



IQTISODIYOT & TARAQQIYOT

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COMPARATIVE STATISTICAL ANALYSIS OF FOREIGN TRADE INDICATORS OF THE REPUBLIC OF UZBEKISTAN

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Abstract: In the past decade, the global economy has undergone rapid, volatile, and transformative developments across a wide range of countries. These dynamic shifts necessitate a revision of traditional economic analysis and the formulation of new conceptual frameworks. This study presents a comparative evaluation of the impact of merchandise exports and imports on GDP between Uzbekistan and its major trading partners. The empirical investigation applies econometric techniques, including the Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects, and Random Effects models. The findings provide practical insights into how trade dynamics influence macroeconomic performance, particularly GDP growth.

Key words: Merchandise exports and imports, GDP, Pooled OLS, Fixed Effects, Random Effects models.

Annotatsiya: So'nggi o'n yillikda global iqtisodiyotda ko'plab mamlakatlar miqyosida tezkor, o'zgaruvchan va transformatsion jarayonlar kuzatildi. Ushbu dinamik o'zgarishlar an'anaviy iqtisodiy tahlil usullarini qayta ko'rib chiqish va yangi nazariy yondashuvlarni ishlab chiqishni taqozo qilmoqda. Ushbu tadqiqot O'zbekiston va uning asosiy savdo hamkorlari o'rtasida tovarlar eksporti va importining yalpi ichki mahsulot (YalM)ga ta'sirini qiyosiy baholashga qaratilgan. Tadqiqotda empirik ma'lumotlar asosida Pooled OLS (oddiy birlashtirilgan kvadratlar), Fixed Effects (fikslangan effektlar) va Random Effects (tasodifiy effektlar) kabi iqtisodiy-ekonometrik modellar qo'llanilgan. Olingan natijalar savdo balansi tarkibining YalMga ta'sir qilish mexanizmlarini aniqlashda amaliy ahamiyat kasb etadi.

Kalit so'zlar: Tovar eksporti va importi, yalpi ichki mahsulot (YalM), Pooled OLS, fikslangan effektlar, tasodifiy effektlar.

Аннотация: За последнее десятилетие глобальная экономика характеризуется стремительными, волатильными и трансформационными процессами в различных странах. Эти изменения подчеркивают необходимость пересмотра традиционного экономического анализа и разработки новых концептуальных подходов. В настоящем исследовании проведена сравнительная оценка влияния экспорта и импорта товаров на валовой внутренний продукт (ВВП) Узбекистана и его торговых партнеров. Эмпирическая часть работы основана на применении эконометрических моделей, включая Pooled OLS (объединённые наименьшие квадраты), Fixed Effects (фиксированные эффекты) и Random Effects (случайные эффекты). Полученные результаты обладают практической ценностью для анализа механизмов воздействия внешней торговли на ВВП.

Ключевые слова: Экспорт и импорт товаров, ВВП, Pooled OLS, фиксированные эффекты, случайные эффекты.

INTRODUCTION

In the contemporary global economic environment, the development of a robust and comprehensive methodological framework to address the limitations of existing approaches to evaluating and enhancing foreign trade indicators has become increasingly critical. Such a framework should be capable of capturing the full complexity and dynamics of foreign economic activity, with particular attention to regional variations and sectoral characteristics.

Within the context of Uzbekistan's ongoing economic development, a key strategic priority for ensuring the long-term sustainability of domestic enterprises lies in enhancing their access to international markets and intensifying their engagement in export-oriented activities. This strategic focus not only contributes to the diversification of the national economy but also serves as a driving force for expanding the country's participation in global trade.

Consequently, the study and clarification of conceptual categories such as "foreign economic activity," "foreign trade activity," "export performance," "import potential," and "trade in goods" are essential to capturing



the international dimensions of foreign trade and affirming the academic relevance of this research. Existing literature underscores the pivotal role of foreign trade in expanding market access, creating high-skilled employment opportunities, promoting a more educated workforce, and enhancing both productivity and wages (Awokuse, 2007; Awokuse, 2008; Bai et al., 2024; Goldin & Katz, 2009; Grossman & Helpman, 2009).

LITERATURE REVIEW ON THE TOPIC

In the context of international trade, the state's role is primarily focused on the formulation and implementation of trade policy instruments aimed at achieving macroeconomic objectives (Sirojiddinov, 2019). As a foundational pillar of the global economy, international trade plays a vital role in guiding global development toward a sustainable trajectory (Zhao et al., 2023). According to the standard model of economic growth, greater international integration particularly through the removal of trade and factor mobility barriers—results in immediate efficiency gains by optimizing the allocation of productive resources. These short-term benefits, often referred to as static gains from integration, lead to increased output without the need for additional inputs. In the medium term, this expanded output fosters higher levels of domestic savings and investment, thereby enlarging the capital stock and accelerating economic growth (Bajo-Rubio & Ramos-Herrera, 2024). The increasing interconnectedness of national economies has positioned international trade as a key mechanism for driving economic development (Yasmeen et al., 2018; Wenlong et al., 2022). In particular, export activities are crucial in bridging foreign exchange gaps and enhancing a country's capacity to import goods and services. A greater import capacity supports industrialization and broadens economic activity, thereby serving as a catalyst for long-term growth (Rahman, Shahbaz & Farooq, 2015). The extent and efficiency of a country's export-import operations directly influence the classification of domestic enterprises and the investment appeal of specific regions. These classifications are often based on the performance of local businesses in foreign trade, which increasingly serves as a strategic tool for attracting foreign direct investment (Barkovsky, Komissarov, Linetsky & Tatarkin, 2011). Ishmukhametov (2020) highlights the critical importance of intensifying foreign economic activity as a key driver of regional socio-economic development. Increased participation in international markets enhances foreign investment inflows, improves living standards, expands employment opportunities, and raises fiscal revenues, all of which contribute to national GDP growth (Kudryashova et al., 2020). In analyzing regional foreign economic potential, Ishmukhametov identifies a strong correlation between foreign trade performance and economic development levels, particularly in relation to foreign investment flows. A comprehensive and accurate assessment of external economic potential—one that considers both internal capacities and external opportunities—serves as the foundation for sound strategic decision-making (Rudakova, 2015). Such an assessment includes identifying opportunities to expand secure and economically viable export-import volumes; recognizing enterprises with high export potential; determining product categories suitable for export expansion; identifying goods appropriate for regional import specialization; and evaluating the investment potential necessary to attract foreign capital (Ishmukhametov, 2018).

RESEARCH METHODOLOGY

This study employs an econometric approach using panel data collected from multiple authoritative sources. Specifically, data were obtained from the World Trade Organization's *World Trade Statistics*, the National Statistics Committee of the Republic of Uzbekistan, and the World Bank (stat.uz). The dataset includes annual percentage changes in merchandise exports and imports between Uzbekistan and ten selected trading partner countries for the period from 2020 to 2022. These trade indicators are analyzed in relation to their influence on GDP, which serves as the dependent variable. GDP growth rates were extracted from World Bank and national statistical databases.

The empirical analysis was conducted using panel data techniques implemented in Stata. The models employed include random effects, fixed effects, robust standard errors, and the pooled Ordinary Least Squares (pooled OLS) regression. These models are standard for estimating relationships in panel datasets and provide a comprehensive framework for identifying the effects of both observable and unobservable factors across time and entities (see Table 2)...

Among the models used, the random effects regression is particularly useful for estimating the impact of individual-specific, time-invariant characteristics that are not directly measurable, such as latent economic conditions or structural efficiencies. This model assumes that the unobserved heterogeneity is uncorrelated with the explanatory variables. It complements the fixed effects model, which captures time-invariant characteristics but allows for correlation between the entity-specific error term and independent variables. The pooled OLS model, though more restrictive, serves as a baseline for comparison with fixed and random effects models, allowing evaluation of model robustness and specification validity.



In this study, the year-on-year (Y-o-Y) percentage growth of GDP is assumed to be linearly related to the Y-o-Y percentage growth of gross capital formation and other explanatory variables. Therefore, the following linear functional form is adopted for regression analysis:

$$Y_{it} = X_{1it}B_{1it} + X_{2it}B_{2it} + e_{it} \quad (1.1)$$

In the above equation, all variables are matrices of a certain size. Assuming n units, k regression variables per unit, and time period T per unit, the dimensions of each matrix variable in the above equation are:

Y_{it} - it is the response variable for unit it (GDP growth). It is a column vector of size $[T \times 1]$.

X_{1it}, X_{2it} - $[T \times k]$ is a matrix of regression variables of size.

B_{1it}, B_{2it} - $[k \times 1]$ is a matrix of coefficients containing the total value of the coefficients for the k regression variables in .

- A column vector of size $[T \times 1]$, one error for each time period T , containing the error terms.

ANALYSIS AND RESULTS

The dataset utilized in this research comprises 33 country-level observations. The average GDP growth rate across the sample is 1.829 percent, with a standard deviation of 4.378, indicating a moderate level of variation among the observed countries. The mean values of merchandise trade exports and imports are 14,424 units and 16,627 units, respectively, reflecting the general scale of international trade flows within the sample. These descriptive statistics are presented in Table 1, which provides an overview of the key economic indicators used in the empirical analysis. (table 1)

Table1: Descriptive statistical analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
i	33	6	3.211	1	11
t	33	2	.829	1	3
GDP growth	33	1.829	4.378	-10	8.6
Merchandise import	33	14.424	12.838	-21	41
Merchandise export	33	16.627	13.806	-1	48

Table 2: Tabulation of countries export and import.

i	t	Countries	GDP_growth	Merchandise_import	Merchandise_export
1	1	Canada	-5	3	4
1	2	Canada	5,2	20	30
1	3	Canada	3,8	15	18
2	1	Brazil	-3,2	4	4
2	2	Brazil	4,76	41	34
3	1	USA	-2,1	5	4
3	2	USA	5,8	22	23
3	3	USA	1,93	15	18
4	1	United Kingdom	-10	3	2
4	2	United Kingdom	8,6	9	18
4	3	United Kingdom	4,34	19	13
5	1	China	2,2	6	7
5	2	China	8,4	30	30
5	3	China	2,9	1	7
6	1	Kazakstan	-2,5	4	3
6	2	Kazakstan	4,3	11	31
6	3	Kazakstan	3,2	20	40



7	1	Japan	-4,1	2	0
7	2	Japan	2,5	21	18
7	3	Japan	0,95	17	-1
8	1	Russia	-2,6	0	2
8	2	Russia	5,6	27	48
8	3	Russia	-2	-21	8
9	1	Africa	0,9	3	2
9	2	Africa	0,9	27	41
9	3	Africa	0,5	16	18
10	1	UAE	-4,97	7	9
10	2	UAE	4,35	41	27
10	3	UAE	7,8	22	41
11	1	Uzbekistan	1,9	10	8,5
11	2	Uzbekistan	7,4	23	11
11	3	Uzbekistan	5,6	28	11,2

The kernel density estimates indicate that both import indicators and GDP growth rates closely approximate a normal distribution, thereby satisfying a key assumption required for the application of standard parametric statistical methods. The assumption of normality for these variables appears to be reasonable based on the observed data patterns. In contrast, the distribution of export indicators displays noticeable leftward skewness, signaling a deviation from normality. This asymmetry reflects a potential imbalance in the export data, which may be attributed to structural trade disparities or outlier effects. As a result, caution is warranted when applying statistical techniques that assume normality for export variables. These findings are illustrated in Figure 1.

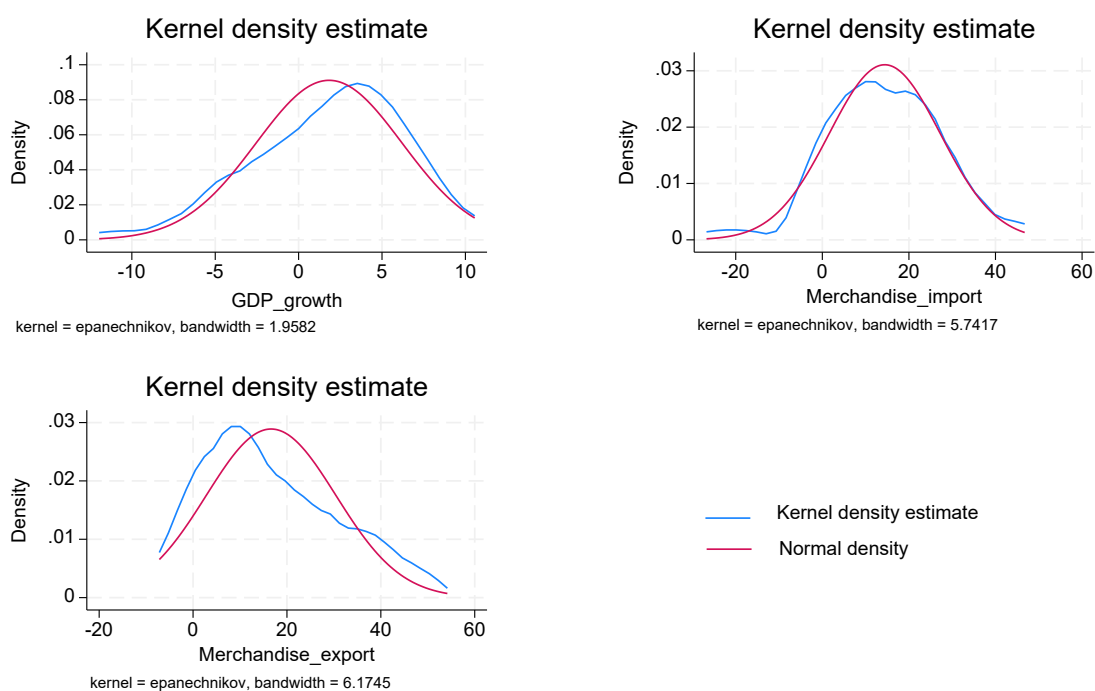


Figure1. Kernel densit estimate.



Table 3. Linear regression.

GDP_growth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Merchandise_import	.133	.061	2.17	.038	.008	.258	**
Merchandise_export	.113	.057	1.99	.056	-.003	.229	*
Constant	-1.967	.945	-2.08	.046	-3.896	-.037	**
Mean dependent var	1.829		SD dependent var	4.378			
R-squared	0.464		Number of obs	33			
F-test	12.972		Prob > F	0.000			
Akaike crit. (AIC)	175.533		Bayesian crit. (BIC)	180.023			

*** p<.01, ** p<.05, * p<.1

Table 4. Pairwise correlations.

Variables	(1)	(2)	(3)
(1) GDP_growth	1.000		
(2) Merchandise_im~t	0.627*	1.000	
	(0.000)		
(3) Merchandise_ex~t	0.616*	0.666*	1.000
	(0.000)	(0.000)	

*** p<0.01, ** p<0.05, * p<0.1

As presented in Table 4, there is a statistically significant relationship between GDP growth and merchandise imports, between imports and exports, as well as between GDP growth and exports.

Table 5. Pooled OLS linear regression.

GDP_growth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Merchandise_import	.133	.048	2.74	.01	.034	.232	**
Merchandise_export	.113	.049	2.33	.027	.014	.212	**
Constant	-1.967	1.022	-1.92	.064	-4.054	.121	*
Mean dependent var	1.829		SD dependent var	4.378			
R-squared	0.464		Number of obs	33			
F-test	13.982		Prob > F	0.000			
Akaike crit. (AIC)	175.533		Bayesian crit. (BIC)	180.023			

*** p<.01, ** p<.05, * p<.1

Based on the data of this panel, when analyzed according to the Pooled OLS estimator model, an equation was created based on the following indicators (Table 5).

$$Y_{it} = 0.133X_{1it} + 0.113X_{2it} - 1.967. \quad (1.2)$$

Here,

- GDP growth picture of countries exporting software products (in percent);
- figure of growth of export volume of merchandise trade (in percent).

As indicated by the above equation, a 1% increase in the export volume of merchandise among the 11 countries exporting software products is associated with a 0.133% increase in GDP.

Table 6. Fixed effect regression results.

Table of final effect regression results:

GDP_growth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Merchandise_import	.089	.089	1.01	.326	-.096	.275	
Merchandise_export	.176	.081	2.18	.041	.008	.345	**
Constant	-2.389	1.022	-2.34	.03	-4.522	-.256	**
Mean dependent var	1.829		SD dependent var		4.378		
R-squared	0.563		Number of obs		33		
F-test	12.906		Prob > F		0.000		
Akaike crit. (AIC)	164.270		Bayesian crit. (BIC)		168.760		
*** p<.01, ** p<.05, * p<.1							

Based on the Fixed Effects model, the following estimation equation can also be derived.

$$Y_{it} = 0.089X_{1it} + 0.176X_{2it} - 2.389. \quad (1.3)$$

Based on the regression results derived from the above equation, it can be concluded that a 1 percent increase in the volume of merchandise imports and exports leads to an estimated increase of 0.089 percent and 0.176 percent, respectively, in the GDP of the export-importing countries, assuming all other variables remain constant (see Table 6). Furthermore, the Fixed Effects (FE) model results indicate that a 1 percent increase in the average volume of imports within the region corresponds to a change in regional average GDP ranging from -0.096 percent to 0.275 percent, while a 1 percent increase in exports is associated with a GDP change between 0.008 percent and 0.345 percent. These findings underscore the differentiated impact of trade flows on economic growth across countries and highlight the importance of considering country-specific effects in the analysis.

Table 7. Random effects regression results.

GDP_growth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Merchandise_import	.133	.061	2.17	.03	.013	.253	**
Merchandise_export	.113	.057	1.99	.047	.002	.224	**
Constant	-1.967	.945	-2.08	.037	-3.819	-.114	**
Mean dependent var	1.829	SD dependent var		4.378			
Overall r-squared	0.464	Number of obs		33			
Chi-square	25.944	Prob > chi2		0.000			
R-squared within	0.554	R-squared between		0.071			

*** p<.01, ** p<.05, * p<.1

The following results represent the regression indicators based on the Random Effects Estimator (REE) model. According to this model, a 1 percent increase in the average volume of merchandise imports in the region leads to a change in the regional average GDP ranging from 0.013 percent to 0.253 percent, while a 1 percent increase in exports results in a GDP change ranging from 0.020 percent to 0.224 percent (see Table 7). These estimates demonstrate the responsiveness of GDP to changes in trade flows across countries in the sample.

Thus, the impact of annual variations in merchandise exports and imports on GDP has been empirically assessed. Based on the results of the random effects estimator and pooled OLS models, a robust GDP growth model for the countries under study was constructed. The reliability and overall significance of the developed model were validated using the Fisher test, which confirmed its adequacy (as $F_t < F_h$).

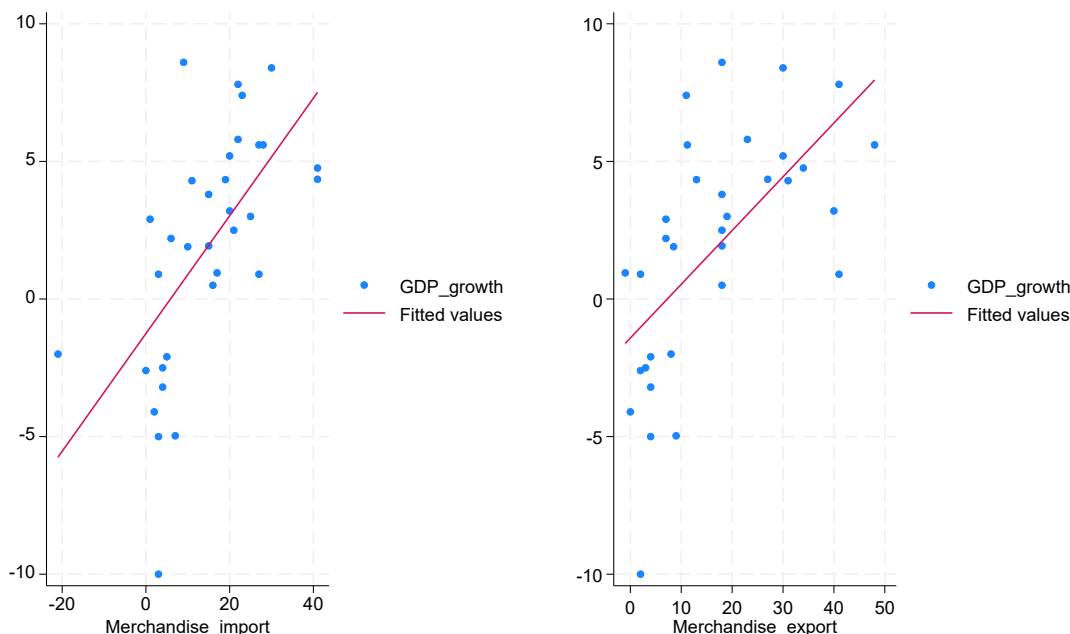


Figure 2. Scatterplot.

The scatterplot indicates that the growth in the volume of imports and exports of goods in the Republic of Uzbekistan positively influences the GDP growth rate. The proximity of the data points to the regression line reflects the reliability of the model. Thus, both graphs demonstrate a positive linear relationship between merchandise imports and exports and GDP growth, suggesting that increases in imports and exports are associated with corresponding growth in GDP (figure 2).

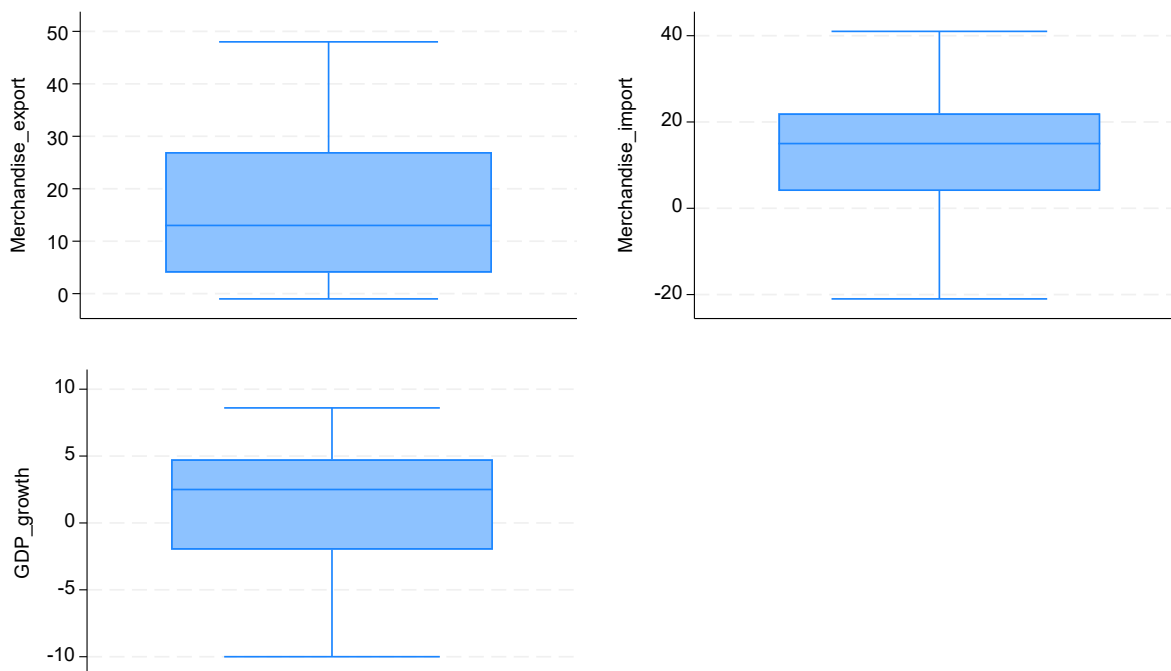


Figure 3. Graph Box

The graphbox illustrate the volatility of exports, imports, and economic growth. There exists a trade-off between exports and imports, with export values generally exhibiting greater stability. Conversely, imports display negative fluctuations, which may be indicative of economic instability or external economic influences.



In contrast, GDP growth has experienced variations, oscillating between negative and positive values over the analyzed period (figure3).

CONCLUSION AND RECOMMENDATIONS

Foreign trade indicators represent a critical component of a country's economic development. The volume, structure, and geographical distribution of exports and imports play a particularly important role in shaping the economic performance of the Republic of Uzbekistan. Assessing the dynamics of Uzbekistan's foreign trade and identifying shifts at the global level through comparative statistical analysis is essential for developing responsive trade strategies and macroeconomic policies.

The findings of this study reveal that, to date, there is no universally accepted methodology for enhancing regional foreign trade statistics—neither globally nor within Uzbekistan. Both Uzbek and international scholars have proposed various approaches to forecasting foreign economic activity and trade indicators; however, each method has inherent advantages and limitations. In light of these observations, the development of a comprehensive and integrated methodological framework is strongly recommended. Such a framework should address the shortcomings of existing approaches and more holistically reflect the realities and dynamics of regional foreign economic activity.

Given the demonstrated positive impact of export and import growth on GDP, it is essential to pursue further liberalization of foreign trade policy, improve logistics infrastructure, and broaden the range of export-oriented products. Special emphasis should be placed on encouraging imports that support domestic production, such as raw materials and technological equipment, while gradually reducing imports that are primarily intended for final consumption.

The observed correlation between export performance and GDP growth underscores the importance of enhancing the international competitiveness of Uzbek products. Achieving this requires support for export-oriented enterprises, particularly through technological modernization, the implementation of quality management systems, and the expansion of access to new foreign markets.

Furthermore, given Uzbekistan's significant reliance on foreign trade, global economic crises can have substantial negative effects on national economic stability. To mitigate these risks, it is recommended to strengthen domestic production capabilities, promote the development of import-substituting industries, and reinforce foreign exchange reserves in order to improve resilience to external economic shocks.

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