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"Global Challenges and Prospects of the Modern Economic Development"****MODELING AND FORECASTING OF ECONOMIC INDICATORS  
FOR BUILDING MATERIALS PRODUCERS**

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***Abstract***

This article is aimed at analyzing the construction cluster of the Samara region economic relations. The subject of this research are key construction organizations and manufacturers of building materials, products and structures and their industrial and economic relations. A survey of regional building materials manufacturers, products and structures, research of scientific works, regulatory legal acts and materials of discussion platforms related to sources of information on the development of the construction industry in the country and the region made it possible to identify the main factors affecting the production and economic activities of building materials manufacturers. The authors developed a mathematical model that allows evaluating the dependence of the production indices of building materials on the inflation rate, the materials most susceptible to this phenomenon have been identified. Regression models were obtained to identify dependencies of output volumes on factors affecting the production and economic activities of building materials industry enterprises, the analysis of the obtained equations is carried out. Based on the available observations on these indicators over a period of 7 years, a variance analysis of the samples was carried out on a monthly basis and regression models of their changes monthly and by year were constructed, the significance and adequacy of the constructed models for 23 types of building materials were estimated. Using the obtained regression dependencies, the studied parameters were extrapolated for the period until 2024, and indicators with a decreasing tendency were identified. Statistical calculations and their analysis were performed in MS Excel and Gretl.

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

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## **1. Introduction**

The information basis for the formation of economic relations of the Samara region construction industry is a deep and comprehensive analysis of factors that comprehensively affect the construction growth rate, building materials production, the infrastructure facilities development, the scope of scientific research and the introduction of innovations in the business entities production processes (Decree of the Government of the Russian Federation of 07.02.2011 N 165-r, 2011). Factors influencing the formation of industrial and economic relations and contractual relations in the field of construction and production of building materials in the Samara region should be understood as a set of essential conditions that determine the main current and forecast value of the construction market main parameters, the degree of its subjects business activity (The state program of the Samara region dated November 27, 2013 No. 684, 2013). The key entities whose industrial and economic relations are the subject of research are construction organizations and manufacturers of building materials, products and structures.

## **2. Problem Statement**

The industry of building materials, products and structures in the Samara region forms an integral part of the building cluster system, and the material and financial flows established in it reflect the quality of the relationship between its main elements (Decree of the Government of the Samara Region dated 03.06.2014 No. 315, 2014). The use of econometric and statistical methods to analyze factors affecting the growth rate of construction, building materials production, may allow 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 expand the range of products. This study allows us to identify manufacturers with a tendency to reduce production. The data for the study were taken from the (Rosstat, 2018; Samarastat, 2018). The data represent the dynamics of monthly time series for the period 2013 - 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 building materials manufacturers;
- conduct a preliminary statistical analysis of the selected indicators;
- build econometric models for the studied indicators;
- compare the predicted potential of the constructed models;
- make a point and interval forecast of production for the coming periods.

#### 4. Purpose of the Study

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

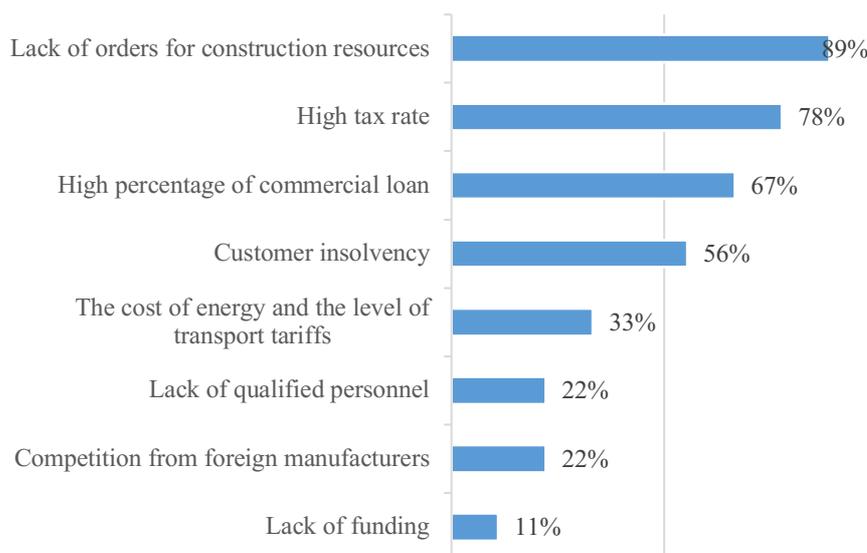
#### 5. Research Methods

To build a system of factors that affect their production and business activities of building materials manufacturers, we used questionnaire methods, research of scientific papers, regulatory legal acts and materials 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 (The state program of the Samara region dated 09.12.2015 No. 822, 2015).

Methods for identifying trends and abnormal observations, stationarity tests, analysis of variance and correlation analysis, and autocorrelation tests were applied to the obtained time series. Modeling and forecasting was carried out using multivariate regression analysis (Tikhomirov, Tikhomirova, & Ushmaev, 2017). The significance and adequacy of the constructed models was tested using the Fisher F-test, the determination coefficient, and the average approximation error. To the obtained models comparison methods of the forecast resources of econometric models were applied..

#### 6. Findings

A survey of regional manufacturers of building materials, products and structures allowed us to identify the following factors (Ru-Stat, 2018) affecting their production and economic activities (Figure 01).



**Figure 01.** Ranking conditions for the effective development of the construction industry of the Samara region for manufacturers of building materials (% of respondents)

Thus, according to the building materials manufacturers in the Samara region, the factors influencing the dynamics of the volume and pace of material resources production needed for construction in the region are:

1) lack of orders is the most significant factor for the majority (89%) of building resources manufacturers. Most manufacturers of building materials, products and structures noted the importance of increasing the volume of orders, especially from government agencies. At the same time, the necessity of observing the principles of transparency and fair competition of the contract system in the public procurement field is noted. In addition, in a decrease in the volume of orders for products of regional building materials manufacturers, there is a close relationship with such factors as fierce local competition, intensified by the presence of products from companies from other regions and foreign suppliers;

2) a high level of taxes, as for construction organizations, is one of the most significant factors affecting the production and economic activities of building materials manufacturers in the Samara region (Federal Tax Service, 2018). The significance of this factor was emphasized by 78% of the companies surveyed. For the period from 2014 to 2016, the indicator of the tax burden of manufacturing enterprises in the Samara region increased by 1% (in the Russian Federation – by 0.8%);

3) 67% of building materials manufacturers as a significant factor determining the financial conditions of their functioning in the regional market, allocated a high percentage of commercial loans (Ivanushkin & Kirshin, 2015). This factor gains particular importance in conditions of asynchrony in production and circulation of manufactured products, when commercial credit becomes almost the only way to maintain the continuity of production processes and ensure capital turnover;

4) insolvency of customers as a significant factor affecting production and business activities for 56% of building materials manufacturers can be characterized by accounts payable by their main contractors – large and medium construction organizations, which at the beginning of September 2018 amounted to 65,559.8 million rubles, which is more than for the same period last year by 15658.5 million rubles or by 31.4%;

5) no less important factor affecting the results of industrial and economic activities of 33% of regional producers in the Samara region is the cost of energy and the level of transport tariffs, which determines the total cost of manufactured and shipped products. The dynamics of tariffs for freight transportation in October 2018 in relation to the same period last year amounted to 5.5%, price indices for providing electric energy, gases and steam, air conditioning – 4.5%, water supply – 4.3%;

6) the lack of qualified personnel in the building materials industry, as well as in construction, is a significant factor, which was allocated by 22% of enterprises. The significance of the factor decreases as issues of cooperation with leading universities of the Samara region, forming professional competencies in the field of construction and the economy as a whole, become more relevant;

7) the influence of competition from foreign manufacturers is significantly manifested in the production and economic activities of 22% of enterprises in the regional building materials industry (Ru-Stat, 2018). In addition to rigidity, competition in the building materials market of the Samara region is notable for its relative heterogeneity due to the territorial location and natural competitive advantages of raw materials, greater availability of a number of imported products against the inflation backdrop in the

domestic construction industry and low economic efficiency of manufacturers of building materials, products and structures. Despite the general tendency for imports of the products considered in this study to decrease, the competition level between foreign manufacturers and the building materials industry in the Samara region remains quite high (National Rating Agency, 2018). Rating of Investment Attractiveness of Russian Regions by the End of 2018);

8) lack of funding, a factor significant for 10% of regional building materials manufacturers, which, as in the case of the construction market, is associated with problems of increasing the number and size of orders for the manufactured products supply. A number of building materials production are characterized by a rather low level of capacity utilization: rolled roofing and waterproofing materials - 29.6%, gypsum building products – 52.6%, prefabricated building blocks and other products for buildings and structures made of cement, concrete or artificial stone – 51.2%. An analysis of 130 manufacturers of building materials, products and structures in the Samara region showed that 52.3% of enterprises are ready to increase production capacity by increasing the volume of orders.

According to the results of scientific works research, normative legal acts and materials of discussion platforms related to sources of information on the development of the construction industry in the country and the region, the list of the above factors affecting the production and business activities of building materials manufacturers is proposed to be supplemented with such as:

9) the state of the region's ecology, which is characterized by a low degree of construction organizations and enterprises of the building materials industry involvement in the use of waste in the production process. At the same time, the use of various industrial, purchased or own construction waste in the production of building materials or in the construction, for example, of the building foundations and some other structural elements, would significantly reduce the need for cash;

10) insufficient supply of raw materials and materials, which should be understood primarily as their price component, since part of the material resources of high quality used in the building materials industry is supplied from other countries (Ukraine, Germany, China, etc.). In general, the construction industry of the Samara region is adequately provided with reserves of mineral raw materials (Government of the Samara Region, 2018). In addition, the priority areas of state support for the construction industry of the Samara region are the development of the effective use of its own mineral resource base for the production of traditional and new structures and materials types using energy-efficient technologies (Kiyutsen, 2016).

Based on the foregoing, such factors as the lack of qualified personnel, the environmental situation in the region, competition from foreign manufacturers and the degree of the building materials industry provision with raw materials, are excluded from further systematization and accounting due to their low importance for the development of production and business activities of manufacturers of building materials, products and structures.

Thus, the activities of building materials manufacturers, due to their presence in one regional economy and one industry, are subject, as in the case of construction organizations, to the influence of such factors as the volume of subsidies for the production of innovative building materials, the level of tax burden, and the availability of loans for legal entities.

To simulate the behavior and make a forecast of the production and economic activity of the building materials industry enterprises, we selected dynamic series of 2013-2017 by the following indicators of the construction industry (Table 01):

**Table 01.** Materials produced by enterprises of the Samara region by groups of building materials

<b>№</b>	<b>Building Materials Group</b>	<b>Materials</b>	<b>Variables</b>
I	Bulk Building Materials	Natural sands, thousand tons	X1
		Gravel, pebbles, crushed stone, thousand tons	X2
		Expanded clay, thousand cubic meters	X3
II	Concrete	Concrete ready for pouring (ready-mixed concrete), thousand cubic meters	X4
		Mixes asphalt concrete road, airfield and asphalt concrete hot, tons	X5
III	Building solutions	Building solutions, thousand cubic meters	X6
IV	Materials based on mineral binders	Building gypsum, thousand tons	X7
		Quicklime, slaked lime and hydraulic lime, thousand tons	X8
		Mixtures for construction, thousand tons	X9
		Cement, thousand tons	X10

The table shows only ten items of materials for four groups of building materials. The analysis was carried out for forty items of building materials (X1 - X40) by fifteen groups of building materials. To analyze the market of building materials manufacturers, it is necessary to assess the dependence of production on factors affecting the production and economic activities of the building materials industry enterprises in the Samara region. When selecting features in the model, a matrix of paired correlation coefficients was analyzed, as a result of the analysis of which the factors affecting the production volumes of building materials were identified (Table 02).

**Table 02.** A List of factors affecting the volume of production of building materials

<b>Factors</b>	<b>Name</b>
Factor 1	The costs of state support of sectors of the economy
Factor 2	Tax burden
Factor 3	The dynamics of the key rate of the Central Bank of the Russian Federation (%)
Factor 4	Producer price indices for certain types of economic activity (%)
Factor 5	Tariff indices for freight transportation by mode of transport (%)
Factor 6	Accounts payable of construction enterprises

For a comprehensive assessment of the influence of various factors, a comprehensive statistical analysis was carried out (Kitaeva, 2002). Regression models were obtained to identify the dependences of output on the factors influencing the production and business activities of the building materials industry

enterprises, an analysis of the equations was carried out, the results of which are presented in the following table, where the angular regression coefficients interpret the dependence of the increment in production on the increment of the corresponding factor (Table 03).

**Table 03.** Dependence of the volume of production of building materials from changes in factors affecting the production and economic activities of enterprises

Variables	F. 1	F. 2	F. 3	F. 4	F. 5	F. 6
X1	0	-2118,5	-37,87	0	0	0
X2	0	0	0	0	-855,8	0
X3	-0,0026	0	0	-12,03	0	-0,002
X4	0	-11262,9	0	0	0	0
X5	0	-36633404	0	0	0	0
X6	0	-1524,242	-2,47	0	0	0
X7	0	-5083,039	0	0	0	0
X8	0	-200,1767	-0,327	0	0	0
X9	0	-432,8622	0	0	0	0
X10	0	0	-25,23	0	-960,33	0

In Table 03 a zero value of the factor means that it does not have a significant effect on the output of this type of product. All six factors have a negative impact on manufacturers, so their values have negative signs. These values show how much output will decrease when this factor increases by one. The analysis showed that the leader in the burden on manufacturers is a high level of taxes.

A multivariate statistical analysis was carried out and an assessment was made of the dependence of building materials production indicators on inflation. It was revealed that the following manufacturers of building materials are most susceptible to inflationary processes:

- manufacture of sanitary ware from ceramics;
- production of plates and ceramic tiles;
- production of tiles, slabs and similar products from cement, concrete or artificial stone;
- production of blocks and other products of prefabricated building unreinforced for buildings and structures of cement, concrete or artificial stone;
- production of prefabricated structures and parts for special purposes;
- production of building products from plaster;
- production of mortar (product release).

Based on the available observations on these indicators for 7 years monthly (84 observations), a variance analysis of the samples was performed and regression models of their changes monthly and by year were built, the significance and adequacy of the constructed models for 23 types of building materials were estimated, some of which are given below (Table 04):

**Table 04.** Models of the time dependence of production indicators of building materials

Indicator	By month	By years
Production of ceramic non-refractory building bricks, million conventional bricks	$X_3 = 9,74 + 0,02t$	$X_3 = 117,09 + 2,76T$
Production of building bricks (including stones) from cement, concrete or artificial stone, a million conventional bricks	$X_4 = 16,59 - 0,08t$	$X_4 = 206,66 - 12,21T$
Production of large wall blocks (including basement wall blocks) from concrete, million conventional bricks	$X_5 = 1,28 + -0,01t$	$X_5 = 15,01 + 1,39T$
Foundation constructions prefabricated reinforced concrete, Th. cbm	$X_9 = 3,19 + 0,023t$	$X_9 = 38,08 + 3,03T$
Production of frame structures for buildings and prefabricated reinforced concrete structures, thousand cubic meters	$X_{10} = -0,25 + 0,033t$	$X_{10} = -5,38 + 4,82T$

In Table 04, the following notation is used: T - year number: 2011 - 1, 2012 - 2, ... 2024 - 14; t - month number: 01.2011 - 1, 02.2011 - 2, ... 12.2024 - 168. Using the obtained regression dependencies, the studied parameters were extrapolated for the period up to 2024, indicators with a tendency to decrease (reduce the production) were identified.

## 7. Conclusion

The results of this study show that among the main factors affecting the volume of building materials production 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 has been 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, the production of tiles, roof 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, the manufacture of products made from plaster, mortar production.

The production of building materials with a tendency to decrease (reduce the 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 (2011). "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 (2014). 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 Tax Service (2018). Tax passport of the subject of the Russian Federation. Tax analytics. Retrieved from: <https://analytic.nalog.ru/portal/index.ru-RU.htm> Accessed: 12.15.2018. [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.].
- Ivanushkin, N. S., & Kirshin, I. A. (2015). Features of financing construction projects in Russia. *Actual Directions of Scientific Research: From Theory to Practice*, 2(4), 198-200. [in Rus.].
- Kitaeva, N. N. (2002). *Methodology of statistical analysis and forecasting the development of the building complex of Moscow*. Ph.D. thesis. Moscow: Moscow State University of Economics, Statistics and Informatics. [in Rus.].
- Kiyutsen, L. I. (2016). Secondary resources in the production of building materials: we determine the economic efficiency of use. *Handbook of an Economist*, 10. Retrieved from: [https://www.profiz.ru/se/10\\_2016/vtor\\_resursy/](https://www.profiz.ru/se/10_2016/vtor_resursy/) 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/analytic\\_article/IPR-6-06112018.pdf](http://www.ra-national.ru/sites/default/files/analytic_article/IPR-6-06112018.pdf) Accessed: 11.03.2018. [in Rus.].
- Samarastat (2018). Construction in the Samara region Retrieved from: <https://samarastat.gks.ru/construction> Accessed: 11.01.2018. [in Rus.].
- Ru-Stat (2018). Import to the Samara Region. 2013-2018. Retrieved from: <http://ru-stat.com/date-Y2013-2018/RU36000/import/world/0525> Accessed: 11.03.2018. [in Rus.].
- Rosstat (2018). Construction in the Russian Federation Retrieved from: <https://www.gks.ru/folder/14458> Accessed: 11.01.2018. [in Rus.].
- The state program of the Samara region dated 09.12.2015 No. 822 (2015). "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 (2013). "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. (2017). *Methods of econometrics and multivariate statistical analysis*. Moscow: Economics. [in Rus.].