Forecasting the Impact of the Structure of Financing Sources on the Results of Production Activity in Agriculture

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Abstract: - The study conducted to assess the impact of the source of financing on the results of production activities of small and medium-sized businesses in agriculture in Kazakhstan is presented in the article. When building the model, the authors used the method of correlation and regression analysis, including calculations of pairwise regression, as well as the method of building statistical equations. Statistical data on the volume of financing of SMEs in agriculture by way of own funds, government resources (concessional lending, subsidies, and leasing), and non-state sources of financing such as borrowed funds from banks, microfinance organizations, credit partnerships, and leasing companies were used as the factors. Firstly, the results of the study showed that such factors as bank lending and leasing financing by private companies do not have a significant impact on production volumes. Secondly, of all the factors analyzed, the greatest impact on gross output was made by financing by microfinance organizations and credit partnerships, which determines and indicates the need for the development of non-state sources of financing. Thirdly, a comprehensive approach combining state financial support as well as available non-state financial resources is needed to achieve the strategic objectives of economic development and ensure the required level of food security.

Key-Words:- Small and medium businesses, Financing, Agriculture, Kazakhstan, Lending, Subsidies, Leasing.

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1 Introduction

Against the background of the new economic reality, one of the most important directions of the state policy of most countries is to ensure the high-quality sustainable development of small and medium-sized businesses in the real sectors of the economy. Moreover, in the current conditions, particular importance should be given to supporting agribusiness entities, as the main category of producers that ensure the food security of the state. According to experts, by 2050, demand for food is predicted to increase by 70% around the world, and for its satisfaction, it is necessary to invest in agricultural enterprises not less than 80 billion US dollars, [1].

SMEs are one of the key drivers in the socio-economic development of a country and its regions, as they ensure the formation and emergence of permanent new jobs. Therefore, they serve as a guarantee of the population's income and ability to pay, [2], [3], [4], [5], [6], [7]. At the same time, the significance and necessity of developing small and medium-sized businesses in agriculture and the need for comprehensive support are noted in the works of many research scientists. Small and medium-sized businesses in the agro-industrial complex are an important sector of the economy, which, unlike large enterprises, has significantly fewer opportunities, but makes a significant contribution to the gross domestic product of the state, [8]. One

of the decisive conditions for the progressive development of the agro-industrial complex is the expansion of small-scale business entities in agriculture. The agrarian structure of small-scale production has positive dynamics and significant growth potential, the implementation of which currently depends on the economic policy of the state, [9].

The development of small business forms is the most important condition for maintaining and further developing agricultural and non-agricultural activities in rural regions. Small farms provide jobs for the bulk of the population employed in agriculture, [10]. Business structures are dynamically developing segments of the domestic agro-industrial complex, which can and should play an important role in taking into account food security, and producing environmentally friendly products. The state, of course, must solve the problems of agricultural entrepreneurship through the implementation of a set of measures aimed at training personnel, improving rural infrastructure, stimulating young professionals, and developing agricultural science. But these measures should not be declarative, they should have a specific financial and non-financial nature, [11]. All business entities should have equal access to material, financial, labor, information, and natural resources and forms of support, [12].

Thus, having considered the various points of view of researchers in this field, we concluded that small and medium-sized businesses in agriculture are an important part of the economy of any country. In addition, due to its versatility, it can solve a number of large-scale tasks and increase the efficiency of development in several economic and socially significant areas of the state's activity at once.

However, in the course of their activities, small and medium-sized businesses, in comparison with large businesses, are extremely lacking financial resources. Agribusiness entities have to constantly search for available sources of financing that will ensure not only the creation of their business, but also allow its further development. At the same time, agriculture, as an industry characterized by the presence of a high degree of natural and climatic risks, and the cyclical nature of production, requires special approaches to the financing process, both from the state and various financial organizations, [13], [14], [15]. Agricultural entrepreneurship is characterized by so-called systemic risks, which market mechanisms cannot insure. Furthermore, agribusiness's riskiness is only increasing due to climate change, [16].

The experience shows that sharp deterioration in natural and climatic conditions is immediately followed by negative consequences in the development of not only agriculture, but also producers and providers of means of agricultural production, and processors of agricultural products, which usually receive the vast majority of such products, [17].

The specifics of the agricultural industry predetermine the need for huge financial investments to ensure its competitiveness and sustainable development, which makes the state the main investor. The state's concern in co-financing agriculture is because it is significant for the national economy (contribution to GDP, employment, natural resources), and even more, each country seeks to ensure food security, [18]. However, despite this, agricultural production suffers significant losses every year due to climate, marketing, and other agricultural risks, and the degree of loss compensation provided by the state is very low, [19].

The lack of sources of continuous financing is because not all resources are converted into commodities and money. The products of most agricultural sectors are of a raw material nature and require transportation, storage, and processing. These features determine the particular importance of the effective functioning of a developed financial and credit infrastructure, which ensures the creation of conditions for the constant financing of small agribusiness, and the provision of borrowed funds for its development, [15].

The study of the world experience in financing small and medium-sized businesses in agriculture has led to the conclusion that there is a variety of forms and tools to support business, most of which are largely represented in the form of direct state support for agricultural producers such as concessional lending, subsidies, rates, insurance quotas, etc., as well as by the provision of loans by banks and other non-banking organizations. At the same time, the mechanisms of state regulation guarantee agricultural producers a sufficient level of income and savings for expanded reproduction. Thus, in the EU countries, 2/3 of the income of agricultural producers is formed at the expense of non-state funds and subsidies, and in Japan - up to 80%, [20]. In addition, the state support for agricultural producers in foreign countries aims not only to develop agriculture, but also to preserve

rural areas and ensure their sustainable development, respect for the natural environment, support for ecology, and preserve the population in historical places of residence.

Therefore, the multiplicity of sources of financing SMEs in agriculture causes an objective need to assess their impact on the results of production activities. In this regard, the application of the most advanced forecasting methods with the coverage of all sources of SME financing is of particular relevance. This will enable more effective and efficient calculation of planned financial needs of agribusiness entities for the production of a certain volume of agricultural products, more rationally and efficiently distribute financial resources by the state to obtain the final result of entrepreneurship development in the industry, region, and country as a whole. At the same time, forecasting, which precedes planning, allows us to assess the specific situation in management and provides a flexible tool for analyzing current situations.

2 Methods and Data

In modern conditions, the method of economic and mathematical modeling, which is based on the method of correlation and regression analysis, is used to obtain better and more objective information about the forecast object in the future. In this case, the most important criterion is to quantify the closeness of cause-and-effect relationships and to identify the form of influence on the result.

Determination of quantitative ratios in the form of regression and comparisons of actual (observed) values with values obtained as a result of substitution into the regression equation allows a better understanding of the nature of the phenomenon under study, and therefore, intervenes in the economic process to obtain the planned results, [21]. The dual and multiple regression methods, [22], [23], [24], will be used by us in forecasting the volume of gross output depending on the sources and forms of financing for small and medium-sized businesses in agriculture. The applied technique is based on the construction of statistical equations of dependencies, which will allow to forecasting the size of the effective feature for the medium term, taking into account the influence of certain factors, [25], [26].

It should also be noted that this method allows to characterize the quantitative relationship between the resultant indicator and various factors, hence determining how much the resultant indicator will change if a factor is changed by one, as well as under what change of factors the expected value of the indicator will be achieved.

The advantages of using this method are the following:

- the initial term of the statistical equation of dependencies has a real value (e.g. economic) because it is always either the minimum or maximum value of the effective variable in the sample;
- the parameter values for individual coefficients and signs for single and multifactor equations are identical;
- the sum of linear deviations of the theoretical values of the effective indicator from the actual values should be minimal (the comparison shows which type of equation is more suitable for describing the phenomenon under study), [27].

The calculation of the dependencies of the effective factor on the factor indicators is made according to the formula (1).

$$y = f(x_1, x_2, \ldots, x_{10}) \tag{1}$$

A comparison base was chosen to make calculations, and according to this base the comparing coefficients are calculated from the floor if there is an increase in the value of the feature:

$$\frac{yi}{y \ \min} \tag{2}$$

When constructing an economic and mathematical model, the following indicators will be used:

- y_x - the symbol of the dependency equation of one-factor relationship;
- y_{min}, y_{max} - the minimum and maximum empirical values of the effective feature;
- $x_i, \ldots, z_i$ - empirical values of factorial features;
- $x_{min}, \ldots, z_{min}$ - the minimum empirical values of factorial features;
- d - the symbol of the modules of deviations from unity of the coefficients of comparison of the effective and factorial features (d_y, $dx \ldots, d_z$);
- $b_1, b_2, \ldots, b_n$ - parameters of the equations of dependencies for individual factorial features (n – the number of the factorial features);

B – the cumulative parameter of the multiple dependency equation;

- r_{yx}- the correlation coefficient of one-factor relationship;

- d_y, d_{xz} - the size of deviations from unity of the coefficients of comparison of the theoretical values of the effective feature, [27].

The parameters *b* for deviations of the comparing coefficients from unity are determined by formula (3) and indicate that a change in the size of deviations of the comparing coefficients of the factorial feature (x_i) per unit leads to a change in the size of the deviations of the comparing coefficients of the effective feature by several times.

$$b = \frac{\sum dy}{\sum dx_1 + \sum dx_2 + \sum dx_3 + \ldots\ldots\ldots + \sum dx_n} \quad \text{or}$$

$$b = \frac{\sum \left(\frac{y_i}{y_{min}} - 1 \right)}{\sum \left(\frac{x_i}{x_{min}} - 1 \right)} \qquad (3)$$

The forecast values of the considered factors, as well as the effective feature, will be determined by formula (4).

$$y_t = y_{min}(1+bdt) \qquad (4)$$

where, y_t is a trend equation;
y_{min} is the minimum value of the feature

The value of t always starts with 1 and $t_{min}=1$.

Based on this, it is considered to be appropriate to apply this methodology and to forecast the gross output of small and medium-sized businesses in agriculture using the example of statistical data for Kazakhstan and taking into account state and borrowed sources of financing for 2023-2027.

3 Results and Discussion

A data file for a certain period on the financing of small and medium-sized businesses in the agricultural sector of the Republic of Kazakhstan is going to be used to conduct the regression analysis. The official statistics of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the 10-year-annual reports of financial development institutions will be taken as initial data. The main effective factor (Y) in the model will be the gross output produced by the small and medium-sized businesses in the agricultural sector. Various sources of financing for the activities of small and medium-sized businesses in agriculture will be identified as factor indicators that can potentially affect the value of the performance indicator, namely:

X1 - own funds;

The group of the public sources of financing: X2 - the credit supply within the framework of the government programs (concessional lending); X3 - the total amount of subsidies to the agricultural industry; X4 - the amount of financing in the form of leasing within the framework of the government sponsored programs;

The group of borrowed sources of financing: X5 - the credit supply allocated by second-tier banks; X6 - the volume of lending by microfinance organizations; X7 - the volume of lending by credit partnerships; X8 – the volume of financing by private leasing companies (Table 1, Appendix). The calculation of the dependencies of the effective factor on the factor indicators according to the formula (1) showed that almost all the studied factors have a close correlation with the effective feature, except for the X5 and X8 factors, therefore, when constructing a forecasting model, these factors will be excluded (Table 2, Appendix).

The correlation coefficient between the gross output and the source of financing in the form of own funds was $r_{yx}=0,98$ and showed a close relationship, and the theoretical value of Y_x indicates its high level, i.e. sufficient for reliable calculations: $\Sigma\hat{y}=\Sigma y_i= 23032736,0$.

The use of the equation of dependencies shows that, in theoretical terms, when the amount of financing from own funds changes, the effective feature increases (5).

$$y=1016202*(1+0,72*dx1) \qquad (5)$$

The calculation of one-factor equations for the dependencies of gross output on six factors according to the described methodology made it possible to obtain the following results (Table 3, Appendix). The calculations made to create a multifactorial equation, presented in Table 4 (Appendix), show the coincidence of the sum of empirical and theoretical values of the effective feature $\Sigma\hat{y}i=\Sigma yi=23032736,0$ which confirms the correctness of the calculations.

Using the formula (3), let's calculate the parameters *b* from the deviations of the comparing

coefficients from unity and derive a multifactorial equation (6).

$$y=1016202[1+0,087\ (dx1+\ dx2+\ dx3+\ dx4+\ dx6+\ dx7)] \quad (6)$$

The parameter *b* in this equation indicates that a change in the size of the deviations of the comparing coefficients of the factorial feature (x_i) per unit leads to a change in the size of the deviations of the comparing coefficients of the effective feature by 0,087 times.

The calculation of the parameter *b* of the trend equation for X1 will allow us to determine how much the effective feature X1 will increase from 2023 to 2027. In this case, the trend equation will be as follows:

$$X1=102431,0*(1+0,72*dt) \quad (7)$$

To establish the forecast indicators of the volume of own funds, let's calculate the share of the influence of factors and predict the change in this indicator for 2023.

$$dt = 11/1 - 1 = 10 \quad (8)$$

Using the formula (6), calculate the forecast value of the factor X_1 for the following years: 2023, 2024, 2025, 2026, 2027:

X_{2023} =102431,0 *(1+0,72*10) = 500609,9.
X_{2024} =102431,0 *(1+0,72*11) = 540427,8.
X_{2025} =102431,0 *(1+0,72*12) = 580245,7.
X_{2026} =102431,0 *(1+0,72*13) = 620063,6.
X_{2027} =102431,0 *(1+0,72*14) = 659881,4.

Therefore, in 2027, the amount of funds required to obtain the forecast volume of gross output should increase by 64381,4 million tenge. Using the methodology described above, we will calculate the forecast values of the remaining factors and the effective feature, i.e. gross output for 2023-2027.

Based on the calculations, the forecast value of gross output for 2027 will be 5020424,8 million tenge, for 2023 – 3876361,1 million tenge, for 2024 – 4162377,0 million tenge, for 2025 – 4448392,9 million tenge, for 2026 – 4734408,8 million tenge (Figure 1).

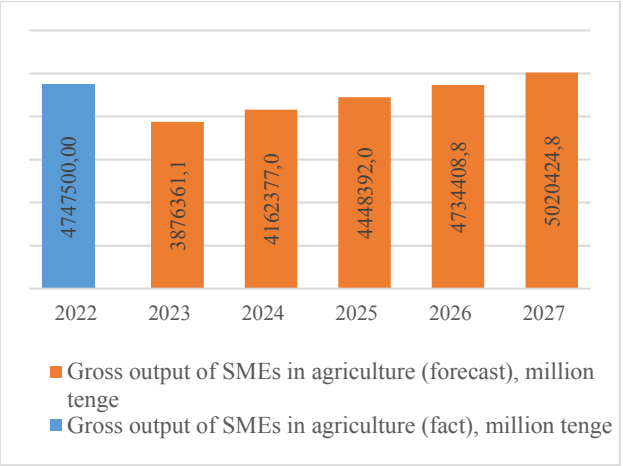

Fig. 1: Forecast of gross output by SMEs in agriculture until 2027

The calculated forecast values of gross output make it possible to calculate the forecast values of the factors that influenced the value of the effective feature. To establish predictive levels of factors, let's calculate the difference from unity between the comparing coefficient of the forecast value and the initial parameter of the equation of multifactor dependency using the following formula:

$$d_{y_н} = \frac{y_н}{y_{\min}} - 1 = \frac{3876361,1}{1016202,0} = 2,81455765 \quad (9)$$

Using the data, let's calculate the values of the forecast levels of factors for 2023-2027 according to the following formula:

$$x_н = \left(\frac{d_{y_н}}{b_x} + 1 \right) x_{\min} \ ;$$

The obtained data on the trend equation and the equation of multifactor dependency are correct, i.e. the forecast calculations are reliable. The forecast levels of the factors and their influence on the effective feature determine the possibility of its increase or decrease.

According to Table 5 (Appendix), it can be seen that, for almost all the indicators, the forecast values for 2023-2027 tend to increase compared to 2022. At the same time, in order the gross output in agriculture to reach 5020424,8 million tenge in 2027, small and medium-sized businesses need to increase funding from their funds by 10,8%, the state should increase the volume of concessional lending by 48,1%, subsidies for entities by 40,3% and leasing by 2,6%, credit partnerships, and microfinance organizations to ensure the growth in

the volume of transactions by 49,2% and 33,2 %, respectively.

The structural analysis of the impact of funding sources on gross output showed that non-state sources of funding have the greatest impact on the effective feature – 47,89%, public funding takes the second place – 40,08%, and then they are followed by own funds – 12,03 % (Table 6, Appendix).

This situation is quite understandable, as these two factors, despite insignificant volumes of financing closely interact with SMEs through the system of direct and indirect lending, as well as through co-financing with the state. This confirms the need to develop and improve financing methods involving these financial institutions.

The study of forecasting the impact of the structure of financing sources on the results of production activity in agriculture by small and medium-sized businesses made it possible to draw the following conclusions:

1) The total number of models was 8, but only 6 of them received positive results. Comparing the forecast indicators of gross output, we concluded that a significant impact on the effective feature is provided by the government funding under the existing programs that stimulate business development, including the agricultural sector. This indicates a high dependence of Kazakh entrepreneurship on the state and, at the same time, limited access to credit resources of financial organizations. This situation is because in recent years there has been a trend towards a decrease in bank financing of agribusiness entities. This is evidenced by the share of SMEs in the agricultural sector in the loan portfolio of second-tier banks, which, as of January 1, 2023, amounted to 5.0%, [28].

2) Comparing the projected gross output figures, we conclude that microfinance organizations and credit partnerships have the largest impact on the outcome indicator. Forecast data on gross output showed that by 2027, this indicator will increase by 272.9 billion tenge. This indicates that agricultural production output will only increase by 5,7 percent with the projected funding levels. Moreover, it confirms the insufficiency of the existing volumes of financing to achieve high indicators of industry development.

3) Considering the low rates of financing of small and medium-sized businesses in the agricultural sector by second-tier bank leasing organizations (low percentage of correlation with the effective feature), the state needs to expand the SME lending instrument with the involvement of financial organizations through the funding mechanism.

4 Conclusion

Currently, Kazakhstan is creating conditions for the further development of entrepreneurship by providing financial, proprietary, and information support. At the same time, small and medium-sized businesses, including those in the agricultural sector, need sufficient financing in the form of available loans and investments to carry out their activities and fulfill their tasks effectively. The study revealed that each of the sources presented has a significant impact on the production performance of the industry. However, the state financial support is still quite significant, which reduces the competitiveness of businesses and requires improvement of mechanisms for financing the industry from non-state sources. This is evidenced by the findings of the study.

Creation of favorable conditions for stable financial support of agricultural enterprises is possible only at the appropriate level of development of financial and credit infrastructure, which envisages improvement of mechanisms for its functioning, interaction of subsystems and elements, distribution and use of financial and credit resources, [29]. The allocation of funds by the state should be a reasonable approach and provide a multiplier effect of the impact of the state's financial investments on the economy as a whole. In addition, the mechanism of financial regulation and incentives should create conditions to develop the business environment, and not to allow business entities to receive gratuitous and non-repayable resources. Lending to small and medium-sized businesses in the agricultural sector by banks and other non-banking organizations should be affordable, flexible, and mutually beneficial, which will allow entrepreneurs to provide production with necessary financial resources, and financial organizations to receive income with minimal credit risks. In addition, the application the use of modern methods of forecasting production based on various factors will allow the state to allocate financial resources effectively in the face of limited budgetary funds, and small and medium-sized businesses to assess how much production can be increased using various sources of financing.

As limitations of the study conducted, the following should be highlighted:

1. the subject of the study is the current system of financing of small and medium-sized businesses in Kazakhstan;
2. the quantitative parameters include data on the volume of financing of SMEs at the expense of the producer's funds, financial support within the framework of state programs and at the expense of non-state sources for the last 10 years, i.e. from 2013 to 2022;
3. the sources of financing of production activities in agriculture used for forecasting were deliberately limited by the authors, firstly, due to their annually growing volume, secondly, due to their stability and continuity over the period under consideration, and thirdly, due to the availability of only these data in official sources of information.

It should be noted that the current course taken by Kazakhstan to build a diversified and innovative economy with the functioning of business entities with high potential, as well as changes in approaches to the provision of state financial support and the transition from direct support measures to indirect ones in the form of guarantees and funding of financial organizations will certainly increase the availability and demand for financial resources by entrepreneurs. However, the effectiveness of these forms of financing and their impact on the production performance of agribusiness entities will have to be assessed in future research.

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APPENDIX

Table 1. Indicators for constructing a regression model, million tenge

Period	Y	X1	X2	X3	X4	X5	X6	X7	X8
2013	1016202	102431	72200	88400	41527	42817	198	8515	32222
2014	1156746	116091	53514	148900	57770	80735	188	9002	16392
2015	1298194	120900	70599	152000	57530	84620	311	8732	18541
2016	1540413	171300	122202	220200	55760	205872	426	12946	23014
2017	1822652	236100	153490	260400	40176	363294	1489	22808	23100
2018	2057209	273800	258700	225900	62971	198213	573	35554	13311
2019	2510170	363400	289800	323200	98513	97295	675	35701	17077
2020	3118669	364300	340400	365100	110000	91742	2826	42889	18048
2021	3764981	472293	322500	372600	141600	151800	2182	45700	37032
2022	4747500	595500	351200	443500	171100	193600	2000	50000	37050

Source: [28], [30], [31]

Table 2. Matrix of paired correlation coefficients

Indicators	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1								
X 1	0,98834	1							
X 2	0,902690	0,92918	1						
X 3	0,952059	0,9606	0,9258	1					
X 4	0,964556	0,94121	0,8363	0,8877	1				
X 5	0,169571	0,2123	0,1439	0,2907	-0,0582	1			
X 6	0,804209	0,7654	0,7921	0,8384	0,711	0,2390	1		
X 7	0,929909	0,9533	0,9890	0,9317	0,8565	0,1992	0,8037	1	
X 8	0,535237	0,4896	0,2499	0,3573	0,5408	0,0738	0,3742	0,3048	1

Note: Complied by authors

Table 3. One-factor dependency equations

Factor	Equation
Own funds	y=1016202*(1+0,72*dx1)
Concessional lending	y=1016202*(1+0,45*dx2)
Subsidies	y=1016202*(1+0,65*dx3)
Leasing	y=1016202*(1+1,17*dx4)
Financing by credit societies	y=1016202*(1+0,26*dx6)
Financing by leasing companies	y=1016202*(1+0,58*dx7)

Note: Compiled by the authors using the method of statistical equations of dependencies

Table 4. Parameters of the multifactorial equation of dependencies of the effective feature

Year	Y (gross output)	Deviation of the comparing coefficients of the factorial features							Σdx_{1-7}	Theoretical value of y, bln. tenge
	y	dy	dx1	dx2	dx3	dx4	dx6	dx7		
2013	1016202,0	0,00	0,00	0,35	0,00	0,03	0,05	0,00	0,43	1016202,00
2014	1156746,0	0,14	0,13	0,00	0,68	0,44	0,00	0,06	1,31	1114323,16
2015	1298194,0	0,28	0,18	0,32	0,72	0,43	0,65	0,03	2,33	1148866,69
2016	1540413,0	0,52	0,67	1,28	1,49	0,39	1,26	0,52	5,62	1510894,97
2017	1822652,0	0,79	1,30	1,87	1,95	0,00	6,91	1,68	13,70	1976359,91
Year	Y (gross output)	Deviation of the comparing coefficients of the factorial features							Σdx_{1-7}	Theoretical value of year, million tenge
	y	dy	dx1	dx2	dx3	dx4	dx6	dx7		
2018	2057209,0	1,02	1,67	3,83	1,56	0,57	2,04	3,18	12,85	2247162,8
2019	2510170,0	1,47	2,55	4,42	2,66	1,45	2,59	3,19	16,85	2890768,6
2020	3118669,0	2,07	2,56	5,36	3,13	1,74	14,00	4,04	30,82	2897233,4
2021	3764981,0	2,70	3,61	5,03	3,21	2,52	10,58	4,37	29,33	3672958,0
2022	4747500,0	3,67	4,81	5,56	4,02	3,26	9,62	4,87	32,14	4557966,4
Total	23032736,0	12,67	17,49	28,02	19,41	10,83	47,70	21,93	145,38	23032736,0

Note: Compiled by the authors using the method of statistical equations of dependencies

Table 5.The forecast values of financial indicators for 2023-2027, million tenge

Indicators	2022	Forecasts, years				
		2023	2024	2025	2026	2027
Y	4747500,0	3876361,1	4162377,0	4448392,9	4734408,8	5020424,8
X 1	595500,0	500609,9	540427,8	580245,7	620063,6	659881,4
X 2	351200,0	386728,4	420049,9	453371,3	486692,8	520014,2
X 3	443500,0	469777,8	507915,6	546053,3	584191,1	622328,9
X 4	171100,0	136884,2	146555,0	156225,9	165896,7	175567,5
X 6	2000,0	2185,4	2385,1	2584,8	2784,5	2984,2
X 7	50000,0	50003,4	54152,3	58301,1	62450,0	66598,8

Note: Compiled by the authors

Table 6.The share of the influence of each factor on the gross output, %

Name of the factor	The sum of deviations of the factor comparison coefficients	The share of the influence of the factor on the effective feature, %
Own sources of financing		
X 1	17,49	12,03
Public sources of financing		
X 2	28,02	19,27
X 3	19,41	13,35
X 4	10,83	7,45
Borrowed sources		
X 6	47,70	32,81
X 7	21,93	15,08
Total	145,38	100,0

Note: Compiled by the authors

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