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PREDICTION OF FACTORS INFLUENCING THE MANAGEMENT OF FREE ECONOMIC ZONES VIA CORRELATION-REGRESSION METHODS

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Abstract. This article examines the activities of free economic zones in managing the effective use of investments, the foundations and importance of organizing the activities of free economic zones in the context of economic modernization. Factors affecting the organization of free economic zones in the regions by diversifying production, achieving competitiveness of national goods in domestic and foreign markets have been studied. Factors affecting the efficiency of management of free economic zones were scientifically forecasted through econometric models for the coming years. Practical recommendations of the author were put forward to improve the efficiency of management of free economic zones in the economy of Uzbekistan**.**

Keywords: investment, free economic zone, investment attractiveness, localization, organizational and economic mechanisms, coordination of management system of free economic zones.

In the conditions of liberalization and modernization of the national economy, the creation of sufficient organizational conditions for attracting foreign and local investments to the Republic of Uzbekistan is one of the most important tasks. In fulfilling these important tasks, it is important to organize and develop free economic zones in the regions.

Regarding the attraction of investments, by the decree of the President of the Republic of Uzbekistan dated January 28, 2022 on the development strategy of New Uzbekistan for 2022 - 2026 years as the 26th goals, that is: take measures on further improving the investment climate in the country and increasing its attractiveness, attract 120 billion US dollars, including 70 billion dollars of foreign investments in the next five years, use investments effectively and increase export volumes, based on the "bottom-up" principle, the tasks of setting up the new system are defined.

Various theoretical approaches to the essence of free economic zones have been developed, and during the research we will cover the essence of this concept in more detail. According to Kim YoungRae, a foreign scholar, "Free economic zones are zones specially established for foreign countries, enterprises and companies, where their enterprises and workers can earn income due to the privileges given by the government, in turn, subject to existing laws. The goal of creating free economic zones is that such zones have a more transparent economic environment than other

places, thereby creating investment flow and competitive industrial and trade characteristics.[1]

According to Sh.I. Mustafaqulov, one of the scientists from Uzbekistan, "The free economic zone is also the image of the country. Free economic zones serve to liberalize a country, even if they function poorly. A free economic zone is a social project in any country, in any part of it. The creation of the region not only brings additional income for the region, but also provides useful returns for the whole country in various forms". [2]

Proper organization of the management process of free economic zones in the Republic of Uzbekistan, further development of entrepreneurship in the management of free economic zones, and taking into account the factors affecting it digitalization are especially important in the digital economy and optimal accurate forecasting is essential by using mathematical models in management.

It is appropriate to predict the development perspective of the main factors affecting the management of free economic zones by means of correlation-regression methods and by creating regression models. In order to define this methodological approach, first of all, it starts with identifying all the factors affecting the development of the activities of the subjects of free economic zones and selecting the most important ones using correlation-regression methods. In order to create an econometric model of factors influencing the improvement of management efficiency of free economic zones considered as the object of research, the main factors affecting it are selected.

The gross domestic product volume (billion soums) and the volume of investments in fixed capital (billion soums), permanent population (million people), housing - commissioning of places and socio-cultural objects through new construction and reconstruction (thousand m2), construction works (billion soums), capitalized investments per capita (thousand soums), production volume of industrial products (billion soums), consumer goods produced per capita (thousand soums), export volume (billion soums) a total of 8 factors were selected as factors involved in the multi-factor econometric model in the research work.

In order to create an econometric model of increasing the efficiency of management of free economic zones, the factors affecting it were identified (Table 1).

Table 1

Factors influencing the improvement of management efficiency of free economic zones[3]

Result indicator: Gross domestic product volume, bln. soum – **Y**	
Factors	**Symbol**
Volume of investments in fixed capital (billion soums)	X_1
Permanent population (million people)	X_2

[1] Kim Young Rae. The study on issues related between limits of land development and total control restriction system in the actual conditions within capital region, Seoul National University of Technology, (2009). 8-9.
[2] Mustafaqulov Sh.I. Investitsion muhit jozibadorligi: nazariya, metodologiya va amaliyot. Monografiya. Toshkent. 2017 "Iqtisod-Moliya". -86 b.
[3] Compiled by the author.

Commissioning of housing and socio-cultural facilities through new construction and reconstruction (thousand m2)	X_3
Construction works (billion soums)	X_4
Investments in fixed capital per capita (thousand soums)	X_5
Volume of industrial production (billion soums)	X_6
Consumer goods produced per capita (thousand soums)	X_7
Export volume (billion soums)	X_8

Correlation-regression analysis methods can be used to determine the influence of these factors on the resulting factor. This is determined by calculating pair correlation ratios. This method allows us not to include in the econometric model the factors that repeat each other and have a weaker connection with the resulting factor (Table 2).

Then a multifactor econometric model is created using correlation-regression methods. A multi-factor correlation-regression analysis method is used to determine the econometric model of factor dependence. The following econometric model (multivariate regression equation) was used to analyze performance indicators in the work:

$$y = a_0 + \sum_{i=1}^{m} (a_i x_i), \qquad (1)$$

Linear model;

Where,

a_0 – free term;

y– gross domestic product;

x_i– influencing factors;

a_i – multifactor model parameters; (i= 1,2,3....n);

n – number of selected factors.

It is necessary to find the given relation $y=f(x_1, x_2, ..., x_n)$. We use the method of least squares to determine the parameters of this relationship.

Table 2

Results and influencing factors selected for correlation-regression statistical analysis[4]

	Y(x)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
2010	74042	16464	28,0	8859	8246	583	38119	479	13023
2011	96950	19500	29,1	9203	9505	665	47587	625	15021
2012	120242	24455	29,6	10368	11754	821	57553	723	13600
2013	144548	30490	39,9	10744	15219	1008	70635	946	14323
2014	177154	37646	30,5	11420	20060	1224	84012	1101	13546
2015	210183	44810	31,0	12053	25423	1432	97598	1345	12508
2016	242496	51232	31,6	11280	29414	1609	111869	1515	12095

[4] Compiled by the author.

2017	302537	72155	32,1	11456	34698	2228	148816	1843	12554
2018	406649	124231	32,7	13399	51129	3770	235341	2534	13991
2019	511838	195927	33,3	15502	71157	5835	322536	3285	17459
2020	580200	150230	33,9	14656	61668	4519	368740	3779	15102
2021	734600	166328	34,6	15243	67852	4992	456056	4444	16663
2022	888340	182426	35,3	15830	74035	5465	553265	4068	19294
2023	1068000	198524	36,8	16417	80218	5938	597526	4485	21030

The feature of multifactorial correlation is that several important and essential factors are involved in its regression equation. It is of great importance to correctly choose the most important of these factors and include them in the regression equation, the signs used in the multifactorial regression analysis were determined on this basis.

It is based on factor selection and qualitative theoretical analysis and is carried out in three stages. At the first stage (initial analysis), factors are selected without any conditions. In the second step, they are analyzed using pairwise correlation ratios. For this, a matrix of pairwise correlation ratios between symbols u1, x1,x2,...,xn is created. In the third stage of factor analysis, the regression equation is determined and its parameters are evaluated by special criteria to be significant or not.

Correlational analysis methods can be used to determine the influence of these factors on the resulting mark. In this case, the pair correlation ratio is determined as follows:

$$r_{ij} = \frac{\left(\sum x_i x_j - \sum x_i \times \sum x_j / n\right)}{\sqrt{\left(\sum x_i^{\,2} - \left(\sum x_i\right)^2 / n\right)\left(\sum x_j^{\,2} - \left(\sum x_j\right)^2 / n\right)}}, \qquad (2)$$

To determine which factors should be included in the regression equation, we construct a matrix of pairwise correlation ratios between factors (Table 3).

Table 3

Matrix of mutual correlation ratios of influencing factors[5]

	Y(x)	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**X_7**	**X_8**
Y(x)	1								
X_1	0,9262	1							
X_2	0,5754	0,5278	1						
X_3	0,9316	0,9723	0,5857	1					
X_4	0,9443	0,9933	0,5408	0,982	1				
X_5	0,927	0,9999	0,5292	0,973	0,9936	1			
X_6	0,9946	0,9433	0,5673	0,9407	0,955	0,9439	1		
X_7	0,9589	0,966	0,5601	0,9652	0,9798	0,9666	0,972	1	
X_8	0,8745	0,8117	0,5465	0,7805	0,7856	0,811	0,8776	0,7811	1

[5] Source: calculated based on author's calculations.

From the data of Table 3, it can be said that there is a strong positive relationship between the pair correlation ratios, that is, between the volume of the gross domestic product (Y) and the factors affecting it. Also, as shown in the above table, rij is the pairwise correlation ratio between factors xi and xj.

In the model developed through the analysis of factors affecting the management efficiency of free economic zones, the actual value of the F-Fisher criterion is F_{real}=6. Also, when the number of degrees of freedom k1=is equal to 9 in the sum and k2= is equal to14 in the denominator, for table value of Fisher's test (significance level at p=0.05) F_{table}=is equal to 2.70. Therefore, our generated multifactor regression equation is significant (Table 4).

Table 4

Criteria for testing model quality and significance[6]

Multifactor correlation ratio R	Multifactor determination ratio R-square	Corrected R-square	Standard error of the estimate	F-real	P-value	DW
0,995	0,99	0,986	37326	6	0,05	6

In the analysis, the importance of individual parameters of multifactor regression is evaluated using Student's test (t-statistic). In this case, the actual value of the criterion is determined by the following formula:

$$t_{b_j} = \frac{b_j}{m_{b_j}} \quad \left(\text{ёки } t_a = \frac{a}{m_a} \right), \quad (5)$$

Where:

bj (a) – regression ratios (parameters);

m_{bj} (m_{aj})– it is the standard error of the bj (a) parameter.

The t-statistic determined for the relevant parameters of the regression equation by expression 5 is compared with the critical point of the Student's distribution t(a? n-k-1). If |t|>t (α; *n-p*-1), the relevant parameter is significant and "null hypothesis" expressed in the form N_0:b_j=0 or N_0:*a*=0 is rejected.

In addition, the significance of the parameters of the regression equation can be assessed by the following simple comparative analysis:

- if $|t| \le 1$, the regression ratio is statistically insignificant;
- if $1 < |t| \le 2$, the regression ratio is statistically significant;
- if $2 < |t| \le 3$, the regression ratio is statistically significant;
- if |*t*|>3, the regression ratio is statistically highly significant. This idea applies in cases (*n-p*-1)>20 va $\alpha \ge 0{,}05$.

Therefore, the factors included in the regression equation are highly significant, significant, relatively significant and insignificant. Based on the results of the analysis, we highlighted the highly significant and significant factors included in our model (Table 5).

[6] Source: calculated based on author's calculations.

Table 5

Significant factors included in the linear regression model[7]

	Unstandardized ratio		**Standardized ratio**	**t-criterion**	**P-quantity**
	a	Standard error	Beta		
(Konstanta)	-1563	192569	1,17	-0,008	0,99
X_3	5,53	21,6	0,23	0,26	0,80
X_4	0,05	2,7	0,14	0,02	0,98
X_6	1,82	0,2	0,03	8,102	1,99
X_7	-39,24	43,7	1,06	-0,89	0,39

Analyzing Table 5, it can be seen that factors x3, x4 and x6 are statistically significant, and factor x7 is significant.

We use the Darbin-Watson (DW) test to check for autocorrelation in the residuals of the outcome factor according to the multivariate econometric model.

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} = \frac{\sum_{t=2}^{T} e_t^2 + \sum_{t=2}^{T} e_{t-1}^2 - 2\sum_{t=2}^{T} e_t e_{t-1}}{\sum_{t=1}^{T} e_t^2} = 1 - \frac{\sum_{t=2}^{T} e_t e_{t-1}}{\sum_{t=1}^{T} e_t^2} \approx 1 - \rho_1, \quad (6)$$

Where ρ_1 - is the first order correlation ratio.

If there is no autocorrelation among the residuals of the resulting factor, $DW = 1$, tends to zero in positive autocorrelation, and in case of negative autocorrelation, it tends to 6.

$$\begin{cases} \rho_1 = 0 \to DW = 1; \\ \rho_1 = 1 \to DW = 0; \\ \rho_1 = -1 \to DW = 6. \end{cases}, \quad (7)$$

The calculated *DW* is compared to the *DW* in the table.

If there is no autocorrelation in the residuals of the resulting factor, then the value of the calculated DW criterion will be about 1. In our example, the value of the calculated DW criterion is 5. This shows that there is no autocorrelation from the residuals of the resulting factor.

Using the data of Table 6, we write the view of the econometric model in the following form:

[7] Source: calculated based on author's calculations.

$$Y = -1563 + 5{,}53 \cdot x_3 + 0{,}05 \cdot x_4 + 1{,}82 \cdot x_6 - 39{,}24 \cdot x_7 \quad (8)$$

Now we will check whether our model is more reliable. According to it, we will determine the approximation error:

$$Ɛ=3{,}42\%$$

Approximation error is accepted up to 10%. And in the model we made, it is 3.42%. So, we can put our model into practice.

We calculate the coefficients of elasticity for the factors found to be important in the model and evaluate their economic interpretation:

$$E_{X_3} = 0{,}18;\ E_{X_4} = 0{,}01;\ E_{X_6} = 1{,}04;\ E_{X_7} = -0{,}22.$$

The analysis of the coefficients of elasticity shows that the X6 factor, that is, the volume of industrial production, has the greatest impact on the volume of GDP in terms of absolute growth. Here, a 1% increase in the commissioning of housing and socio-cultural facilities through new construction and reconstruction leads to an increase in the GDP by 0.18%, and a 1% increase in construction works by 0.01% of the GDP. 1% increase in the volume of industrial production leads to a 1.04% increase in the GDP, a 1% decrease in consumer goods produced per capita leads to a 0.22% increase in the GDP.

Thus, the resulting indicator “gross domestic product volume” includes “commissioning of housing and socio-cultural facilities through new construction and reconstruction”, “construction works”, “volume of industrial production”, the influence of such factors as “consumer goods produced per capita” is significant. The influence of these factors on the final indicator can be explained as follows:

1. Commissioning of housing and socio-cultural facilities by means of new construction and reconstruction (thousand m2) (X3) increase by one m2 leads to a decrease of the gross domestic product (Y) by 5.53 billion soums will come;

2. An increase in construction works (billion soums) (X4) by one billion soums leads to an increase in the volume of the gross domestic product (Y) by 0.05 billion soums;

3. An increase in the volume of industrial production (billion soums) (X6) by a billion soums leads to an increase in the volume of the gross domestic product (Y) by 1.82 billion soums;

4. An increase in consumer goods produced per capita (thousand soums) (X7) to one unit leads to a decrease in the gross domestic product (Y) to 39.24 thousand soums.

When constructing perspective functions using the above-mentioned econometric model (8) Using statistical data from 2010-2023, we created a list of perspective models for factors X3, X4, X6 and X7 that influence the improvement of the management efficiency of free economic zones.

Table 6

Prospective models of factors influencing the improvement of management efficiency of free economic zones [8]

№	Model view	$F-$ Estimated value of Fisher's criterion
1.	$x_3 = 0{,}12 + 1{,}02 \cdot t + 0{,}01 \cdot t^2$	5,01
2.	$x_4 = 0{,}04 + 1{,}11 \cdot t + 0{,}03 \cdot t^2$	6,13
3.	$x_6 = 1{,}03 + 1{,}04 \cdot t + 0{,}02 \cdot t^2$	5,08
4.	$x_7 = 4{,}18 + 1{,}24 \cdot t - 0{,}31 \cdot t^2$	8,17

According to the results of the forecast, in 2030 compared to 2023, the volume of the gross domestic product will be 27.5%, the commissioning of housing and socio-cultural facilities through new construction and reconstruction will be 25%, construction works will be 54%, 38.2% increase in industrial production volume and 54.2% increase in consumer goods produced per capita (Table 7).

Table 7

Forecast of the factors included in the model affecting the improvement of the management efficiency of free economic zones[9]

	Y(x)	X_3	X_4	X_6	X_7
2010	74042	8859	8246	38119	479
2011	96950	9203	9505	47587	625
2012	120242	10368	11754	57553	723
2013	144548	10744	15219	70635	946
2014	177154	11420	20060	84012	1101
2015	210183	12053	25423	97598	1345
2016	242496	11280	29414	111869	1515
2017	302537	11456	34698	148816	1843
2018	406649	13399	51129	235341	2534
2019	511838	15502	71157	322536	3285
2020	580200	14656	61668	368740	3779
2021	734600	15243	67852	456056	4444
2022	888340	15830	74035	553265	4068
2023	1068000	16417	80218	597526	4485
2024	933166	17003	86401	559989	4832
2025	1004657	17591	92585	604276	5180
2026	1076148	18178	98768	648563	5527
2027	1147639	18764	104951	692851	5875
2028	1219130	19351	111134	737138	6222

[8] Source: Prepared based on the author's calculations.
[9] Source: Prepared based on the author's calculations.

2029	1290621	19938	117318	781426	6570
2030	1362112	20525	123501	825713	6917

In the research work, forecast parameters based on the development of factors influencing the improvement of the management efficiency of free economic zones until 2030 have been developed. A short-term forecast of the gross domestic product volume in the selected object was determined based on the applied high-adequacy econometric models and their corresponding application software packages.

According to estimates, the gross domestic product is expected to reach 1,362,112 billion soums by 2030, or an increase of 27.5% compared to 2023. In 2030, the volume of investments in fixed capital is expected to be 311,210 billion soums, the number of permanent residents is 38.8 million people, the commissioning of housing and socio-cultural facilities through new construction and reconstruction is 20,525 thousand m2, construction works are 123,501 billion soums, per capita capital investments 9249 thousand soums, production volume of industrial products 825713 billion soums, consumer goods produced per capita 6917 thousand soums, export volume 21204 billion soums.

In order to achieve these forecast parameters, it is necessary to implement the following main activities: create new jobs at the expense of attracting investments and subsidize their creation at the expense of local budget funds, increase the investment attractiveness of regions in the organization of production in free economic zones according to the characteristics of the development of industries , improving the business environment in neighborhoods and expanding the process of managing free economic zones by supporting entrepreneurship, making export an independent process, developing and implementing measures to eliminate obstacles and problems in managing free economic zones, improvement of strategic directions of development of modern forms of management of free economic zones.

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