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STATISTICAL ANALYSIS

OF THE DIFFERENTIATION OF RUSSIAN REGIONS BY THE LEVEL OF CONSTRUCTION DEVELOPMENT

ANÁLISIS ESTADÍSTICO DE LA DIFERENCIACIÓN DE LAS REGIONES RUSAS SEGÚN EL NIVEL DE DESARROLLO DE LA CONSTRUCCIÓN

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ABSTRACT

In order to assess the state and prospects of housing construction development as a key driver of economic growth and ensuring socio-economic security of Russia, the paper presents the results of an analysis of the differentiation of housing construction development in the territory of the Russian Federation. The base of comparison was 2018 and 2023, as periods of comparison of the results of the implementation of the housing policy of the Russian Federation and the National project “Housing and Urban Environment”. In this study, the authors present the results of a multidimensional classification of regions according to the 16 most significant indicators assessing the level of socio-economic development of territories, the standard of living of the population, the influence of the banking sector as an intermediary between the population and the developer. The study revealed that the dynamics of construction development is characterized by the presence of variable trends caused by the negative impact of the pandemic and the positive impact of the introduction of housing lending programs, which proved to have a stimulating effect on the growth of demand in the primary housing market.

Keywords: Housing construction, Cluster analysis, Short series, Indicator system.

RESUMEN

Con el fin de evaluar el estado y las perspectivas del desarrollo de la construcción de viviendas como un motor clave del crecimiento económico y la garantía de la seguridad socioeconómica de Rusia, el artículo presenta los resultados de un análisis de la diferenciación del desarrollo de la construcción de viviendas en el territorio de la Federación de Rusia. La base de comparación fueron los años 2018 y 2023, como períodos de comparación de los resultados de la implementación de la política de vivienda de la Federación de Rusia y el proyecto nacional «Vivienda y entorno

urbano». En este estudio, los autores presentan los resultados de una clasificación multidimensional de las regiones según los 16 indicadores más significativos que evalúan el nivel de desarrollo socioeconómico de los territorios, el nivel de vida de la población, la influencia del sector bancario como intermediario entre la población y el desarrollador. El estudio reveló que la dinámica del desarrollo de la construcción se caracteriza por la presencia de tendencias variables provocadas por el impacto negativo de la pandemia y el impacto positivo de la introducción de programas de préstamos para vivienda, que demostraron tener un efecto estimulante en el crecimiento de la demanda en el mercado primario de vivienda.

Palabras clave: Construcción de viviendas, Análisis de conglomerados, Series cortas, Sistema de indicadores.

INTRODUCTION

Housing construction has a systemic impact on the development of the country, as it affects various areas of its socio-economic development (Grushina & Krasnoshtanova, 2022). This is due to the wide sphere of influence of housing construction on various areas of modern society, which is inextricably linked with the development of the construction industry and housing and communal services, improving the standard and quality of life of the population, and the development of the banking sector (Grönroos, 2001; Lozovskaya, 2023). Collectively, the system processes under consideration will have an impact on increasing the country's economic growth, demographic situation, growth of investment and innovation activity, development of scientific potential and labor productivity growth (Astakhova et al., 2021; Melikhov et al., 2021).

In scientific literature, studies consider this trend from various perspectives (Soboleva & Dubinkina, 2023). Much attention is paid to analyzing trends, development prospects and forecasting the development of housing construction (Borisova, 2022). These areas of research are reflected in a series of articles. For example, in an article by authors Lukashenok & Efimova (2023), an analysis of housing construction in Russia was carried out. The paper notes that the state and development of housing construction depends on state regulation, which is aimed at solving not only social problems, but also problems existing in construction (Ovsyannikova et al., 2018). The authors propose a model of housing construction organization based on the interaction of the federal and regional levels of government. In the work of Vernikovsky & Ivanova (2023), raise the question of whether the growth in real estate prices and housing construction volumes correspond to real solvent demand, analyzes existing models of the crisis in the construction industry and possible scenarios for the development of the situation. According to the results of the study, the authors conclude that a slowdown in the growth rate of prices per square meter of total living space will force enterprises to work more efficiently. In the study by Gimadieva (2023), a rating assessment of the regions of the Volga Federal District in terms of housing development was proposed. The study was conducted from 2018 to 2022, which made it possible to assess the dynamics of housing construction development, identify leading and lagging regions.

The relevance of studying trends and directions of housing construction development is confirmed by the ongoing housing policy of the Russian Federation and the National Project "Housing and Urban Environment". Within the framework of this national project, there are Federal projects: "Formation of a comfortable urban environment", "Housing" and "Ensuring sustainable reduction of uninhabitable housing stock" with an implementation period from 01.10.2018 to 12/31/2024 (Lyubushin et al., 2019).

The presence of asymmetry in the socio-economic development of territories, characteristic of Russia, is reflected in the development of housing construction. Its causes (Gimadieva, 2023; Ignasheva, 2015) may be related to the level of transport accessibility, economic development of territories, and demographic processes (Bakhirev & Chernyshov, 2023; Shcherbakova & Naumov, 2016).

Within the framework of the current documents, the Ministry of Construction of the Russian Federation has published a Strategy for the development of the housing sector of the Russian Federation for the period up to 2025. Among the main strategic guidelines for the development of this sphere by 2025, it is necessary to highlight the achievement of a housing construction level of 120 million square meters; an increase in construction volumes from 2016 to 2025 - at least 1.5 times; an increase in the average level of housing provision - up to 30 square meters. m per capita; ensuring the availability of mortgages for at least 50% of families and increasing the mortgage portfolio to 15-20% of GDP. The implementation of these targets is expected under the condition of an average annual GDP growth rate of 2.7%, real household incomes of 3.8% and a reduction in the key rate and inflation to 5.0 and 4.0% levels (Gusakova, 2024).

According to the results of the past 2023, it can be concluded that the reduction in the key rate and the inflation rate deviated from the set parameters, which could not but have an impact on the implementation of the National Project "Housing and Urban Environment".

The purpose of this study was to analyze the differentiation of housing construction development in the territory of the Russian Federation. The comparison base was 2018 and 2023, as periods of comparison of the results of the implementation of the housing policy of the Russian Federation and the National Project "Housing and Urban Environment".

Within the framework of this goal, the following tasks are defined:

to consider the current trends in the development of housing construction in Russia, to identify the factors characterizing the development of housing construction in the regions;

to form a system of indicators and conduct a multidimensional classification;

select clusters with their subsequent description.

MATERIALS AND METHODS

The multidimensional classification of Russian regions was performed using the Principal Component method. The authors have formed a system of indicators that reflects various aspects of the development of housing construction, which are formed into three enlarged groups:

development of the construction business (Group No. 1);

the standard of living of the population (group No. 2);

Socio-economic development of territories (group No. 3).

The first group includes indicators characterizing the level of development of the construction business in the regions, and characterized by the following indicators: "Commissioning of apartments per 1000 people (x4), "The volume of work performed by type of economic activity "Construction" (in actual prices; million rubles) (x9), "Net financial result (profit minus loss) in construction, million rubles (x14), "The proportion of unprofitable organizations in construction, %" (x15).

The second group includes indicators characterizing the standard of living of the population from the standpoint of its financial capabilities. The following indicators were included in this group: "The total area of residential premises, on average per inhabitant, m^2/person" (x5), "Average per capita monetary income of the population, thousand rubles" (x6), "The volume of housing mortgage loans provided by credit organizations to individuals in rubles" (x10), "Population density, thousand people/km2" (x16).

The third group is represented by indicators characterizing the achieved level of socio-economic development of the regions. It is represented by the following indicators: "Density of public railway tracks, km of tracks per 10,000 km^2 of territory" (x2), "Density of paved public roads, at the end of the year; km of tracks per 1000 km2 of territory" (x3), "Gross regional product per capita, R." (x8), "Average prices in the primary housing market (at the end of the year; rubles per m2 of total area)" (x11), "Average prices in the secondary housing market (at the end of the year; rubles per m2 of total area)" (x12).

The Jewish Autonomous Region and the Chukotka Autonomous Okrug were excluded from the study due to the lack of information on a number of indicators.

Since the values of the indicators selected for the study had a wide range of values, the next step was the application of a universal scale to bring the indicators to a standardized form. The construction of a matrix of paired correlations revealed the presence of multicollinear relationships, which served as the basis for component analysis. During its implementation, according to the data of 2018 and 2022, three main components were identified, the total variance of which was 79.85% and 74.54%, respectively (Table 1).

Table 1. Eigenvalues of the main components and their contribution to the total variance in 2018 and 2022.

Main components f_v	Eigenvalues λ_v	Cumulative contribution of the main component, %
2018 г.		
f_1	6,580	54,83
f_2	1,613	68,27

f_3	1,389	79,85
2022 г.		
f_1	5,831	44,85
f_2	2,58	64,7
f_3	1,279	74,54

Source: own elaboration

The component analysis according to the data of 2022 was carried out on the basis of 13 indicators, and according to the data of 2018 – on 12 indicators. The reason for the exclusion from the system of indicators of the "Proportion of unprofitable organizations in construction, %" was a fairly uniform distribution of its values across the first three main components.

The composition of the first three main components according to the data of 2018 and 2022 differs in composition, but not significantly. The analysis carried out according to 2018 data revealed sufficiently high eigenvalues of the first main component, which determined its contribution to the total variance of 54.83%, while the contribution to the total variance of the first main component according to 2022 data takes a lower value (44.85%).

This feature of the results of the component analysis according to 2018 data did not affect the interpretation of the main components, which coincides for the analyzed periods. The first main component characterizes the level of development of construction and transport accessibility of territories, the second is the economic development of territories, and the third reflects the level of housing provision for the population.

According to the results of the component analysis, according to data for 2018, the third main component included the indicators "Commissioning of apartments per 1000 people (x4) and "The total area of residential premises per inhabitant, m2/person on average" (x5). The second main component was represented by one indicator - "Gross regional product per capita, million rubles."

The first main component was represented by all the other nine indicators: "Density of public railway tracks, km of tracks per 10,000 km^2 of territory" (x2), "Density of paved public roads, at the end of the year; km of tracks per 1000 km^2 of territory" (x3), "Volume of work performed by type economic activity "Construction" (in actual prices; billion rubles) (x9), "The volume of housing mortgage loans provided by credit institutions to individuals, thousand rubles" (x10), "Average prices in the primary housing market (at the end of the year; thousand rubles per m^2 of total area)" (x11), "Average prices in the secondary housing market (at the end of the year; thousand rubles per m^2 of total area)" (x12), "Net financial result (profit minus loss) in construction, billion rubles (x14), "Population density, thousand people/km^2" (x16), "Average per capita monetary income of the population, R." (x6), The share of unprofitable organizations in construction, %" (x15) (Ermilova, 2016).

According to the results of the component analysis, according to data for 2022, the composition of the indicators included in the third main component remained unchanged, the second was represented by three indicators: "Average per capita monetary income of the population, rubles." (x6), "Gross regional product per capita, thousand rubles." (x8), "The proportion of unprofitable organizations in construction, %" (x15).

The first main component includes the remaining eight indicators: "Density of public railway tracks, km of tracks per 10,000 km^2 of territory" (x2), "Density of paved public roads, at the end of the year; km of tracks per 1,000 km^2 of territory" (x3), "Volume of work performed on type of economic activity "Construction" (in actual prices; billion rubles) (x9), "The volume of housing mortgage loans provided by credit institutions to individuals, thousand rubles" (x10), "Average prices in the primary housing market (at the end of the year; thousand rubles per m^2 of total area)" (x11), "Average prices in the secondary housing market (at the end of the year; thousand rubles per m^2 of total area)" (x12), "Net financial result (profit minus loss) in construction, billion rubles (x14), "Population density, thousand people/km^2" (x16) (Efimov, 2023).

The multidimensional classification was carried out according to the data of 2018 and 2022 using the Ward method. According to the results of the classification, four clusters were formed, the average values of which are shown in Tables 2 and 3.

Table 2. Results of the cluster analysis of regions according to 2018 data.

Indicators	I cluster	II cluster	III cluster	IV cluster
The number of regions included in the clusters	2	8	50	20
Density of public railway tracks, km of tracks per 1 million km^2 of territory	2,50*	0,02**	0,189	0,10
Density of paved public roads, at the end of the year; km of tracks per 100 thousand km^2 of territory	25,07*	0,23**	3,00	2,47
Commissioning of apartments per 1000 people	9,65*	4,23	7,37	4,14**
The total area of residential premises, on average per inhabitant, m^2/person	22,35	25,03	28,156*	21,78**
The average per capita income of the population, thousand rubles. ***	81,44*	56,23	38,95	30,17**
Gross regional product per capita, million rubles. ***	1,72	1,90*	0,63	0,41**
The volume of work performed by the type of economic activity «Construction», billion rubles. ***	970,81*	237,96	118,60	65,60**
The volume of residential mortgage loans provided by credit institutions to individuals, million rubles. ***	383,98*	47,21	47,78	20,58**
Average prices in the primary housing market (at the end of the year; thousand rubles per m^2 of total area) ***	184,81*	86,37	61,17	55,02**
Average prices in the secondary housing market (at the end of the year; thousand rubles per m^2 of total area) ***	174,03*	89,45	60,78	55,02**
Net financial result (profit minus loss) in construction, billion rubles. ***	-20,95**	0,10*	-0,86	0,09
Population density, thousand people/km^2	4499,75*	1,74**	13,32	11,97

Note: in the table, the maximum values are marked with a "*" sign, and the minimum values are marked with a "**" sign, "***" - the values are recalculated into comparable prices in 2022.

Source: own elaboration.

Table 3. Results of the cluster analysis of regions according to the data of 2022.

Indicators	I cluster	II cluster	III cluster	IV cluster
The number of regions included in the clusters	2**	5	47*	26
Density of public railway tracks, km of tracks per 1 million km^2 of territory	2,50*	0,23**	1,98	0,91
Density of paved public roads, at the end of the year; km of tracks per 100 thousand km^2 of territory	25,92*	0,13**	3,08	2,54
Commissioning of apartments per 1000 people	10,65*	8,06	8,18	5,47**
The total area of residential premises, on average per inhabitant, m^2/person	24,55**	27,88	31,25*	24,76
The average per capita income of the population, thousand rubles	79,48*	71,14	35,89	34,45**
. Gross regional product per capita, million rubles.	3,18*	2,13	0,70	0,61**
The volume of work performed by the type of economic activity «Construction», billion rubles.	1099,29*	315,88	139,15	96,74**
The volume of residential mortgage loans provided by credit institutions to individuals, million rubles.	476,53*	64,21	56,63	33,49**
Average prices in the primary housing market (at the end of the year; thousand rubles per m^2 of total area)	302,95*	125,37	90,53	83,86**
Average prices in the secondary housing market (at the end of the year; thousand rubles per m^2 of total area)	227,99*	113,44	77,66	80,83**

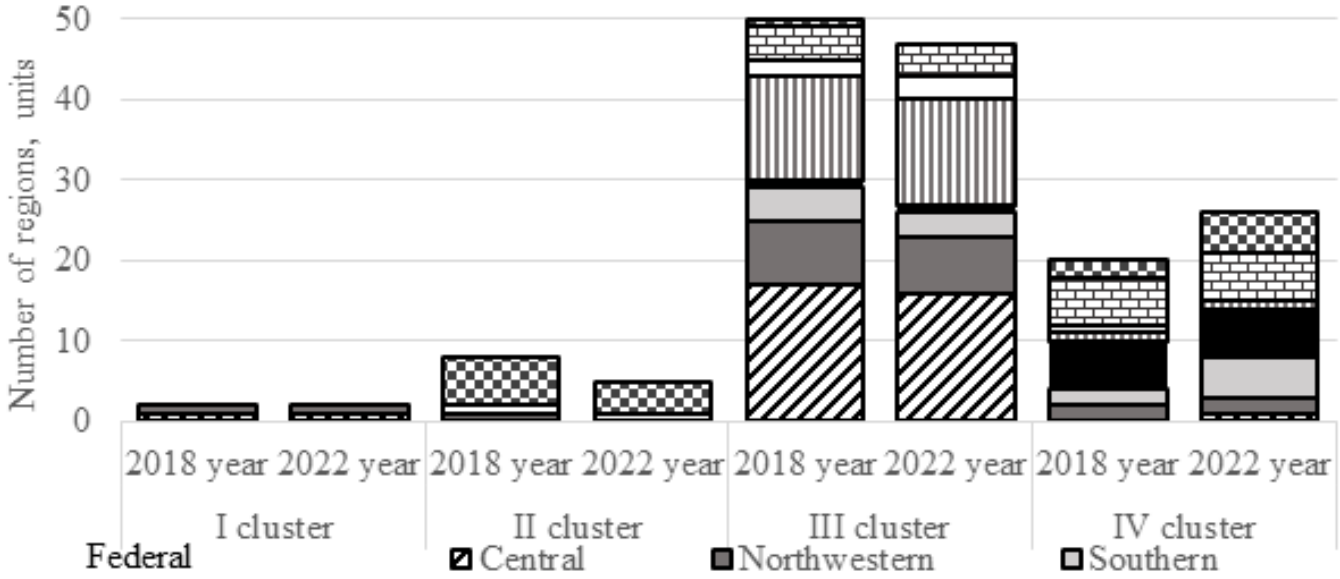
Net financial result (profit minus loss) in construction, billion rubles.	137,85*	5,94	1,62	0,86**
The share of unprofitable organizations in construction, %	32	48*	23,81**	31,89
Population density, thousand people/km^2	4665,93*	1,03**	19,67	5,31

Note: in the table, the maximum values are marked with a "*" sign, and the minimum values are marked with a "**" sign.

Source: own elaboration.

The regions were unevenly distributed among the clusters. The third cluster turned out to be the most numerous, and the first cluster was the least numerous. Figure 1, shows the distribution of the number of regions of federal districts by clusters based on the results of the multidimensional classification in 2018 and 2022.

Fig 1. Distribution of regions of federal districts by clusters.



Source: own elaboration.

It follows from the figure that the distribution of regions by clusters has not changed significantly, but during the analyzed period the number of regions included in the third and fourth clusters increased, with an increase in the number of regions included in the fourth cluster.

RESULTS AND DISCUSSION

According to the classification results for 2018, four clusters were identified. The third cluster (50 regions) became the most numerous, and the first cluster, which is represented by two regions: Moscow and St. Petersburg, became the smallest.

The second cluster includes eight regions: Tyumen, Sakhalin, Murmansk and Magadan regions, Primorsky, Khabarovsk and Kamchatka Territories and the Republic of Sakha (Yakutia). This cluster is largely represented by the regions of the Far Eastern Federal District.

The fourth cluster included the regions: Astrakhan, Kurgan, Volgograd, Kemerovo, Omsk Region, Republic of Khakassia, Republic of Kalmykia, Udmurt Republic, Republic of Altai, Republic of Buryatia, Kabardino-Balkarian Republic, Karachay-Cherkess Republic, Republic of Crimea, Chechen Republic, Republic of Dagestan, Republic of Ingushetia, Republic of Tyva, Stavropol, Altai Territory, Trans-Baikal Territory. All other 50 regions were included in the third cluster.

The third cluster is most represented by the regions of the Central, Northwestern and Volga Federal Districts, and the fourth cluster includes a significant number of regions of the North Caucasus and Siberian Federal Districts.

Most of the indicators included in the first cluster take maximum values, and in the fourth cluster, on the contrary, most of them take minimum values (Table 2).

The regions forming these clusters in 2018 are significantly differentiated. For example, the differences in the level of per capita monetary incomes of the regions of the first cluster compared to the regions of the fourth cluster were 2.70 times, with a slight difference in prices in the primary and secondary housing markets: 3.36 and 3.16 times. It should be noted that the net financial result in construction for all clusters is either negative or near zero. This is due to the high proportion of unprofitable organizations in construction, the share of which reached 34.7%.

As a result of the classification according to the data for 2022, four clusters were also obtained. The composition of the regions representing the first cluster has remained unchanged compared to 2018 and is represented by the cities of Moscow and St. Petersburg. The number of regions included in the second cluster was reduced to five: Tyumen, Sakhalin, Magadan regions, the Republic of Sakha (Yakutia) and the Kamchatka Territory.

The fourth cluster is represented by 26 regions, including Sevastopol, Murmansk, Bryansk, Astrakhan, Omsk, Tomsk, Volgograd, Kemerovo and Amur regions, the Republic of Komi, the Republic of Ingushetia, the Republic of Kalmykia, the Republic of Dagestan, the Republic of Crimea, the Republic of Tyva, the Republic of Buryatia, the Republic of Karachay-Cherkess, the Republic of Altai, the Republic of Udmurtia, The Republic of Kabardino-Balkaria, the Chechen Republic, Khabarovsk, Primorsky, Stavropol, Zabaikalsky and Krasnoyarsk Territories.

All other 47 regions were included in the third cluster.

For regions (Table 3), which were included in the first cluster, the maximum values of most indicators are characteristic, with the exception of the indicator “The total area of residential premises, on average per inhabitant, m2 / person”, which is the minimum and average level of the proportion of unprofitable organizations in construction.

For the regions included in the second and third clusters, the indicators are characterized mainly by average values. The features of the regions included in the second cluster include the minimum population density, the minimum density of public railways, km of tracks per 10,000 km2 of territory, the density of paved public roads at the end of the year; km of tracks per 1,000 km2 of territory, the maximum proportion of unprofitable organizations in construction.

The regions included in the third cluster had the maximum total area of residential premises per average resident and the minimum per capita income of the population, and the proportion of unprofitable organizations in construction was minimal.

For the regions representing the fourth cluster, most of the indicators take a minimum value.

Clusters are characterized by significant differentiation, for example, the level of per capita monetary incomes of the regions of the first cluster exceeds the same indicator of the regions of the fourth cluster by 2.31 times, while prices in the primary housing market differ by 3.6 times, and in the secondary by 2.8 times. These differences are also complemented by a significant differentiation of territories in terms of population density. It should be noted that the balanced financial result in construction for all clusters is positive and takes on the greatest importance in the first cluster.

Thus, during the period from 2018 to 2022, changes in the development of construction among the regions were observed in Russia, which had an impact on their differentiation.

Most of previous researches, concerning the connections between quality, involvement and satisfaction, have been conducted in Western countries, so there is no certainty whether these connections between these constructs can be also revealed in the developing post-Soviet countries. Also, most researches were based on SERVQUAL model proposed by Parasuraman et al. (1985), it means that only the effect of functional quality has been analyzed, but as Gronroos (2001), proposed two additional quality facets, namely technical and reputation facets should be also analyzed. Furthermore, researches based on the Gronroos model did not consider the third “image” facet and its impact on involvement. Also, research gap was related to which quality facet is more important in forming satisfaction of clients and whether the connection between quality and involvement is straight or consequential (Tsiotsou & Vasioti, 2006).

In this regard, in this research we applied the Gronroos model, including three quality facets in order to fully capture the construct of quality. As to the connections between functional and technical facets and image, the analysis revealed that only functional facet has considerable impact on image of a bank, at the same time the effect of technical quality is not considerable. It means that in most cases clients consider only the communication with a bank and its personnel demeanor when evaluating reputation of a bank in a market.

Also, the analysis stated that there is a direct significant connection only between functional facet and involvement

of clients, while technical and reputation facets do not have significant impact on involvement in the banking industry of the Kyrgyz Republic.

Also, functional quality influences significantly the level of satisfaction both directly and indirectly through involvement, that is, functional quality is the most important and notable factor in forming satisfaction, followed by technical quality that has only significant direct influence on satisfaction.

The main theoretical contributions of this research are that only functional facet considerably affects reputation of a bank and involvement of clients; functional and technical facets and involvement have important direct influence on the level of satisfaction of clients. Thus, the most important and significant characteristic of quality, influencing satisfaction of clients both directly and indirectly through involvement, is its functional aspect. At the same time technical facet of quality should on appropriate level, since if it is not appropriate most clients will definitely switch to another bank, as it is the core of each service.

A number of researchers claim that the level of quality mainly affects satisfaction, also researchers emphasize that there can be a connection between the level of involvement of clients and their satisfaction. Ideally, banks should apply the following algorithm of interactions with their clients in order to understand their needs and wants and then apply this knowledge to achieve high level of satisfaction:

• Attract clients through offering a wide and diversified range of services;

• Then conduct analysis in order to determine clients' needs, preferences and anticipations concerning banking services, that is, mainly strive to understand clients;

• Then banks should try to go ahead of its clients, that is, predict their wants and anticipations, and try to meet them fully and in advance;

• Then banks should analyze the level of satisfaction among its clients in order to examine what they are doing correctly and recognize the mistakes they omitted, and if necessary, they should conduct all the previous activities again.

So, as we can see the procedure of banking services is of great importance for satisfaction enhancement both directly and indirectly through involvement in the banking industry of the Kyrgyz Republic. It means that managers of banks should first of all emphasize the importance of this service aspect and improve its staff's skills appropriately through trainings and quality control strategies. It is recommended to apply quality control models based on foreign successful models, but with individual approach since economies in transition have some particularities.

CONCLUSIONS

The article presents the results of clustering of Russian regions according to the 16 most significant indicators assessing the level of socio-economic development of territories, the standard of living of the population, the influence of the banking sector as an intermediary between the population and the developer.

When conducting a multidimensional classification based on the data of 2018 and 2022 using the Ward method, four clusters were identified, which turned out to be differentiated by the number of regions included in their composition (Tables 2, 3). The smallest in terms of the number of regions included was the first cluster, which included two regions: Moscow and St. Petersburg, and the most numerous was the third cluster, represented in the bulk by regions belonging to the Central, Volga and Northwestern Federal Districts.

The positive results of the development of construction should include the contribution of the housing policy carried out in Russia. The result of its implementation was an increase in the total area of residential premises, accounting for an average of one inhabitant, if in 2018 this indicator was 25.8 m2, then in 2022 it was 28.2 m2., i.e., an increase of 9.3%, a decrease in the differentiation of this indicator by clusters should also be attributed to positive results.

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