



ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN GDP AND EXPORTS IN UZBEKISTAN

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Abstract. *This article analyzes the relationship between gross domestic product (GDP) and export volume in Uzbekistan based on an econometric approach. The study uses a time series based on official statistical data for 2014–2024 and uses a regression model to assess the relationship between variables. The results of the analysis reveal that an increase in export volume has a positive impact on GDP growth. At the same time, despite the high coefficient of determination of the model, some regression coefficients were found to be statistically insignificant, justifying the need for caution in interpreting the model results.*

Keywords. *Type I error (α), Type II error (β), statistical hypothesis, regression analysis, p-value, GDP, export volume, coefficient of determination.*

Аннотация. *В данной статье анализируется взаимосвязь между валовым внутренним продуктом (ВВП) и объемом экспорта в Узбекистане на основе эконометрического подхода. В исследовании на основе официальных статистических данных за 2014–2024 годы сформирован временной ряд, а взаимосвязь между переменными оценена с использованием регрессионной модели. Результаты анализа показали, что увеличение объема экспорта оказывает положительное влияние на рост ВВП. Вместе с тем установлено, что несмотря на высокий коэффициент детерминации модели, отдельные регрессионные коэффициенты являются статистически незначимыми, что обосновывает необходимость осторожного подхода к интерпретации полученных результатов.*

Ключевые слова. Ошибка первого рода (α), ошибка второго рода (β), статистическая гипотеза, регрессионный анализ, p -значение, ВВП, объем экспорта, коэффициент детерминации.

***Annotatsiya.** Mazkur maqolada O'zbekistonda yalpi ichki mahsulot (YaIM) va eksport hajmi o'rtasidagi o'zaro bog'liqlik ekonometrik yondashuv asosida tahlil qilindi. Tadqiqotda 2014–2024 yillar bo'yicha rasmiy statistik ma'lumotlar asosida vaqtli qator shakllantirilib, regressiya modeli yordamida o'zgaruvchilar o'rtasidagi bog'liqlik baholandi. Tahlil natijalari eksport hajmining oshishi YaIMning o'sishiga ijobiy ta'sir ko'rsatishini aniqladi. Shu bilan birga, modelning determinatsiya koeffitsiyenti yuqori bo'lishiga qaramay, ayrim regressiya koeffitsiyentlarining statistik jihatdan ahamiyatsizligi aniqlanib, bu holat model natijalarini talqin qilishda ehtiyotkorlikni talab etishi asoslab berildi.*

***Kalit so'zlar.** I tur xatolik (α), II tur xatolik (β), statistik gipoteza, regressiya tahlili, p -qiymat, YaIM, eksport hajmi, determinatsiya koeffitsiyenti.*

Introduction.

In modern economic research and strategic decision-making processes, econometric modeling is widely used as an important scientific and methodological tool. However, the complexity of economic processes, the presence of many random factors and incomplete data limit the achievement of absolute accuracy through any statistical model. Therefore, identifying “true” and “false” errors in econometric analysis, studying the causes of their occurrence and assessing the impact of these errors on the final results is one of the urgent scientific problems. In the process of testing statistical hypotheses, the researcher is always faced with the risk of two types of errors. The first type of error (type I error) is the assumption of a relationship that does not actually exist, that is, obtaining a “false positive” result. The second type of error (type II error), on the contrary, represents the rejection of a significant relationship that actually exists, that is, a “false negative” result.

Such errors in economic policy and management decisions can lead to misallocation of resources, reduce the accuracy of macroeconomic forecasts, and negatively affect overall economic stability. In particular, when analyzing the relationship between gross domestic product (GDP) growth and export volume, it is important to statistically evaluate the parameters of the regression model. In practice, it is often observed that, despite the high coefficient of determination (R^2), the p-values of some regression coefficients exceed the level of statistical significance. This increases the likelihood of “false” conclusions in the model results. In such situations, it is necessary to correctly assess the power of the test and the trade-off between type I and type II errors. The purpose of this article is to shed light on the theoretical and mathematical foundations of type I and type II errors based on the methodology of statistical hypothesis testing and to analyze their practical impact on the example of economic indicators of Uzbekistan. In the research process, the results of regression analysis and the "confusion matrix" approach are used to substantiate the level of reliability of the conclusions obtained theoretically and practically.

Literature review.

Determining the relationship between economic indicators using econometric models and assessing their reliability is one of the important areas of modern macroeconomic research. In particular, studying the relationship between gross domestic product (GDP) and export volume is of great importance in identifying factors of economic growth and conducting effective economic policy. At the same time, the accuracy and reliability of the results of econometric analysis are closely related to statistical errors, including type I and type II errors .

The theory of econometric modeling is widely covered in foreign economic literature. In particular, the science of econometrics, founded by Jan Tinbergen and Ragnar Frisch, made it possible to analyze economic processes using mathematical and statistical methods [1;2] . Later, in the works of Damodar N. Gujarati and

Douglas C. Montgomery, regression analysis, hypothesis testing, and model evaluation methods were developed in detail [3;4]. Type I and II errors play an important role in the theory of statistical hypothesis testing. These concepts were first developed by Jerzy Neumann and Egon Pearson, who justified the need to estimate the probability of errors in the process of statistical decision-making [5]. Type I error (α) means the incorrect rejection of the null hypothesis, and type II error (β), on the contrary, the incorrect acceptance.

The relationship between GDP and exports has been widely studied in macroeconomic research. In particular, studies by Robert Barro have shown that exports and an open economy have a positive impact on economic growth [6]. Also, studies by Jeffrey Sachs and Andrew Warner have emphasized the crucial role of exports in economic growth in an open economy [7]. At the same time, the problem of “spurious regression” has been proven by Clive Granger and Paul Newbold, who have shown that a high R^2 does not always indicate a true economic relationship [8]. Among scientists from the CIS countries, Abel Aganbegyan, analyzing the factors of economic growth, emphasized the important role of exports in the economy [9]. The relationship between economic growth and foreign trade has also been widely studied by Uzbek economists. Saidrasul Gulyamov's research notes that increased exports have a positive impact on production and economic growth [10]. In general, existing scientific research confirms the existence of a positive relationship between GDP and exports. However, in order to properly assess this relationship, it is important to consider the reliability of the econometric model, statistical tests, and the possibility of type I and type II errors.

Research methodology.

Econometric analysis plays an important role in modern economic research, allowing to identify and quantify the relationships between economic variables. In the scientific literature, regression analysis is recognized as one of the most effective methods in the study of economic processes. At the same time, many

studies emphasize the need to test statistical hypotheses and take into account the probability of errors when assessing the reliability of model results. According to theoretical sources, there are two types of errors in the process of testing statistical hypotheses - type I error (α) and type II error (β), which directly affect the reliability of model results. Type I error means accepting a relationship that does not actually exist as existing, while type II error, on the contrary, is explained by the inability to detect an existing relationship. Minimizing the probability of these errors is an important task in scientific research, since they can lead to incorrect economic conclusions and ineffective decisions. In this study, regression analysis was chosen as the main method to determine the relationship between economic indicators . In particular, a linear regression model was used to assess the relationship between gross domestic product (GDP) and export volume. The model is generally expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

where:

Y – GDP,
 X_1 – export volume,
 β_0 – free term (constant),
 $\beta_1, \beta_2, \beta_3$ – regression coefficients of independent variables (the impact of exports on GDP),
 ε – random error component.

The least squares method (LSM) was used to estimate the model parameters, which is based on minimizing the differences between the observed and theoretical values. The coefficient of determination (R^2), p-value, and statistical criteria were used to assess the quality of the model. In particular, the p-value represents the probability of the observed result occurring under the condition that the null hypothesis is true. If the p-value is less than the selected significance level,

the model parameters are considered statistically significant. Otherwise, the probability of the results being “false” increases, which can lead to the occurrence of a type II error. The study also took into account the interdependence of errors. That is, when the significance level (α) is reduced, the probability of a type I error decreases, but this leads to an increase in the probability of a type II error (β). Therefore, maintaining a balance between these errors is important when evaluating the model results. In addition, the “confusion matrix” approach was used to evaluate the model results. This method separated true and false results (True Positive, True Negative, False Positive, False Negative) and comprehensively assessed the accuracy of the model. This allowed for a more in-depth analysis of the reliability of economic forecasts. Thus, the chosen methodology, combining regression analysis, statistical hypothesis testing, and error theory, allows for a comprehensive assessment of the reliability of econometric model results.

Analysis and results.

In this study, the relationship between gross domestic product (GDP) and export volume was analyzed using econometric methods in the case of the Uzbek economy. In the process of empirical assessment, a time series database for the period 2014–2024 was formed based on official macroeconomic data published by the Agency for Statistics of the Republic of Uzbekistan. The main reason for choosing this period is the expansion of foreign trade in the country, the strengthening of diversification processes in the structure of exports, and significant changes in macroeconomic indicators as a result of economic reforms. Therefore, this period is considered sufficiently representative for determining the relationship between GDP and exports. The study selected gross domestic product (GDP) as the resulting (endogenous) variable. GDP is the main macroeconomic indicator that reflects the overall result of a country's economic activity and is widely used to assess the level of economic growth. Export volume was selected as the independent (exogenous) variable. Export is an important indicator reflecting the country's

foreign economic activity, and its growth directly affects GDP through an expansion of production volumes, an increase in foreign exchange earnings, and an increase in economic activity. The primary statistics used for the analysis are presented in the table below.

Table 1*GDP and export data (2014–2024)¹*

years	GDP (billion soums) Y	Exports (mln\$) X
2014	210,998.30	13,545.70
2015	250 544.60	12,507.60
2016	290 213.40	12,094.60
2017	369,612.80	12,553.70
2018	494,814.80	13,990.70
2019	620,083.20	17,458.70
2020	705,076.50	15 102.30
2021	861 170.80	16,662.80
2022	1,041,877.90	19,732.60
2023	1,261,806.00	24,869.50
2024	1,535,431.70	27 270.10

The results of the regression analysis showed that the model has a high level of explanatory power. In particular, the multivariate correlation coefficient $R = 0,925$ indicates a strong relationship between the variables. The coefficient of determination $R^2 = 0,856$ is equal to , which means that the model can explain

¹ **Source:** Compiled by the author based on data from the Statistical Agency of the Republic of Uzbekistan.

85.6 percent of the changes in GDP. The normalized R^2 value of 0.820 indicates a high level of fit of the model. The standard error of 0.284 indicates a relatively high accuracy of the model's forecasts. **The following are the general statistical indicators of the model:**

Table 2.

Regression statistics results²

Variables	Coefficient (β)	Standard error	t- statistic	P- value
Export (X_1)	41.69	27.91	1.49	0.173
X_2 variable	-2.02	1.43	-1.42	0.195
Constant term (const)	-201.25	136.61	-1.47	0.179

Table 3 .

Model specifications:

Indicator	Value
Coefficient of determination (R^2)	0.856
F-statistic	23.86
Probe > F	0.00042
Number of observations	11

As can be seen from the table, the F-statistic value is 23.86, and the corresponding probability level is 0.00042. Since this value is much smaller than the chosen $\alpha = 0.05$ level, the null hypothesis is rejected. This indicates that the model

²**Source :** Calculated by the author in the STATA program based on statistical data from the stat.uz website.

is statistically significant in general and that there is a non-random relationship between the variables. A high value of the F-statistic indicates that the factors included in the model together have a significant effect on the resulting variable. This indicates that the model is structurally sound in general. However, this result does not mean that each individual factor in the model is significant. One of the most common cases in practice is that the model is significant in general, but its components (variables) are insignificant when evaluated separately.

According to the calculations, the following regression equation was formed:

$$Y = -201.25 + 41.69X_1 - 2.02X_2$$

here:

Y – gross domestic product

X₁ – export

X₂ – approximately how much GDP will change if the second factor changes

According to this equation, the coefficient of the variable X_1 is positive, indicating that an increase in export volume has a positive effect on GDP growth. That is, when exports increase by 1 unit, GDP increases by an average of 41.69 units. The coefficient of X_2 is negative, indicating that an increase in this factor leads to a decrease in GDP. This is explained by the complex interaction between economic factors. The positive value of the X_1 variable confirms the important role of exports in economic growth. This is especially observed in export-oriented economies, since an increase in foreign trade increases production, employment, and foreign exchange earnings. The negative value of the X_2 variable indicates the complexity of economic processes. This result may indicate the presence of an inverse relationship between some factors or the absence of some important factors in the model. It is also possible that this situation is associated with multicollinearity or incorrect model specification. The individual statistical significance of the model parameters was assessed based on t-statistics and p-values.

The p-value for the X_1 variable is 0.173, and for the X_2 variable is 0.194. Since these values are above the 0.05 level, these variables are considered not statistically significant individually. This situation is directly related to the main idea of the study - true and false errors. That is, the model is statistically significant overall, but the individual regression coefficients in it are insignificant when evaluated separately. This creates an important methodological problem in econometric analysis. From an economic point of view, if the researcher concludes that export factors have a significant impact on GDP despite these results, this creates the risk of a type I error, i.e. a false positive result. Conversely, rejecting the existing relationship leads to a type II error, i.e. a false negative result. Also, the relatively high standard errors of the coefficients indicate that the reliability of the model estimates is limited. This affects the accuracy of the forecast results and requires caution when making economic decisions.

These results show that, despite the presence of a high coefficient of determination, it is not possible to have complete confidence in the results of the model. This creates a very important problem in econometric modeling - the condition of “false confidence”. In such a situation, the researcher may come to the wrong conclusion, that is, the model seems to work well, but its internal structure is not sufficiently substantiated. It is at this point that the economic significance of type I and type II errors becomes clear.

In practice, this can lead to the following risks:

adopting wrong economic policies;

inefficient allocation of resources;

making decisions based on incorrect forecasts.

Therefore, an integrated approach to evaluating model results in econometric analysis is necessary, in which R^2 , F-test, p-value, and error probability should be analyzed together.

Conclusion .

According to the results of the econometric analysis, it was found that there is a significant positive relationship between gross domestic product (GDP) and export volume. The results of the regression model confirm that an increase in export volume has a positive effect on GDP growth. The coefficient of determination of the model $R^2 = 0,856$ is equal to , which means that 85.6 percent of the changes in GDP are explained by the factors included in the model. This result indicates that the overall explanatory power of the model is high. Also, according to the results of the F-test, the model was proven to be statistically significant in general, which means that there is a non-random relationship between the variables. However, an individual analysis of the regression coefficients showed that their p-values are high, that is, some factors are not statistically significant in isolation.

This situation creates an important problem in econometric modeling - the discrepancy between the overall significance of the model and the insignificance of individual parameters. The results of the study show that, despite the presence of a high coefficient of determination and overall statistical significance, it is not always correct to express complete confidence in the model results. This confirms that “true” and “false” errors directly affect the accuracy of economic forecasts. In particular, drawing conclusions without taking into account the insignificance of individual factors can lead to the occurrence of a type I error (false positive result). On the contrary, the failure to adequately determine the existing relationship increases the risk of a type II error (false negative result). In practical terms, these results require caution in making economic decisions. In particular, export development can be considered one of the important factors of economic growth, but to strengthen this conclusion, it is necessary to take into account additional factors, improve the model, and reduce statistical errors. Therefore, it is recommended that future research include additional macroeconomic indicators in the model, increase the number of observations, and use advanced econometric methods.

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