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ECONOMETRIC ANALYSIS OF ENDOGENOUS AND EXOGENOUS FACTORS AFFECTING THE AMOUNT OF IMPORT DUTIES TRANSFERRED TO THE STATE BUDGET

Quvatova Zakhro Orifjonovna
Independent researcher of the Customs Institute, Tashkent, Uzbekistan
zahrokuvatova@gmail.com

Abstract. This scientific article presents an econometric analysis of endogenous and exogenous factors affecting the amount of import duties transferred to the state budget. Based on the research results, scientific proposals and practical recommendations are given.

Key words: import customs duty, benefits and preferences, import volume, trend model, econometric models, outcome factor, variable factors.

1.Introduction

The deepening of foreign economic relations and Uzbekistan's integration into the global trade system make state regulation of foreign trade particularly important. One of the main instruments of such regulation is the import duty, which affects the volume of imports, the structure of the domestic market, price levels, the competitiveness of domestic producers, and the formation of the revenue component of the state budget. In this context, analyzing the factors that determine the dynamics and efficiency of import duty implementation represents a pressing scientific and practical task.

In recent years, Uzbekistan has undertaken extensive reforms in the field of customs and tariff regulation, aimed at liberalizing foreign trade, reducing tariff barriers, and creating favorable conditions for attracting investment. These changes necessitate a comprehensive assessment of the impact of macroeconomic, foreign trade, and institutional factors on import duty indicators. The use of econometric methods enables the identification of quantitative relationships between these indicators, the evaluation of their influence, and the enhancement of the justification for managerial decision-making.

In the Presidential Decree "On the Strategy 'Uzbekistan – 2030'" dated September 11, 2023, under the priority direction "Ensuring the Welfare of the Population through Sustainable Economic Growth," Goal 46, titled "Ensuring Fiscal Stability and Effective Management of State Obligations," sets the task of ensuring that the consolidated budget deficit does not exceed

4 percent of gross domestic product in 2024 and remains below 3 percent in subsequent years [1].

Currently, customs payments account for 25 percent of the revenue component of the state budget, and this indicator has been steadily increasing over the past five years, highlighting the growing importance of this area [2].

In light of the above, conducting an econometric analysis of the endogenous and exogenous factors affecting the amount of import duties transferred to the state budget is of significant importance.

2.Literature Review

It should also be noted that domestic scholars such as B.Yu. Khodiev, T.Sh. Shodiev, and B.B. Berkinov have conducted research on econometric modeling of economic development [3–4], 12. Burkhanov A. U.[12], Tursunov B. O.[11], Usmonov, B., while Yu. Mukhamedov has studied the factors and econometric models of sustainable socio-economic growth [5].

Typically, the factors influencing the collectability of customs duties are conditionally classified into two groups: exogenous factors, which are not dependent on customs authorities, and endogenous factors, which are directly dependent on them. Exogenous factors exert the greatest influence on the collectability of customs payments, whereas endogenous factors represent those variables managed by customs authorities and serve to ensure the completeness of revenue collection [8].

3.Research Methodology

This article systematically analyzes the problems arising in the calculation and collection of customs fees. Research methods such as analysis, synthesis, grouping and comparison are widely used in it.

4.Analysis and Results

In this article, we examine the issues of econometric modeling of endogenous and exogenous factors affecting the amount of import duties transferred to the state budget. During this study, a multivariate econometric model was developed. The following factors were selected for the model: the dependent variable is the volume of import duties transferred to the state budget, in billion soms (Y), while the independent variables include import volume, in million USD (X1); the average import customs duty rate, % (X2); the average exchange rate of

the US dollar, USD/som (X3); deficit (by CN FEA), in million soms (X4); and the customs value index, coefficient (X5). Since the variables included in the multivariate econometric model have different measurement units, their values were logarithmically transformed to unify the measurement scale.

The preliminary analysis begins with the descriptive statistics of the variables included in the multivariate econometric model. Descriptive statistics represent a set of statistical methods used to analyze a dataset and to summarize its main characteristics in a concise, accurate, and systematic manner.

The results of the descriptive statistical analysis for the factors affecting the volume of import duties transferred to the state budget are presented in Table 1.

Table 1

Descriptive Statistics Results by Factors

	lnY	lnX_1	lnX_2	lnX_3	lnX_4	lnX_5
Mean	7.750204	9.766774	10.39375	8.433724	20.14938	0.875373
Median	7.476405	9.615509	8.000000	8.310297	7.525000	0.919823
Maximum	9.371370	10.52995	14.80000	9.468079	122.2000	1.081985
Minimum	6.397130	9.069400	4.100000	7.320527	1.000000	0.650643
Std. Dev.	0.981452	0.486320	4.100320	0.840185	37.09631	0.106476
Skewness	0.344373	0.364635	0.051938	0.017766	2.168882	-0.279461
Kurtosis	1.866030	1.736800	1.301870	1.284398	6.013496	2.789516
Jarque-Bera	1.173505	1.418340	1.929623	1.963035	18.59824	0.237798
Probability	0.556130	0.492052	0.381055	0.374742	0.000092	0.887897
Sum	124.0033	156.2684	166.3000	134.9396	322.3900	14.00596
SumSq. Dev.	14.44871	3.547614	252.1894	10.58866	20642.04	0.170057
Observations	16	16	16	16	16	16

From the table data, the mean, median, maximum, and minimum values of each factor can be observed. In addition, the standard deviation (std. dev. — which indicates the extent to which each variable deviates from its mean) of each factor is presented.

For selecting factors to be included in the multivariate econometric model of import duties transferred to the state budget, it is necessary to calculate and analyze the strength of the relationships between the factors. For this purpose, a correlation analysis is conducted, whereby the partial and pairwise correlation coefficients between the factors are calculated. The matrix of partial and pairwise correlation coefficients between the factors is presented in Table 2.

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Table 2

Matrix of Partial and Pairwise Correlation Coefficients between Factors

Covariance Analysis: Ordinary

Date: 01/13/26 Time: 10:57

Sample: 2010 2025

Included observations: 16

Correlation

t-Statistic

Probability	lnY	lnX_1	lnX_2	lnX_3	lnX_4	lnX_5
lnY	1.000000					
lnX_1	0.960823	1.000000				
	12.97093	-----				
	0.0000	-----				
lnX_2	-0.678689	-0.500169	1.000000			
	-3.457697	-1.969297	-----			
	0.0038	0.0625	-----			
lnX_3	0.848661	0.644981	-0.605366	1.000000		
	7.22230	3.04873	-2.853531	-----		
	0.0005	0.0103	0.0122	-----		
lnX_4	-0.625073	0.612024	-0.412726	0.607881	1.000000	
	2.909424	2.894247	-1.695417	2.864487		
	0.0115	0.0120	0.1121	0.0123		
lnX_5	0.662244	0.231730	0.145389	-0.054263	0.276714	1.000000
	3.033348	0.891314	0.549838	-0.203335	1.077442	
	0.0097	0.3878	0.5911	0.8418	0.2995	

From Table 2, it can be observed that the partial correlation coefficients indicate the strength of the relationship between the dependent variable, the volume of import duties transferred to the state budget (lnY), and the independent factors. Thus, the partial correlation coefficients show the presence of various types of relationships between the dependent variable, lnY, and the influencing factors.

Thus, the strength of the relationship between the volume of import duties transferred to the state budget (lnY) and the import volume (lnX1) is 0.9608, indicating a strong positive

correlation between these two variables. The correlation between lnY and the average import customs duty rate (lnX2) is -0.6787, reflecting a moderately strong negative relationship. There is a strong positive correlation between lnY and the average US dollar exchange rate (lnX3), with a partial correlation coefficient of 0.8487. The correlation between lnY and the deficit (by TIF TN) (lnX4) is -0.6251, indicating a moderately strong negative relationship. Additionally, the volume of import duties (lnY) and the customs value index (lnX5) exhibit a moderately strong positive correlation, with a partial correlation coefficient of 0.6622.

In addition, Table 2 also presents the pairwise correlation coefficients between the independent factors. These coefficients are used to detect multicollinearity among the independent variables (lnXi, lnXj). If the calculated pairwise correlation coefficient between two independent factors exceeds 0.7, multicollinearity is considered to be present. From the matrix of partial and pairwise correlation coefficients presented in Table 2, it can be seen that none of the calculated pairwise correlation coefficients between the independent factors exceed 0.7. This indicates that all selected factors can be included in the multivariate econometric model.

In addition, Table 2 presents the calculated statistics for assessing the significance and probability of the correlation coefficients (values located in the rows below the calculated coefficients). For each correlation coefficient, the lower part of the table shows its Student's t-value and the corresponding probability (prob.). A significance threshold of 0.05 is applied for all correlations. For example, the partial correlation coefficient between the volume of import duties transferred to the state budget (lnY) and import volume (lnX1) is $r_{\ln Y,\ln X1} = 0{,}9608$, $t = 12{,}9709$ and $\text{prob.} = 0{,}0000$ .This indicates a strong relationship between the two factors, confirms the statistical reliability of the partial correlation coefficient, and demonstrates that a positive, strong correlation exists between the two variables at a 95% confidence level.

Thus, the correlation coefficients between the factors included in the multivariate econometric model for the volume of import duties transferred to the state budget (lnY) fully satisfy the requirements based on the Student's t-values and associated probabilities. This indicates that all selected factors can be incorporated into the multivariate econometric model for lnY.

In general, the multivariate econometric model takes the following form:

$$\ln y = a_0 + a_1 \ln x_1 + a_2 \ln x_2 + ... + a_n \ln x_n + \varepsilon \,, \qquad (1)$$

here, lnY is the dependent variable, represents the independent factors, and denotes the random error term.

The unknown parameters of the multivariate econometric model (1) were estimated using the **ordinary least squares (OLS) method.** The results are presented in Table 3.

Table 3

Estimated Parameters of the Multivariate Econometric Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\ln X_1$	1,661174	0,509519	3,260279	0.0125***
$\ln X_2$	-0,029289	0,006683	-4,382613	0.0012***
$\ln X_3$	0,215254	0,034888	6,169858	0.0000***
$\ln X_4$	-0,003299	0,001441	-2,290076	0.0464***
$\ln X_5$	1,574431	0,725242	2,170902	0.0503**
C	9,282209	3,747199	2,477104	0.0067***
R-squared	0.912458	Mean dependent var		7.750204
Adjusted R-squared	0.903687	S.D. dependent var		0.981452
S.E. ofregression	0.232902	Akaike info criterion		0.203597
Sumsquaredresid	0.542433	Schwarzcriterion		0.493318
Loglikelihood	4.371222	Hannan-Quinn criter.		0.218433
F-statistic	51.27373	Durbin-Watson stat		2.241538
Prob(F-statistic)	0.000001			

Using the data from Table 3 above, we express the analytical form of the multifactor econometric model for the volume of import customs duties allocated to the state budget (lnY):

$$\ln\hat{Y} = 9{,}282 + 1{,}661\ln X_1 - 0{,}029\ln X_2 + 0{,}215\ln X_3 - 0{,}003\ln X_4 + 1{,}574\ln X_5$$

(2)

The estimated multifactor econometric model (2) shows that if the import volume (lnX1) increases on average by 1 percent, the volume of import customs duties transferred to the state budget (lnY) increases on average by 1.661 percent. If the average rate of import customs duties (lnX2) increases on average by 1 percent, the volume of import customs duties transferred to the state budget (lnY) decreases on average by 0.029 percent. If the average exchange rate of the US dollar (lnX3) increases on average by 1 percent, the volume of import customs duties transferred to the state budget (lnY) may increase on average by 0.215 percent. If the deficit (according to HS TN) (lnX4) increases on average by 1 percent, the volume of import customs duties transferred to the state budget (lnY) may decrease on average by 0.003 percent. If the

customs value index (lnX5) increases on average by 1 percent, the volume of import customs duties transferred to the state budget (lnY) may increase on average by 1.574 percent.

To assess the quality of the multifactor econometric model (2) constructed for the volume of import customs duties transferred to the state budget, the coefficient of determination is used. The coefficient of determination shows what percentage of the dependent variable is explained by the factors included in the model. The estimated coefficient of determination (R^2 – R-squared, Table 3) is equal to 0.9124. This indicates that 91.24 percent of the volume of import customs duties transferred to the state budget (lnY) in the republic is explained by the factors included in the multifactor econometric model (2). The remaining 8.76 percent (100.0 − 91.24) is explained by the influence of factors not included in the model.

Fisher's F-test is used to assess the statistical significance and adequacy (goodness of fit) of the multifactor econometric model (2) constructed for the volume of import customs duties paid to the state budget (lnY). The calculated value of the Fisher F-statistic is compared with its tabulated (critical) value. If the condition F(calculated) > F(tabulated) is satisfied, the multifactor econometric model (2) is considered statistically significant, and it may be used to forecast the dependent variable—the volume of import customs duties paid to the state budget (lnY) — for future periods.

To test the statistical significance of the multifactor econometric model (2), the tabulated value of the F-statistic is first determined. For this purpose, the corresponding degrees of freedom and the significance level are specified. Based on the selected significance level and the given degrees of freedom, the tabulated value of the F-statistic is equal to 3.33. The calculated value of the F-statistic is F(calculated) = 51.2737 , while the tabulated value is F(tabulated) = 3.33. Since the condition F(calculated) > F(tabulated)is satisfied, the multifactor econometric model (2) can be regarded as statistically significant. Consequently, this model can be used to forecast the volume of import customs duties paid to the state budget (lnY) for future periods.

Student's t-test is used to check the reliability of the estimated parameters of the multivariate econometric model (2) constructed for the volume of import duties transferred to the state budget (lnY). By comparing the calculated Student's t-value (t_calc) with the table value (t_table), we accept or reject the null hypothesis H_0. To do this, we find the table value of the t-statistic based on the chosen significance level (α) and the degrees of freedom (df). Here, n is the number of observations and p is the number of parameters.

For a significance level of α and degrees of freedom of df, The t-statistic table value is equal to 2.06.

From the calculations for the multivariate econometric model, it can be seen that all factors are significant at the 5% and 10% confidence levels (Table 3). This indicates that all factors are reliable and allows them to be included in the multivariate econometric model.

The Durbin-Watson (DW) criterion is used to test for the presence of autocorrelation in the residuals of the explanatory variable (lnY) in the multi-factor econometric model (2), which was developed based on the tax amount determined by the audit in the Republic.

The calculated DW value is compared with the DWL and DWU in the table. If the calculated DW is less than DWL, it is said that there is autocorrelation in the residuals of the estimated coefficient. If the calculated DW is greater than DWU, it is said that there is no autocorrelation in the residuals of the estimated coefficient. The lower bound of the Durbin-Watson criterion is DWL = 0.56 and the upper bound is DWU = 2.21. The calculated DW = 2.2415. Therefore, since the DW statistic is greater than the upper bound of the DWU, there is no autocorrelation in the residuals of the outcome variable (the volume of import duties transferred to the state budget (lnY)).

The absence of autocorrelation in the residuals of the dependent variable also indicates that the above-mentioned (2) multi-factor econometric model can be used for forecasting.

The coefficient MAARE (Mean Absolute Percent Error) is calculated for forecasting the dependent variable for future periods using the derived (2) multi-factor econometric model. If the calculated MARE coefficient value is less than 15.0 percent, the model can be used to forecast the outcome variable; otherwise, it cannot. The MARE coefficient for the volume of import duties transferred to the state budget (lnY) under study is 2.0920 percent (Figure 1).

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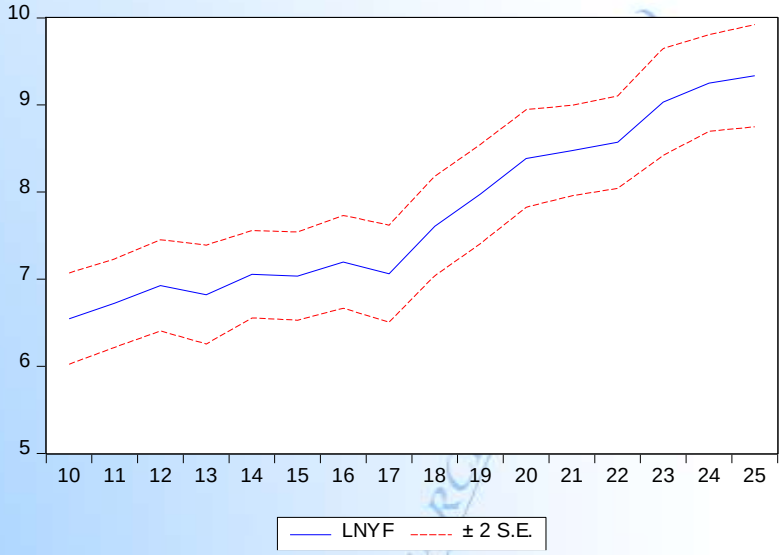

Forecast: LNYF	
Actual: LNY	
Forecast sample: 2010 2025	
Included observations: 16	
Root Mean Squared Error	0.184125
Mean Absolute Error	0.154123
Mean Abs. Percent Error	2.092060
Theil Inequality Coefficient	0.011792
Bias Proportion	0.000000
Variance Proportion	0.009566
Covariance Proportion	0.990434
Theil U2 Coefficient	0.832573
Symmetric MAPE	2.092104

Figure 1. Indicators of using the forecast based on the estimated multivariate econometric model

Since this value is less than 15.0 percent (MAPE = 2.0920), it can be concluded that the multivariate econometric model (2) can be used to forecast the volume of import customs duties transferred to the state budget.

Thus, the multivariate econometric model (2), constructed on the basis of the volume of import customs duties transferred to the state budget, meets all the required criteria, and this model can be used to forecast the volume of import customs duties transferred to the state budget.

For this purpose, we first construct a trend model for each influencing factor. A trend model is a function of the influencing factor depending on time and generally has the following form

$$\ln X_i = \beta_0 + \beta_1 \cdot t + \varepsilon \qquad (3)$$

The trend model for the import volume ($\ln X_1$) has the following form:

$$\ln X_1 = 8{,}9453 + 0{,}0966 \cdot t \qquad (4)$$

$$R^2 = 0{,}8950,\ F_{\text{хисоб}} = 119{,}3789,\ t_{\text{хисоб}} = 10{,}9261$$

The trend model for the average import customs duty rate ($\ln X_2$) has the following form:

$$\ln X_2 = 16{,}0525 - 0{,}066 \cdot t \qquad (5)$$

$$R^2 = 0{,}7507,\ F_{\text{хисоб}} = 20{,}7847,\ t_{\text{хисоб}} = -4{,}5590$$

Model for the average US dollar exchange rate ($\ln X_3$) has the following form:

$$\ln X_3 = 6{,}9760 + 0{,}1715 \cdot t \quad (6)$$

$$R^2 = 0{,}9443,\ F_{\text{хисоб}} = 237{,}5351,\ t_{\text{хисоб}} = 15{,}4122$$

The trend model for the trade deficit (by HS code) ($\ln X_4$) has the following form:

$$\ln X_4 = -25{,}768 + 5{,}402 \cdot t \quad (7)$$

$$R^2 = 0{,}6807,\ F_{\text{хисоб}} = 12{,}9575,\ t_{\text{хисоб}} = 3{,}5997$$

The trend model for the customs value index ($\ln X_5$) has the following form:

$$\ln X_5 = 0{,}876 + 0{,}000062 \cdot t \quad (8)$$

$$R^2 = 0{,}6807,\ F_{\text{хисоб}} = 7{,}1253,\ t_{\text{хисоб}} = 3{,}4975$$

Analysis of the trend models constructed between the influencing factors and the time factor shows that the statistical significance of all calculated coefficients and the reliability of their parameters in trend models (4) – (8) have been established. Thus, (4) – we compute the trend models (4) – (8) and, by substituting their computed values into the multivariate econometric model (2), first obtain the forecast values of the influencing factors (lnXj) and then perform the forecast calculations for the outcome factor (lnY). As a result, we obtain the forecast values of the variables included in the (2) multi-factor econometric model for the volume of import duties transferred to the state budget (lnY) (Table 4). (We convert the logarithmic values to their natural form by exponentiation).

Table 4

Dynamics of import customs duties transferred to the state budget and the factors affecting them for the years 2010–2025 and forecast values for 2026–2030

Years	Import customs duties transferred to the state budget, billion UZS, Y	Import volume, million USD, X_1	Average import customs duty rate, %, X_2	Average US dollar exchange rate, USD/UZS, X_3	Trade deficit (by HS code), million UZS, X_4	Customs value index, X_5

2010	600,12	8685,42	14,80	1511,00	0,00	0,794
2011	680,50	10765,03	14,70	1640,00	0,00	0,917
2012	759,70	12322,56	14,80	1795,00	0,00	0,944
2013	1007,38	12997,29	14,80	1985,00	0,00	1,082
2014	1350,04	12864,16	14,70	2203,00	0,00	0,934
2015	1481,50	11462,54	14,80	2424,00	0,00	0,841
2016	1449,54	11328,41	14,70	2817,00	0,00	0,744
2017	1707,34	12035,21	6,50	3232,00	6,40	0,772
2018	1826,43	17301,06	4,10	5114,00	8,65	0,830
2019	2302,69	21824,81	5,60	8070,00	16,66	0,948
2020	3553,68	19919,94	8,00	10054,00	8,82	0,651
2021	4764,90	23740,37	7,90	10610,00	12,84	0,793
2022	5745,70	28162,41	8,00	11051,00	14,94	0,922
2023	9606,10	36781,74	8,00	11737,00	20,36	0,932
2024	10001,00	35289,76	7,90	12653,00	104,52	0,934
2025	11747,20	37419,72	7,83	12261,00	122,20	0,967
2026*	**12272,53**	**39663,83**	**7,67**	**12008,00**	**66,07**	**0,973**
2027*	**14927,96**	**43688,19**	**7,61**	**11893,00**	**71,47**	**0,978**
2028*	**18157,95**	**48120,86**	**7,55**	**11564,00**	**76,87**	**0,983**
2029*	**22086,82**	**53003,28**	**7,49**	**11310,00**	**82,27**	**0,987**
2030*	**26865,79**	**58381,07**	**7,44**	**11047,00**	**87,67**	**0,993**

Note: The * years * symbol indicates the forecast period.

5. Conclusion and Recommendations

Based on the econometric analysis of endogenous and exogenous factors affecting the volume of import customs duties transferred to the state budget, the following key conclusions and recommendations were formulated:

- according to the multivariate econometric model calculated using data on import duties and influencing factors, if the import volume increases on average by 1%, the volume of import customs duties transferred to the state budget is likely to increase by an average of 1.661%.

- if the customs value index increases on average by 1%, the volume of import customs duties transferred to the state budget is likely to increase by an average of 1.574%.

- if the average rate of import customs duty increases by 1%, the volume of import customs duties transferred to the state budget is likely to decrease by an average of 0.029%.

- if the average exchange rate of the US dollar increases by 1%, the volume of import customs duties transferred to the state budget is likely to increase by an average of 0.215%.

Considering the above, it is recommended to use factors such as import volume, average import duty rate, average US dollar exchange rate, trade deficit (by HS code), and customs value index to form forecasts of import duty revenues for the state budget and to project the state budget revenues from import duties up to 2030.

References:

1. Decree of the President of the Republic of Uzbekistan dated September 11, 2023, No. PF-158, “On the Strategy ‘Uzbekistan — 2030’.” Available at: https://lex.uz/docs/6600413

2. T.N. Pardaev. Fiscal Activity of the Customs Service. Textbook. Tashkent, 2022, pp. 29–33.

3. B.Yu. Khodiev, T.Sh. Shodiev, B.B. Berkinov. Econometrics. Textbook. Tashkent: TDIU, 2017, 144 p.

4. B.B. Berkinov. Econometrics. Textbook. Tashkent: Fan va texnologiya, 2015, 184 p.

5. Yu. Mukhamedov. Factors and Econometric Models of Sustainable Socio-Economic Growth (Case of the Republic of Uzbekistan). Doctoral Dissertation in Economics, TDIU, Tashkent, 2006.

6. **Customs Code of the Republic of Uzbekistan.** https://lex.uz/docs/5535133

7. O. Sarmanov, T. Pardaev, F. Muxammatqulov. “Ways of Optimization of Privileges from Customs Payments.” International Scientific Journal ISJ Theoretical & Applied Science, Philadelphia, USA, Issue 11, Volume 115, November 30, 2022.

8. Adiljonovich, S. O. (2025). O‘ZBEKISTONDA BOJXONA TO‘LOVLARI TUSHUMINING SAMARADORLIGIGA TA’SIR ETUVCHI OMILLAR TAHLILI. Scientific Journal of Actuarial Finance and Accounting, 5(03), 249-256.

9. Nosirovich, T. P., Rixsibayevich, A. S., & Adiljonovich, S. O. (2021). Prospects for increasing the effectiveness of the application of privileges and preferences from customs duties. ACADEMICIA: An International Multidisciplinary Research Journal, 11(7), 69-76.

10. Пардаев, Т., Сарманов, О., & Камалов, С. (2022). ГЛОБАЛЛАШУВ ШАРОИТИДА МИЛЛИЙ БОЖ ТАРИФИ ТИЗИМИНИ ХАЛҚАРО ТАЛАБЛАРГА УНИФИКАЦИЯЛАШ. Economics and Innovative Technologies, 10(6), 425-433.

11. Tursunov, B. (2021). Cluster Analysis of the Industrial Sector in Ensuring the Financial Security of Textile Enterprises of Uzbekistan. Asian Journal of Technology & Management Research (AJTMR) ISSN, 2249(0892).

12. Burkhanov, A. U., Tursunov, B. O., Usmonov, B., & Mamayusupova, S. U. (2024). Assessment of Financial Security of Joint-Stock Companies: The Case of Uzbekistan. In Development of International Entrepreneurship Based on Corporate Accounting and Reporting According to IFRS: Part B (pp. 205-213). Emerald Publishing Limited.