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MULTIDIMENSIONAL STATISTICAL ANALYSIS OF ECONOMIC INDICATORS OF DEVELOPER ORGANIZATIONS IN SAMARA REGION

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Abstract

This article is devoted to the study of the most significant factors that determine the dynamics of the volume and pace of construction in the Samara region. According to the results of a survey of regional organizations-developers, studies of regional and federal statistics in the field of construction, scientific works, regulatory acts related to sources of information on the development of the construction industry in the Russian Federation and the region, the main factors affecting production and business activities were identified participants in the regional construction cluster. To build the models, only statistically significant factors-arguments were selected, which are in significant correlation with the modeled indicator, and are relatively independent of each other, their list is relatively exhaustive. Mathematical models are constructed that reflect the dependence of the volume of work performed in construction on these factors. An analysis of the obtained models allows us to conclude that the most significant negative factors affecting the volume of work performed are the dynamics of prices for finished metal products and the dynamics of prices for transmission and distribution of electricity. Factors that positively affect the volume of work performed include the dynamics of reproduction of the population of the Samara region and the dynamics of real disposable cash income. The adequacy of the models was evaluated using the Fisher F-test. Statistical calculations and their analysis were performed in MS Excel and Gretl.

Keywords: Building cluster, construction, regression models, forecasting.

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1. Introduction

The dynamics of the economic indicators of the construction industry requires a deep and comprehensive analysis of the factors that comprehensively affect the growth rate of construction in the Samara region (Federal State Statistics Service, 2018).

Developing organizations need to identify factors affecting the formation of industrial and economic relations and contractual relations in the field of construction in the region (Government of the Samara Region, 2018). The combination of these factors determines the main current and forecast values of the main parameters of the construction market, the degree of business activity of its subjects. Construction organizations are the key subjects whose industrial and economic relations are the subject of research.

2. Problem Statement

The main constituent part of the construction cluster system of the Samara region is the developer organization. The use of econometric and statistical methods to analyze factors affecting the growth rate of construction will allow the regional authorities to develop a competent economic strategy for the development of the construction cluster, and construction companies to adjust their plans and make rational management decisions to reduce or increase the volume of construction.

The study revealed factors that positively and negatively affect the activities of organizations-developers, the corresponding econometric models are built. The data for the study were taken from Rosstat reports on construction organizations of the Russian Federation and the Samara region. Data represent the dynamics of monthly time series for the period 2013-2018 (Federal State Statistics Service, 2018). Statistical calculations and their analysis were performed in MS Excel and Gretl.

3. Research Questions

The study attempted to solve the following problems:

- Highlight the factors affecting the production and economic activities of organizations-developers;
- Conduct a preliminary statistical analysis of the selected indicators;
- Create econometric models for the studied indicators;
- Compare the predicted potential of the constructed models.

4. Purpose of the Study

The aim of this work is to build econometric models of economic indicators of the activities of organizations-developers, to calculate the forecast values of the selected factors, to develop recommendations for the enterprises of the construction cluster to improve their economic activities.

5. Research Methods

To build a system of factors that affect the production and business activities of organizations-developers, we used questionnaire methods, research of scientific papers, regulatory legal acts and materials

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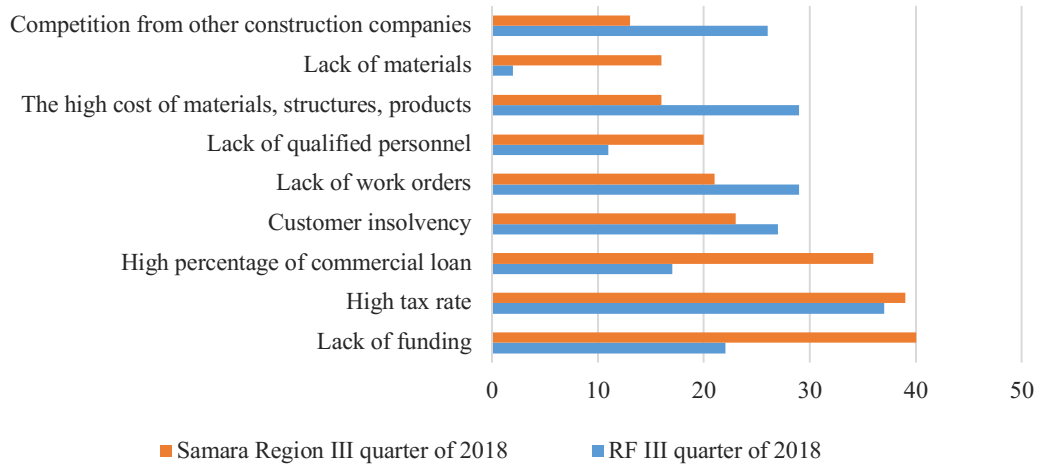
of discussion platforms. The reports of the Federal State Statistics Service on construction organizations of the Russian Federation and the Samara Region were analyzed and actual data on the studied factors were selected (Federal State Statistics Service, 2018).

Methods for identifying trends and abnormal observations, stationarity tests, analysis of variance and correlation analysis, and tests for autocorrelation were applied to the obtained time series. Modeling and forecasting was carried out using multivariate regression analysis. The significance and adequacy of the constructed models was tested using the Fisher F-test, determination coefficient, and the average approximation error. To the obtained models, methods were used to compare the forecast resources of econometric models (Tikhomirov, Tikhomirova, & Ushmaev, 2011).

6. Findings

According to the results of the federal and regional statistical survey of construction organizations, a list of the most significant factors affecting the results of their production and economic activity is determined (Figure 01).

Of particular interest, from the point of view of this study, is the comparison of the significance of certain factors for the construction industry of the Russian Federation as a whole, and the Samara region in particular (Government of the Samara Region, 2018). The period closest to the end of the current year (Q3 2018) was chosen as the general period for comparative analysis.



Source: author based on (Government of the Samara Region, 2018).

Figure 01. Factors affecting the production activities of construction organizations in the Russian Federation and the Samara region

According to the construction organizations of the Samara region, the most significant factors determining the dynamics of the volume and pace of construction in the region are:

1) Competition from other construction companies, named by 13% of respondents, due to the limited number of developers, differs significantly from the federal level (26%). About 60% of the space

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and facilities under construction belong to the 10 largest construction companies in the Samara region, the remaining 40% of the market is distributed among 79 developers. In general, competition in the regional construction market is assessed as moderate. According to the builders of the Samara region, the competitive environment in the industry has improved slightly, by 0.88% in the IV quarter of 2018 compared to the same period of the previous year (Ministry of Economic Development and Investments of the Samara Region, 2017);

2) The lack of materials noted by 16% of regional developers should be understood first as the need for innovative building materials by local manufacturers in the construction of energy-efficient and environmentally friendly buildings and structures (Government of the Samara Region, 2018);

3) The high cost of building materials, products and structures as a factor affecting the production and economic activities of the builders of the Samara region, is significant for 16% of enterprises. The market for construction materials in the Samara region is quite saturated, the competition of local manufacturers intensifies amid the active expansion of suppliers from other regions of the Russian Federation, as well as importers, which determines the price structure of material resources for construction (Ru-Stat, 2018);

4) The lack of qualified personnel, as a factor, is significant for 20% of regional builders, especially those who use innovative technologies and construction resources in their production and economic activities that require relevant professional competencies in the construction industry;

5) The significance of the impact of insufficient orders for construction work is emphasized by 21% of the organizations surveyed. In the III quarter of 2018, construction companies were provided with orders for an average of 6 months. Moreover, the largest group of companies (26%) had contracts in their portfolio for a period of 1 to 3 months, 10% - more than a year (Decree of the Government of the Samara Region dated 03.06.2014 No. 315);

6) 23% of developers in the Samara region as a factor determining the nature of relations with partners in the construction industry, note insolvency of customers. The volume of overdue receivables in October 2018 in the construction sector amounted to 285 million rubles, of which 77.5% accounted for buyers (Samarastat, 2018a);

7) 36% of companies report a rather high level of commercial credit, which in turn is subject to the influence of lending conditions of legal entities. The significance of this factor for enterprises remains for several years, despite a decrease in the refinancing rate of the Central Bank of the Russian Federation to 7.75% by the end of 2017. This factor in the near future will take on special significance in connection with the entry into force of the amendment to the Federal Law “On Participation in the Shared Construction of Apartment Buildings and Other Real Estate Objects and on Amending Certain Legislative Acts of the Russian Federation” dated December 30, 2004 N 214-FZ. Construction financing will be carried out at the expense of a bank loan, the interest rates for which are supposed to be set the lower, the higher the amount attracted to the special accounts of equity holders (The state program of the Samara region dated 09.12.2015 No. 822);

8) One of the most significant, along with a high percentage of commercial credit and a lack of financing, factors affecting production and business activities, according to 39% of regional developers, is the high level of taxation of enterprises. Despite the relative stability of the tax burden in the Samara region,

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compared with last year, the share of organizations noting the importance of this factor increased by 7.72% (Federal Tax Service, 2018);

9) The most significant factor for 40% of regional construction organizations is the lack of funding, which in turn is associated with problems of increasing the number and size of orders for construction projects, fulfillment of financial obligations in the process of implementing production and business relations and contractual relations, as well as the changes noted above in the legislation establishing restrictions on the size of payment by shareholders of the cost of purchased housing (not more than 10%). In addition, in the Samara region there is a decrease in investment activity in the construction industry from 7544.1 million rubles. In 2015 to 2306 million rubles. in 2017 (The state program of the Samara region dated November 27, 2013 No. 684).

In addition, factors such as lack and deterioration of machines and mechanisms were highlighted - 6% of the enterprises surveyed noted and 10% of the respondents identified adverse weather conditions. These factors were excluded from consideration due to their low importance for the development of industrial and economic activities of construction organizations.

According to the results of research of scientific works, regulatory legal acts and materials of discussion platforms relating to sources of information on the development of the activities of construction organizations, the list of factors of the construction market discussed above was supplemented by such factors as:

1) State support for the production and economic activities of developers from the executive authorities, provided for by achieving the targets of various state programs. So, the amount of subsidies paid on October 1, 2018 to the budgets of the constituent entities of the Russian Federation for measures to stimulate housing development programs of the constituent entities of the Russian Federation amounted to 123498617.75 rubles (Decree of the Government of the Russian Federation of 07.02.2011 N 165-r);

2) The availability of mortgage lending, which, together with the dynamics of the solvency of the population, provides demand for housing projects. In the Samara region, according to the Central Bank as of March 1, 2018, 6.8 billion rubles were issued. housing loans. At the same time, the average interest rate on a mortgage since the beginning of 2018 amounted to 9.79% per annum. Over the year, the growth in mortgage lending amounted to 88.8%, and the average interest rate decreased by 2.18% (National Rating Agency, 2018);

3) The direct solvency of the population, affecting the possibility of acquiring housing, including mortgages, and along with the population, determining the capacity of the construction market. In January-September 2018, the real disposable cash income of the population, compared to the same period last year, amounted to 99.8% (Samarastat, 2018a);

4) The dynamics of consumer prices also determines the ability of the population to form savings for the purchase of housing or monthly payment of the principal and interest on mortgages. Inflation (2017 level - 0.40) changes the structure of population spending. For example, in January-October 2018, the share of household income used to purchase real estate, livestock and poultry decreased by 13% compared to the same period last year, while the cost of acquiring goods and services increased by 7% (Samarastat, 2018b);

5) The demographic situation in the Samara region, affecting the level of capacity of the construction market, shaping its potential. A decrease in the birth rate leads to a reduction in demand for

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commissioned living space. For the period January-September 2018, the natural population decline amounted to 7828 people, which is 11.96% more than in the same period last year;

6) The presence of deferred (hidden) demand for rental housing as a solution to the problem of its inaccessibility for the majority of the population for the purpose of acquiring ownership, including on the terms of mortgage lending. At the same time, it should be noted that the Ministry of Construction of the Samara Region did not receive new applications for the construction of rental houses. Currently, one rental house has been built in Samara for the needs of the Kuznetsov plant. According to representatives of the regional authorities, the construction of rental houses is an unattractive object for investment (Decree of the Government of the Samara Region dated 03.06.2014 No. 315).

Factors such as public distrust in shared construction, administrative barriers, and irrational use of free land were excluded from further systematization and accounting due to their low importance for the development of production and economic activities of construction organizations.

The factors listed above are reflected in the statistical information space and can be measured by indicators that demonstrate the level of socio-economic development of the Samara region in general and the construction sector in particular (Federal State Statistics Service, 2018).

These factors reflect both the individual business conditions of each construction organization (the state of the material and technical base, the movement of personnel, the availability of material resources, the presence of unfulfilled obligations of contractors), and the general market conditions of the country's economy as a whole, and the construction industry, in particular (demographic shifts, financial assistance from the state, the nature of taxation in the country, inflationary processes, banking system conditions).

When making the calculations, the database of the Federal State Statistics Service and its Territorial Authority for the Samara Region was used, as well as information resources that systematize official statistics. Data on the performance indicators of the construction industry are stored on the servers of Rosstat in the form of time series, therefore, the study used methods of multivariate statistical analysis (Federal State Statistics Service, 2018).

The first part of the study examined factors affecting the activities of construction organizations. At the preliminary analysis stage, a large number of indicators (65) were selected that reflect the state of the construction industry in the region, for two groups - the main and non-main. The statistics corresponding to these factors were taken on the Rosstat website (Federal State Statistics Service, 2018).

Based on these factors, the dynamic series for one year were selected on a monthly basis (October 2017 - September 2018). As the resulting indicators were considered: the dynamics of the volume of work performed on construction in the Samara region (million rubles), the volume of commissioning of residential buildings, (thousand square meters).

A correlation analysis of the data was carried out to identify relationships between factor attributes, and between the effective attribute and each factor attribute.

The model includes only those factors that are most associated with the effective indicator. In addition, factors that duplicate the same information about an effective indicator should not be included in the model (Tikhomirov, Tikhomirova, & Ushmaev, 2011). The matrix of paired correlation coefficients was calculated and the factors affecting the resulting factors were identified.

At the initial stage of the study, the following trends were identified:

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- Y1- The volume of work performed (million rubles) significantly depends on:
- X1- Dynamics of real disposable cash income (%);
- X3- The dynamics of the use of cash income for the purchase of real estate (%);
- X9- Dynamics of prices for finished metal products (%);
- X12- Dynamics of prices for transmission and distribution of electricity (%);
- X38 Dynamics of prices for the production of cement, lime (%);
- X47- Dynamics of prices for the production of asphalt mixtures (%);
- X57- The dynamics of reproduction of the population of the Samara region (%);
- X58- Migration increase / decrease (thousand people).
- Y2- The volume of work performed (thousand square meters) significantly depends on:
- X1- Dynamics of real disposable cash income (%);
- X3- The dynamics of the use of cash income for the purchase of real estate (%);
- X9- Dynamics of prices for finished metal products (%);
- X12- Dynamics of prices for transmission and distribution of electricity (%);
- X38 The dynamics of prices for the production of cement, lime (%);
- X40- Silicate block production volume (million pcs);
- X45- The dynamics of the production of concrete for pouring (%);
- X57- The dynamics of reproduction of the population of the Samara region (%).

To study the relationship of the selected factors, a correlation matrix was constructed for them and a repeated correlation analysis was performed.

Since the number of observations in the time series is not large (12 observations), it is advisable to select no more than 2 factors as an argument. In addition, some factors from substantive considerations and interdependent argument factors should be excluded from consideration.

The following regression models were obtained for the resulting factor Y1 - the volume of work performed (million rubles):

$$Y_1 = 261556{,}67 + 2712{,}7X_1 + 168{,}97X_3$$

$$Y_1 = 5512750 - 38452{,}1X_9 - 1606{,}75X_{12}$$

$$Y_1 = 152787{,}9 - 826{,}52X_{38} - 0{,}43X_{47}$$

$$Y_1 = 207540{,}1 + 4276{,}98X_{57} - 24{,}68X_{58}$$

Let us pass to the statistical analysis of the obtained regression equations: checking the significance of the equations and its coefficients. The tightness of the joint influence of factors on the result is estimated by the coefficient of multiple correlation. In the first model, the coefficient of multiple correlation R = 0.66. The determination coefficient R2 = 0.44, i.e. in 44% of cases, changes in X lead to a change in Y1. The variation in the indicator the volume of work performed by 44% is due to a variation of factors included in the model, and by 56% due to a variation of other factors not included in this model. In the second model, the coefficient of multiple correlation R = 0.75. Determination coefficient R2 = 0.622. those. in 62.2% of cases, changes in X lead to a change in Y1. The variation in the indicator, the volume of work performed by 62.2% is due to a variation of factors included in the model, and by 0.8% due to a variation of other

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factors not included in this model. Similar statistical indicators of adequacy have the other models presented in this paper.

Similarly, the resulting factor Y2 was considered - the volume of work performed (thousand square meters) and the following regression models were obtained:

$$Y_2 = -216{,}67 + 3{,}41X_1 + 0{,}18X_3$$

$$Y_2 = 7289{,}98 - 49{,}36X_9 - 21{,}68X_{12}$$

$$Y_2 = 101{,}04 - 1{,}01X_{38} + 14{,}29X_{40} + 1{,}25X_{45}$$

$$Y_2 = 556{,}45 + 105{,}38X_{57} + 0{,}0003X_{58}$$

Analyzing the obtained models, we can conclude that the most significant negative factor affecting the volume of work performed is the dynamics of prices for finished metal products. A 1% increase in prices in this segment leads to a decrease in the volume of work performed by 38,452.1 million rubles. or 49.36 thousand square meters m. of finished housing. The second most important indicator adversely affecting the volume of work performed is the dynamics of prices for transmission and distribution of electricity. An increase in the price of electricity by 1% leads to a decrease in the volume of work performed by 1,606.75 million rubles. or 21.68 thousand square meters m. of finished housing. Factors that positively affect the volume of work performed are the dynamics of reproduction of the population of the Samara region and the dynamics of real disposable income. An increase of these indicators by 1% leads to an increase in the resulting indicator by 4276.98 million rubles. and 2712.7 million rubles. respectively.

At the second stage of the study, 19 indicators were selected that affect the production and economic activities of construction organizations. Based on these factors, dynamic series for five years 2013-2017 were selected. As a result indicator, Z1- the volume of work performed by the type of activity “Construction” (billion rubles) was considered, which significantly depends on the indicator X1- Cash income of the population, billion rubles. The following regression model for the selected factor was obtained:

$$Z_1 = -227{,}04 + 0{,}38X_1$$

Consequently, the increase in cash incomes of the population by 1 billion rubles. leads to an increase in the resulting indicator, the volume of work performed by type of activity "Construction" by 0.38 billion rubles.

At the third stage of the study, 23 indicators were selected. Based on these factors, the dynamic series for six years 2012-2017 were selected. As the resulting indicators were considered: T1 - the commissioning of residential buildings, the total area (thousand square meters), which significantly depends on:

- X12 - Capacity utilization (% of the total);
- X21 - Producer price indices for construction products %;
- X22 - The cost of production by type of "construction" (kopecks per 1 ruble of work performed);

The following regression models were obtained for the resulting factor:

$$T_1 = 2225{,}16 + 20{,}61X_{12}$$

$$T_1 = 4731{,}05 - 28{,}02X_{21}$$

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$$T_1 = 3919{,}1 - 24{,}2X_{22}$$

From the obtained models, it follows that an increase in producer price indices for construction products by 1% leads to a decrease in the commissioning rate of residential buildings, the total area of 28.02 thousand square meters. m., and an increase in the use of production capacity by 1% gives an increase of 20.61 thousand square meters.

7. Conclusion

The results of this study show that among the main factors affecting the volume of production of building materials such as: government support costs for the national economy, the level of tax burden, the dynamics of the key rate of the Central Bank of the Russian Federation, producer price indices for certain types of economic activity, freight tariff indices transportation by mode of transport, accounts payable to construction enterprises, the leader in terms of the burden on manufacturers is a high level of taxes.

It is shown that the following manufacturers of building materials are most susceptible to inflationary processes: the production of sanitary ware from ceramics, the production of ceramic tiles and tiles, the production of tiles, tiles, slabs and similar products from cement, concrete or artificial stone, the production of blocks and other prefabricated building products unreinforced for buildings and structures made of cement, concrete or artificial stone, the manufacture of special-purpose precast concrete structures and parts, industrial duction of products made from plaster, mortar production. The production of building materials with a tendency to decrease (decrease in production) was revealed, such as: sanitary ware made of ceramics, building brick (including stones) made of cement, concrete or artificial stone, prefabricated reinforced concrete walls and partitions. The study also showed that the constructed models are quite reliable and can be used to predict the monthly output and other financial indicators.

References

Decree of the Government of the Russian Federation of 07.02.2011 N 165-r “On approval of the Strategy for socio-economic development of the Volga Federal District until 2020”. Retrieved from https://bazanpa.ru/pravitelstvo-rf-rasporiazhenie-n165-r-ot07022011-h1612615/strategiia/5/6/ Accessed: 11.03.2018. [in Rus.].

Decree of the Government of the Samara Region dated 03.06.2014 No. 315 “On approval of the concept for the development of the cluster of the building materials industry and industrial housing in the samara region until 2020 and an action plan for the development of the cluster of the industry of building materials and industrial housing in the Samara Region until 2020”. Retrieved from http://docs.cntd.ru/document/464011116 Accessed: 10.12.2018. [in Rus.].

Federal Law “On participation in the shared construction of apartment buildings and other real estate objects and on amending certain legislative acts of the Russian Federation” dated December 30, 2004 N 214-FZ. Retrieved from http://www.consultant.ru/document/cons_doc_LAW_51038/ Accessed: 11.01.2018 [in Rus.].

Federal State Statistics Service (2018). Construction in the Russian Federation. Retrieved from https://www.gks.ru/folder/14458 Accessed: 11.01.2018. [in Rus.].

Federal Tax Service (2018). Tax analytics. Retrieved from: https://analytic.nalog.ru/portal/index.ru-RU.htm Accessed: 15.12.2018. [in Rus.].

Government of the Samara Region (2018). Raw material base. Retrieved from https://www.samregion.ru/economy/source/ Accessed: 04.04.2018. [in Rus.].

Ministry of Economic Development and Investments of the Samara Region (2017). RAEX rating agency (Expert RA) upgrades investment climate of Samara region. Retrieved from http://economy.samregion.ru/press-center/sobytiya/reytingovoe-agentstvo-raex-ekspert-ra-povysilo-reyting-investitsionnogo-klimata-samarskoy-oblasti-/ Accessed: 11.03.2018. [in Rus.].

National Rating Agency (2018). Rating of investment attractiveness of Russian regions by the end of 2018. Retrieved from: http://www.ra-national.ru/sites/default/files/analitic_article/IPR-6-06112018.pdf Accessed: 11.03.2018. [in Rus.].

Ru-Stat (2018). Import to the Samara Region for 2013-2018. Retrieved from: http://ru-stat.com/date-Y2013-2018/RU36000/import/world/0525 Accessed: 11.03.2018. [in Rus.].

Samarastat (2018a). Finance. Organizations. Retrieved from https://samarastat.gks.ru/finance Accessed: 11.01.2018 [in Rus.].

Samarastat (2018b). The population of the Samara region. Retrieved from https://samarastat.gks.ru/population/ Accessed: 11.03.2018. [in Rus.].

The state program of the Samara region dated 09.12.2015 No. 822 "Development of the infrastructure of urban development in the territory of the Samara Region" for 2016 - 2019 years". Retrieved from: http://docs.cntd.ru/document/434605300 Accessed: 10.12.2018. [in Rus.].

The state program of the Samara region dated November 27, 2013 No. 684 "Development of housing construction in the Samara Region" until 2020" Retrieved from http://docs.cntd.ru/document/464012122 Accessed: 10.12.2018 [in Rus.].

Tikhomirov, N. P., Tikhomirova, T. M., & Ushmaev, O. S. (2011). *Methods of econometrics and multivariate statistical analysis.* Moscow: Economics. [in Rus.].