



Article

Econometric Study of Indicators of the Macroeconomic Impact of Multilateral and Regional Trade Agreements on the Economy of Uzbekistan

Toshpulatova Malika Ulugbek qizi*¹

1. PhD student at the Institute of Macroeconomic and Regional Studies

*Correspondence: info@reu.uz

Citation: Ulugbek qizi T. M. Econometric Study of Indicators of the Macroeconomic Impact of Multilateral and Regional Trade Agreements on the Economy of Uzbekistan. American Journal of Economics and Business Management 2026, 9(8), 49-58.

Received: 19th May 2026

Revised: 20th Jun 2026

Accepted: 20th Jul 2026

Published: 08th Aug 2026



Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license

(<https://creativecommons.org/licenses/by/4.0/>)

Abstract: This article economically analyzes the macroeconomic impact of multilateral and regional trade agreements on the economy of the Republic of Uzbekistan. Based on quarterly time-series data comprising 40 observations from 2016 to 2025, a multi-factor econometric model was developed to evaluate the relationship between real Gross Domestic Product (GDP) and key macroeconomic determinants: foreign direct investment (FDI), inflation rate (INF), and economic openness (OPENEC). The empirical analysis utilized Ordinary Least Squares (OLS) alongside rigorous diagnostic evaluations, including Augmented Dickey-Fuller (ADF) stationarity tests, correlation matrix assessments, and residual diagnostics. The findings demonstrate that foreign direct investment and economic openness exert a statistically significant positive effect on real GDP growth, whereas inflation impacts economic dynamics negatively. Based on the calibrated econometric model, future forecast trajectories for Uzbekistan's real GDP were calculated, providing empirical insights for optimizing foreign trade strategies.

Keywords: multilateral trade agreements, regional integration, real GDP, Ordinary Least Squares (OLS), econometric modeling, foreign direct investment, economic openness.

1. Introduction

In the context of globalization processes and deepening regional economic integration, international trade agreements are becoming one of the main factors determining the direction of macroeconomic development of national economies. Multilateral and regional trade agreements have a complex impact on macroeconomic indicators such as economic growth, foreign trade turnover, export and import composition, foreign investment flows, employment and price levels [1]. For countries with a developing market economy, including the Republic of Uzbekistan, participation in international trade agreements is of particular importance in the context of integration into the world economy and increasing the competitiveness of national production [2]. In recent years, Uzbekistan has been pursuing an active foreign economic policy aimed at liberalizing trade, expanding trade and economic cooperation, and deepening ties with international and regional economic associations [3]. The desire to join multilateral trade institutions, as well as participation in regional trade agreements, necessitates a comprehensive assessment of their macroeconomic consequences. At the same time, the impact of trade agreements is ambiguous and can manifest itself both in the form of

stimulating economic growth and diversifying exports, and in the form of increasing competitive pressure on certain sectors of the economy [4].

From this point of view, the use of econometric analysis methods that allow quantitatively assessing the impact of multilateral and regional trade agreements on the main macroeconomic indicators of Uzbekistan is of particular relevance. The econometric approach makes it possible to identify cause-and-effect relationships, assess the scale and direction of the impact of trade integration, as well as to verify the statistical significance of the results obtained on the basis of empirical data [5].

2. Material and Methods

The article is based on a qualitative and descriptive-analytical research design. The methodological approach combines sectoral classification, comparative analysis, and historical-institutional periodization. In this research, an econometric analysis of the indicators of the foreign economic activity of the Republic of Uzbekistan (40 observations for the quarters of 2016-2025) was carried out. Based on the methodology of econometric modeling, the following factors were selected for conducting a multifactor econometric analysis. The resulting factor is the volume of real GDP of the Republic of Uzbekistan, billion soums (GDP), and the influencing factors are the inflow of foreign direct investment, million soums (FDI), the inflation rate in Uzbekistan, % (INF) and the degree of openness of the economy of Uzbekistan, coefficient (OPENEC).

We use the "Least Squares" method to identify factors affecting the volume of real GDP (GDP) based on the multilateral and regional trade agreements of Uzbekistan and to build econometric models based on them. The information base is linked to official data and classifications used by the National Statistics Committee of the Republic of Uzbekistan.

3. Results

Econometric research of the macroeconomic impact of multilateral and regional trade agreements on the economy of Uzbekistan is an urgent scientific problem of both theoretical and practical importance. The results of such research can be used in the formation of the country's foreign trade and macroeconomic policy, as well as in the development of strategies for Uzbekistan's integration into the international trade system [6].

Based on this method, we conduct descriptive statistics on factors for conducting econometric research. The results of descriptive statistics conducted on the selected factors are presented in Table 1 below [7].

Table 1. Results of descriptive statistics on factors influencing the volume of real GDP of the Republic of Uzbekistan.

	<i>GDP</i>	<i>FDI</i>	<i>INF</i>	<i>OPENEC</i>
Mean	354986.8	5685246.	10.83240	31.59649
Median	345749.0	4550285.	10.82873	29.33687
Maximum	545947.9	20775111	16.45699	60.07025
Minimum	225222.5	-13960.63	5.400047	6.094514
Std. Dev.	76874.17	4561705.	3.045678	15.71198
Skewness	0.546145	1.224004	-0.079249	0.030498
Kurtosis	2.716454	4.533973	2.315458	2.114069
Jarque-Bera	1.825243	2.538455	3.450419	0.977765
Probability	0.401470	0.281049	0.178136	0.613312
Sum	111.7270	507.2079	93.13434	267.7600
Sum Sq. Dev.	5.584815	36.41702	2.273247	182.3118
Observations	25	25	25	25

The table data shows the mean, median, maximum, and minimum values of each variable in the sample being monitored [8]. For example, the mean value of the outcome factor (real GDP of the Republic of Uzbekistan) is 354986.8, the median value is 345749.0, the maximum value is 545947.9, and the minimum value is 225222.5.

The distribution function graphs of all factors are presented in Figure 1 below.

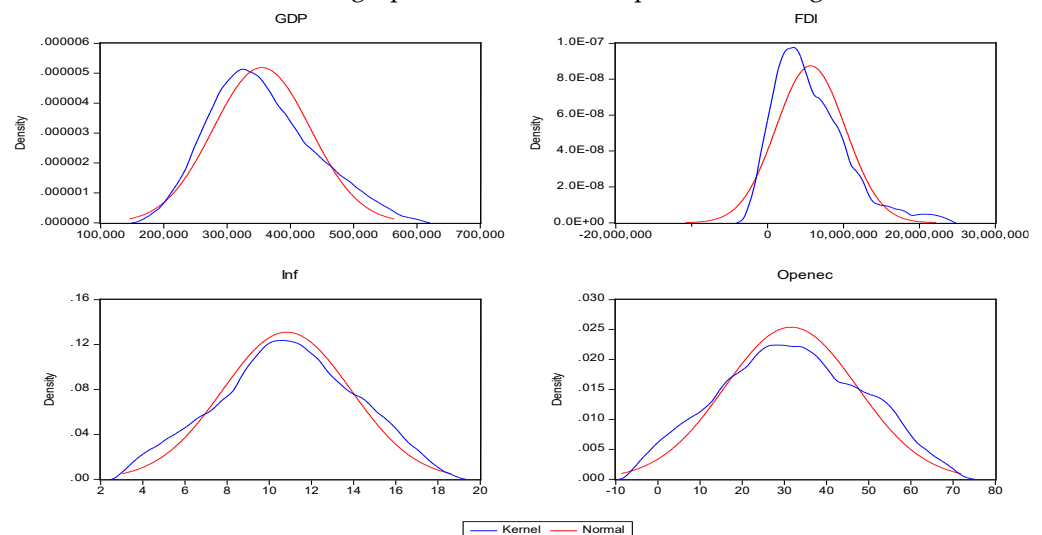


Figure 1. Graphs of factor distribution functions.

Thus, from the graphs presented in Figure 1, it can be seen that the asymmetry coefficients of the GDP, FDI, and OPENEC factors are positive (Table 1), indicating that the distribution is shifted to the right. However, the asymmetry coefficient of the INF factor is negative (Table 1), indicating that the distribution is shifted to the left [9].

The values of the matrix of correlation coefficients between factors as a result of correlation analysis are presented in Table 2.

Table 2. Matrix of correlation coefficients between factors.

Covariance Analysis: Ordinary

Date: 07/28/26 Time: 00:13

Sample: 2016Q1 2025Q4

Included observations: 40

Correlation

t-Statistic

Probability	GDP	FDI	INF	OPENEC
GDP	1.000000			
FDI	0.813282	1.000000		
	8.616020	-----		
	0.0000	-----		
INF	-0.086900	-0.125774	1.000000	
	-0.537721	-0.781529	-----	
	0.5939	0.4393	-----	
OPENEC	0.681435	0.641395	0.066105	1.000000
	5.739538	5.153499	0.408394	-----
	0.0000	0.0000	0.6853	-----

As can be seen from the data in Table 2, here are presented the indicators of the density of connections between the factors included in the multifactor econometric model - the correlation matrix [10]. This correlation matrix contains the calculated values of 2 types of correlation coefficients.

1) Private correlation coefficients, i.e. reflect the connections between the resulting factor (GDP) and the influencing factors (FDI, INF, OPENEC).

2) Paired correlation coefficients, i.e. reflect the connections between the influencing factors (FDI, INF, OPENEC) [11].

The connection density between the real GDP of the Republic of Uzbekistan (GDP) and the inflow of foreign direct investment (FDI) is 0.8133. This indicates the presence of a strong, direct connection between these two factors. The correlation coefficient between the real GDP of the Republic of Uzbekistan and the inflation rate in Uzbekistan (INF) is -0.0869 [12]. There is a weak, inverse relationship between these factors. Also, the correlation coefficient between the real GDP of the Republic of Uzbekistan and the openness of the economy of Uzbekistan (OPENEC) is 0.6814, which indicates that there is a positive relationship between these factors, which is above average [13].

Table 2 also presents the pairwise correlation coefficients between the influencing factors based on the calculated data. These coefficients determine multicollinearity between the factors. If the calculated value of the pairwise correlation coefficient between the influencing factors (FDI, INF, OPENEC) is greater than 0.7, then multicollinearity between the factors is said to exist [14]. From Table 2, which calculates the matrix of private and pairwise correlation coefficients between factors, it can be seen that the calculated value of the pairwise correlation coefficient between the factors affecting the real GDP of the Republic of Uzbekistan is not greater than 0.7. This, in turn, corresponds to the condition of including all selected factors in a multifactor econometric model [15].

Also in Table 2, coefficients were calculated to determine the reliability and probability of correlation coefficients (values in the rows below the calculated correlation coefficients). At the bottom of each correlation coefficient, its Student's t-test value and probability (prob.) are presented. The condition is that the calculated probability between the factors should not be greater than 0.05. For example, the private correlation coefficient between the real GDP of the Republic of Uzbekistan and foreign direct investment (FDI) is

equal to , and . This indicates that there is a strong connection between these two factors, the private correlation coefficient is reliable, and with a 95% accuracy there is a strong positive connection between the two factors.

Thus, the correlation coefficients between the factors included in the multifactor econometric model of the real GDP of the Republic of Uzbekistan fully meet the requirements of the Student's t-test in terms of estimated value and probability. This indicates that all factors affecting the real GDP of the Republic of Uzbekistan should be included in the multifactor econometric model.

Another way to check for multicollinearity among the influencing factors is to calculate the VIF (Variance Inflation Factors) coefficients. The VIF coefficients calculated for each factor are presented in Table 3 below.

Table 3. Measuring the effect of multicollinearity among influencing factors.

Variance Inflation Factors

Date: 07/28/26 Time: 00:22

Sample: 2016Q1 2025Q4

Included observations: 40

Variable	Coefficient Variance	Centered VIF
FDI	4.15E-06	1.785056
INF	5501043.	1.055319
OPENEC	345618.0	1.764529
C	8.37E+08	NA

If there is multicollinearity between the influencing factors, then CenteredVIF>10. From Table 3, it can be seen that the VIF coefficients of all influencing factors on the real GDP of the Republic of Uzbekistan are less than 10. Therefore, this also indicates that there is no multicollinearity between the influencing factors, as does the correlation analysis between the factors.

In addition, the extended Dickey-Fuller test was conducted to check the stationarity of all factors included in the multifactor econometric model, that is, to determine whether they have a single root. The results of the extended Dickey-Fuller test for the resulting factor real GDP of the Republic of Uzbekistan are presented in Table 4.

Table 4. Extended Dickey-Fuller test for stationarity of the output factor (GDP) series.

Null Hypothesis: GDP has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.439501	0.0079
Test critical values: 1% level	-3.632900	
5% level	-2.948404	
10% level	-2.612874	
*MacKinnon (1996) one-sided p-values.		

The results of the extended Dickey-Fuller test for stationarity of the influencing factors are presented in Tables 5-7 below.

Table 5. Extended Dickey-Fuller test for stationarity of the influencing factor (FDI) series.

Null Hypothesis: FDI has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-10.06460	0.0000
Test critical values: 1% level	-3.615588	
5% level	-2.941145	
10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Table 6. Extended Dickey-Fuller test to check the stationarity of the influence factor (INF) series.

Null Hypothesis: INF has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.925247	0.0144
Test critical values: 1% level	-3.615588	
5% level	-2.941145	
10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Table 7. Extended Dickey-Fuller test to check the stationarity of the influencing factor (OPENEC) series.

Null Hypothesis: OPENEC has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-7.413779	0.0000
Test critical values: 1% level	-3.626784	
5% level	-2.945842	
10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

When we checked all the factors included in the multifactor econometric model for stationarity using the extended Dickey-Fuller tests, it was found that the probability (Prob.) of all factors is less than 5 percent. This, in turn, indicates that all factor series are stationary.

Therefore, taking into account the multicollinearity between the factors and the stationarity of all factor series, we construct a multifactor econometric model for the real GDP of the Republic of Uzbekistan and the factors affecting it (FDI, INF, OPENEC). This multifactor econometric model has the following form:

$$GDP = \alpha_0 + \alpha_1 FDI + \alpha_2 INF + \alpha_3 OPENEC + \varepsilon \quad (1)$$

where GDP is the resulting factor, FDI, INF, OPENEC are influencing factors, and ε is a random error.

We used the “least squares method” to determine the values of the unknown parameters in the multivariate econometric model (1). The results are presented in Table 8 below.

Table 8. Estimated parameters of the multivariate econometric model.

Dependent Variable: GDP

Method: Least Squares

Date: 07/28/26 Time: 00:20

Sample: 2016Q1 2025Q4

Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	0.010647	0.002037	5.227619	0.0000***
INF	-651.4791	345.4301	-2.132990	0.0425***
OPENEC	1359.794	517.8929	2.625628	0.0308***
C	258549.8	28924.94	8.938644	0.0017***
R-squared	0.705442	Meandependentvar		354986.8
Adjusted R-squared	0.680895	S.D. dependentvar		76874.17
S.E. of regression	43425.71	Akaikeinfocriterion		24.29013
Sumsquaredresid	6.79E+10	Schwarzcriterion		24.45902
Loglikelihood	-481.8026	Hannan-Quinncrier.		24.35119
F-statistic	28.73900	Durbin-Watsonstat		1.978083
Prob(F-statistic)	0.000000			

Note: *** - 0.05 percent accuracy, ** - 0.1 percent accuracy

4. Discussion

Using the calculated data in Table 8, we express in analytical form the multifactor econometric model calculated for the real GDP of the Republic of Uzbekistan:

$$GDP = 258549,8 + 0,0106 \cdot FDI - 651,4791 \cdot INF + 1359,794 \cdot OPENEC \quad (2)$$

The calculated multifactor econometric model (2) shows that if the foreign direct investment (FDI) increases by an average of one million soums, the real GDP of the Republic of Uzbekistan increases by an average of 0.0106 billion soums. If the inflation rate (INF) in Uzbekistan increases by an average of one percent, the real GDP of the Republic of Uzbekistan decreases by an average of 651.4791 billion soums. Also, if the openness of the economy of Uzbekistan (OPENEC) increases by an average of one percentage point, the real GDP of the Republic of Uzbekistan increases by an average of 1359.794 billion soums.

We use the coefficient of determination to check the quality of the multifactor econometric model (2) built on the real GDP of the Republic of Uzbekistan. The coefficient of determination shows how much of the resulting factor is due to the factors included in the model. The calculated coefficient of determination (R-squared (Table 8)) is equal to 0.7054. This means that 70.54 percent of the real GDP of the Republic of Uzbekistan is due to the factors included in the calculated (2) multifactor econometric model. The remaining 29.46 percent (100.0-70.54) is due to the influence of factors not taken into account.

It can be seen that the calculated values of the t-test for all factors included in the multivariate econometric model are greater than the tabular values in terms of precision $\alpha = 0,05$ and $\alpha = 0,1$ accuracy (Table 8). This indicates that all factors are reliable and allows these factors to participate in the multivariate econometric model.

The actual (Actual), fitted (Fitted) values of the (2) multifactor econometric model calculated for the real GDP of the Republic of Uzbekistan, and the differences between them (Residual) are presented in Figure 3 below.

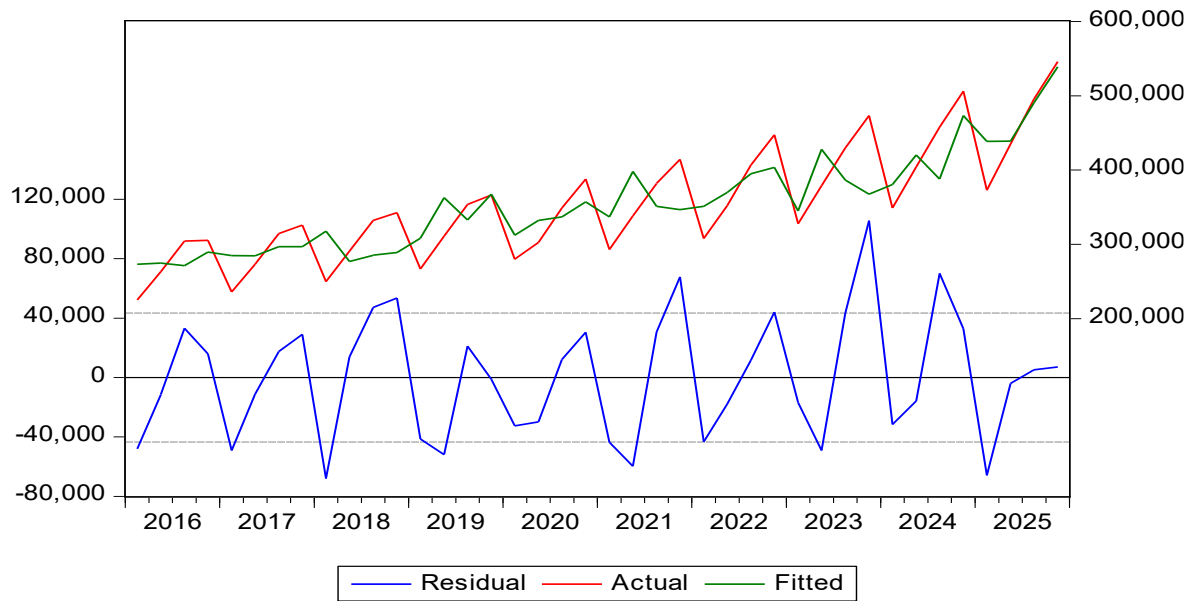


Figure 3. Graph of the actual (Actual), estimated (Fitted) values of the real GDP of the Republic of Uzbekistan and the differences between them (Residual).

It can be seen from Figure 3 that the graph of the calculated values of the real GDP of the Republic of Uzbekistan according to the calculated (2) multifactor econometric model is very close to the graph of its actual values, and the differences between them are not very large. This is another proof that the calculated (2) multifactor econometric model can be used to forecast the real GDP of the Republic of Uzbekistan for future periods.

The MAPE (Mean absolute percent error) coefficient is calculated when forecasting the resulting indicator from the calculated (2) multifactor econometric model for future periods. If the value of the calculated MAPE coefficient is less than 10.0 percent, the model can be used to forecast the resulting factor, otherwise it cannot be used. The value of the MAPE coefficient for the real GDP of the Republic of Uzbekistan under study is 4.1231 percent (Figure 4).

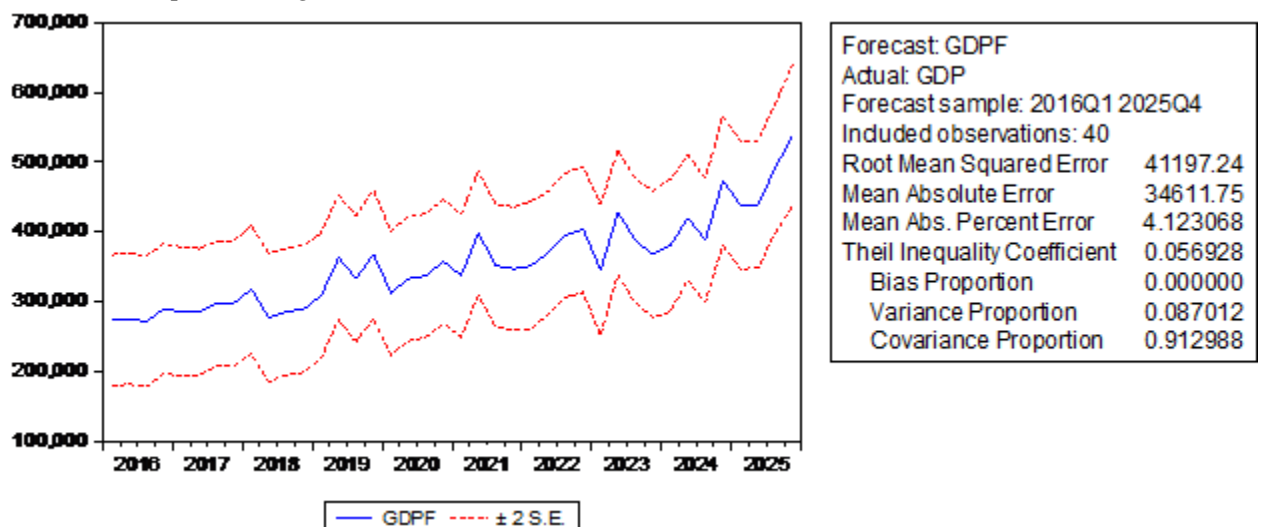


Figure 4. Indicators of using the calculated model in the forecast.

This is less than 10.0 percent (MAPE=4.1231), that is, it is 4.1231 percent. Therefore, it can be concluded that the multifactor econometric model (2) can be used to forecast the real GDP of the Republic of Uzbekistan.

5. Conclusion

In this study, the impact of multilateral and regional trade agreements on the macroeconomic indicators of the Republic of Uzbekistan was analyzed comprehensively using the Ordinary Least Squares (OLS) method based on quarterly data for 2016–2025. The diagnostic tests and empirical results confirmed that the volume of foreign direct investment and the level of openness of the economy have a positive and statistically significant impact on the growth of the country's real GDP, while the inflation rate exerts negative pressure on economic dynamics. According to the forecast results provided by the developed model, the consistent continuation of Uzbekistan's regional and multilateral integration processes will serve to ensure a stable trajectory of economic growth in the coming periods. Based on this, the most priority areas for ensuring macroeconomic stability are stimulating the flow of foreign investment by strengthening institutional guarantees within the framework of trade agreements, diversifying the composition of exports, and firmly continuing the policy of curbing inflation that mitigates the impact of external shocks.

REFERENCES

- [1] M. Toshpulatova, "Uzbekistan's foreign trade strategy: Economic analysis of WTO and EAEU directions," *Economics, Finance and Management Review*, no. 4, vol. 24, pp. 33–44, 2025.
- [2] M. U. Q. Toshpulatova, "Prospects for economic development of Uzbekistan within the World Trade Organization: Analysis of multilateral trade agreements," *Annali d'Italia*, no. 63, pp. 4–8.
- [3] B. Umarov, N. Eshonqulova, and S. Gaziyeva, "WTO membership is an access for transforming national markets in Uzbekistan," *International Journal on Integrated Education*, vol. 2, no. 6, pp. 5–14, 2019.
- [4] National Statistics Committee of the Republic of Uzbekistan, *Official Statistical Data on Innovation Activity and Economic Sectors*. Tashkent, Uzbekistan: National Statistics Committee of the Republic of Uzbekistan, 2024.
- [5] National Statistics Committee of the Republic of Uzbekistan, *Official Statistical Data on Macroeconomic Indicators and National Accounts*. Tashkent, Uzbekistan: National Statistics Committee of the Republic of Uzbekistan, 2025.
- [6] National Statistics Committee of the Republic of Uzbekistan, *Official Statistical Data on Foreign Economic Activity and Trade Statistics*. Tashkent, Uzbekistan: National Statistics Committee of the Republic of Uzbekistan, 2025.
- [7] Central Bank of the Republic of Uzbekistan, *Main Directions of Monetary Policy for 2026 and the Period of 2027–2028*. Tashkent, Uzbekistan, 2025. [Online]. Available: https://cbu.uz/upload/medialibrary/107/fej1yp983519jzi9fc8z6wfstex3b1df/Asosiy_yunalishlar_22_11_2025_kirill_6_website.pdf
- [8] Central Bank of the Republic of Uzbekistan, *Monetary Policy Review: Fourth Quarter 2025*. Tashkent, Uzbekistan, 2025. [Online]. Available: https://cbu.uz/upload/medialibrary/968/3gk4ca0woe35hjit16t60oirtzx849ft/Pul_kredit_siyesati_shar_i_2025_yil_IV_chorak.pdf
- [9] International Monetary Fund, *Republic of Uzbekistan: 2025 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for the Republic of Uzbekistan*. Washington, DC, USA: International Monetary Fund, Jan. 2025. [Online]. Available: <https://www.imf.org/-/media/files/publications/cr/2025/english/1uzbea2025001-print-pdf.pdf>
- [10] World Bank, *Uzbekistan Country Economic Memorandum: Toward a Prosperous and Inclusive Future*. Washington, DC, USA: World Bank, 2022.

-
- [11] Asian Development Bank, Asian Development Outlook 2025: Economic Prospects in Developing Asia. Manila, Philippines: Asian Development Bank, Apr. 2025.
 - [12] World Trade Organization, World Trade Report 2024: Trade and Inclusiveness. Geneva, Switzerland: World Trade Organization, 2024.
 - [13] Organisation for Economic Co-operation and Development, OECD Economic Surveys: Uzbekistan 2025. Paris, France: OECD Publishing, 2025.
 - [14] United Nations Conference on Trade and Development, Trade and Development Report 2024. Geneva, Switzerland: United Nations, 2024.
 - [15] European Bank for Reconstruction and Development, Transition Report 2024–25: Navigating Industrial Policy. London, U.K.: European Bank for Reconstruction and Development, 2024.