrial production, 30-35% of retail trade and paid services and 35% of the total gross domestic product of the country. The Central Federal district is the leader among Federal districts in many indicators of social and economic development.

Against the background of all subjects of the Russian Federation there are two groups of regions of the Central Federal district – a group of developed regions – Belgorod, Kaluga, Lipetsk, Moscow, Tula region, Moscow and a group of all other subjects.

In a comprehensive assessment of the adopted socio-economic indicators, the regions of the Central Federal district in 2015 differed more than three times.

The rating of regions can be presented in the following sequence: Moscow (6th place among 80 regions), Lipetsk (8), Kaluga (10), Belgorod (16), Tula (21), Moscow (22), Vladimir (29), Yaroslavl (31), Voronezh (36), Ryazan (38), Smolensk (42), Kur-sky (44), Tambov (45), Bryansk (49), Tver (50), Orel (54), Kostroma (56) and Ivanovo (68) regions.

The North-Western Federal district (NWFO) includes 10 subjects of the Federation. The population of the northwestern Federal district is 9.5% of the population of Russia, the share of the district in industrial production reaches about 12%, in the gross domestic product of the country – 10%. The district's economy is growing at a slower pace than the Russian economy as a whole.

The ranking of the NWFO regions by the level of socio-economic development is as follows: Leningrad region (7th among 80 regions), St. Petersburg (9), Kaliningrad region (11), Komi Republic (13), Vologda (14), Novgorod (24), Murmansk (26), Arkhangelsk region (27), Republic of Karelia (55) and Pskov region (59). A feature of the development of the regions of the northwestern Federal district is the lag in the pace of development of the real sector of the economy of St. Petersburg, which occupies a low 66th place among all regions of Russia and the last among the regions of the northwestern Federal district. This is due to the low growth rate of goods and services in the city's industry in 2012–2015.

The southern Federal district (SFD) includes 8 subjects of the Federation. The population of the southern Federal district is 11.2% of the Russian population as of January 1, 2018. The district produces 5.1% of industrial output and 6% of the total gross domestic product of the country. Climatic, transport and transit advantages and positive demographic trends of the southern Federal district determine favorable prospects for economic development of the entire region. However, the analysis indicates until a low level of development of subjects of the southern Federal district.

The corresponding places in the ranking for the southern Federal district are as follows: Volgograd region – 33rd place among 80 regions of Russia, Krasnodar region – 37th place, Rostov region – 40, Astrakhan region – 53, Republic of Adygea and Kalmykia respectively 65th and 78th place. A feature of the SFD regions is the lag in the level and pace of development of the Republic of Kalmykia, where there is a depopulation of the population, where the population for 12 years decreased by 22 thousand people from 291 to 279 thousand people.

The Volga Federal district (PFD) includes 14 subjects of the Federation. The population of the PFD is 29.5 million people (2018), which is 20.1% of the population of Russia, 71.9% of the population are citizens. The share of industrial production of PFD in the Russian economy accounts for 23.9%, the highest rate in the country (in second place is the Central Federal district). The share of the district in the gross domestic product of the country is 15.6%. The Volga Federal district has very favorable conditions for economic development. The middle position between the Western and Eastern regions of the country and the

existing transport and transit advantages provide the Volga Federal district with close ties with the Eastern raw areas and Central regions of Russia. The Volga Federal district is characterized by a high level of development of both mining and manufacturing industries, the concentration of qualified personnel, which determines the prospects for the development of the region.

Conclusion

Against the background of all subjects of the Russian Federation, there are two groups of regions of the PFD – a group of developed regions of the Republic of Bashkortostan and Tatarstan, Perm, Nizhny Novgorod and Samara regions, and a group of all other subjects. The rating of the PFD regions by level of development can be presented in the following sequence: Republic of Tatarstan (15th place among 80 regions), Nizhny Novgorod region (17), Perm region (18), Samara region (25), Republic of Bashkortostan (28), Orenburg region (34), Udmurt Republic (41), Republic of Mari El (46), Ulyanovsk (48), Kirov (61), Penza (62) regions, Republic of Mordovia (63), Saratov region (64) and Chuvash Republic (69).

The most developed regions of Russia are the Chukotka Autonomous Okrug (1st among 80 regions), Sakhalin (2), Tyumen (3), Magadan (4) regions and the Republic of Sakha (5).

Such way, cluster analysis makes it possible to identify homogeneous regions with a similar level of development and combine them into appropriate groups. The study allowed to conduct a comparative analysis of the subjects of the Russian Federation on the basis of a set of socio-economic and environmental indicators. The obtained results indicate a clear agglomeration effect of the development of individual territories of the country at the expense of all other regions. The results of the work are of practical importance, as they will allow to identify the problems of the regions, and can be used to improve the tools of strategic forecasting of regional development, which is a priority goal of state construction.

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КЛАСТЕРИЗАЦИЯ РЕГИОНОВ РОССИИ ПО ПОКАЗАТЕЛЯМ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОГО РАЗВИТИЯ

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Цель: кластеризация регионов России по показателям социально-экономической и экологической устойчивости с целью выявления конкретного состояния и развития регионов страны. *Обсуждение*: развитие субъектов РФ имеет важное значение для страны. Именно поэтому автор решил сгруппировать объекты в однородные группы по сходным признакам, выявить и обобщить особенности ситуации субъектов России, оценить тенденции развития групп регионов в период 2012-2016 гг. *Результаты*: социально-экономическая устойчивость регионов оценивалась по семи показателям, характеризующим уровень развития субъектов Федерации, экологическая устойчивость – по шести показателям. Кластерный анализ проводился методом k-средних в программном продукте Statistica. Анализ полученных результатов показал, что большинство регионов России не является одновременно социально-экономическими и экологически устойчивыми.

Ключевые слова: субъекты Российской Федерации, социально-экономическое развитие, кластерный анализ, показатели социально-экономической и экологической устойчивости.

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