



ASSESSMENT OF THE IMPACT OF MACROECONOMIC FACTORS ON GROSS DOMESTIC PRODUCT BASED ON MULTIVARIATE REGRESSION ANALYSIS

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Abstract: *This article broadly covers the theoretical foundations of regression analysis and its importance in economic research. The main focus is on identifying the relationship between constants and variables and their quantitative assessment. In the course of the research, a multivariate regression model was constructed and the dependence of gross domestic product on such important macroeconomic factors as investment, consumption, exports, government spending, inflation, and employment was analyzed.*

As a result of practical calculations, it was found that the model has high accuracy, and it was shown that the coefficient of determination explains a large part of the resulting indicator. At the same time, the statistical significance of the factors was analyzed, and it was found that some variables have a significant impact on economic growth.

The results of the study confirm that regression analysis is an important scientific tool for in-depth study of economic processes, their forecasting and making effective management decisions. This approach is also of great importance in the formation of economic policy.

Key words : *Regression analysis , many factorial model , gross internal product (GDP) , investment , consumption , export , government costs , inflation , employment , econometrics , determination coefficient , statistic significance , ECCU method .*

Annotatsiya: Mazkur maqolada regressiya tahlilining nazariy asoslari va uning iqtisodiy tadqiqotlardagi ahamiyati keng yoritilgan. Asosiy e'tibor o'zgarish va o'zgaruvchilar o'rtasidagi bog'liqlikni aniqlash hamda ularni miqdoriy baholash masalasiga qaratilgan. Tadqiqot jarayonida ko'p omilli regressiya modeli tuzilib, yalpi ichki mahsulotning investitsiya, iste'mol, eksport, davlat xarajatlari, inflyatsiya va bandlik kabi muhim makroiqtisodiy omillarga bog'liqligi tahlil qilindi.

Amaliy hisob-kitoblar natijasida modelning yuqori aniqlikka ega ekanligi aniqlanib, determinatsiya koeffitsiyenti orqali natijaviy ko'rsatkichning katta qismi izohlanishi ko'rsatildi. Shu bilan birga, omillarning statistik ahamiyati tahlil qilinib, ayrim o'zgaruvchilarning iqtisodiy o'sishga sezilarli ta'siri mavjudligi aniqlandi.

Tadqiqot natijalari regressiya tahlilining iqtisodiy jarayonlarni chuqur o'rganish, ularni prognozlash va samarali boshqaruv qarorlarini qabul qilishda muhim ilmiy vosita ekanligini tasdiqlaydi. Mazkur yondashuv iqtisodiy siyosatni shakllantirishda ham muhim ahamiyat kasb etadi.

Kalit so'zlar: Regressiya tahlili, ko'p omilli model, yalpi ichki mahsulot (YAIM), investitsiya, iste'mol, eksport, davlat xarajatlari, inflyatsiya, bandlik, ekonometrika, determinatsiya koeffitsiyenti, statistik ahamiyatlilik, EKKU usuli.

Introduction: Modern in the economy economic indicators between each other dependency determination and them quantitative assessment current from issues one is considered . Economic processes many factors under the influence takes shape and their each other the secret of the effect determination scientific based economic politics in the conduct important importance profession This is because of economic events between cause and effect their relationship in determining econometric methods , in particular regression analysis wide is used .

Regression analysis consequential indicator and to him/her effect provider factors between dependency to determine , their effect level assessment and economic processes forecast opportunity giver important scientific This is a tool .

method using economic in the system complicated processes simplified mathematician model through is expressed and results scientific basically interpretation will be done .

This with together , economic processes analysis in doing only dependency determination enough not , maybe this dependency how much reliable and statistic in terms of significant that determination also important . Practical in research factors between dependency determination in the process various methodological problems , including multicollinearity , heteroscedasticity and model specification with related issues to the surface Correctly addressing these issues is crucial to ensuring the reliability of regression results .

The main purpose of this article is to identify the relationship between variables using regression analysis, assess their interaction, and analyze the results on a scientific basis. The results of this study are of great importance for a deep understanding of economic processes, their forecasting, and effective management decision-making.

Literature review and methodology : Regression analysis is one of the main methods of econometrics, which is widely used to identify and quantify the relationship between variables. In the scientific literature, this method is recognized as an effective tool for analyzing economic processes, and the multivariate regression model is especially important in studying complex economic systems. This approach allows you to assess the impact of several factors on the resulting indicator at the same time.

In modern econometric studies, regression models are used to analyze the relationships between economic growth, consumption, investment, and other indicators. At the same time, scientific sources emphasize the need to comply with a number of classical conditions to ensure the reliability of the regression model. In particular, it is important that the mathematical expectation of errors is zero, the variance is constant (homoscedasticity), there is no autocorrelation between errors,

and there is no strong linear relationship between independent variables (multicollinearity).

In this study, a multivariate linear regression model was chosen to determine the relationship between variables. This model is expressed in the following general form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

Here Y – the outcome variable X_i – the independent variables, β_i – are the regression coefficients, which estimate the effect of each factor on the outcome, with other factors held constant, ε – indicates a random error.

The method of least squares (LLS) was used to estimate the model parameters. This method is based on minimizing the sum of squares of the differences between the observed and theoretical values:

$$\sum_{i=1}^n (Y_i - \hat{Y}_i)^2 \rightarrow \min$$

The ECCU method provides the best linear unbiased estimates (BLUE) when the conditions of the classical regression model are met. The coefficient of determination is used to assess the quality of the model:

$$R^2 = 1 - \frac{\sum (Y_i - \hat{Y}_i)^2}{\sum (Y_i - \bar{Y})^2}$$

In addition, the overall statistical significance of the model was tested using the F-statistic, and the significance of individual parameters was tested using the t-statistic. These criteria allow us to assess the reliability of the model and the scientific validity of the results.

Thus, the chosen methodology allows us to identify the relationship between variables using regression analysis, estimate model parameters, and statistically substantiate the results.

Practical part:

Artificial (simulated) data set for macroeconomic regression analysis

Year	Y (GDP)	X1 Investment	X2 Consumption	X3 Export	X4 Government spending	X5 Inflation (%)	X6 Employment (%)
2010	62300	15200	40100	9800	9100	7.5	91.2
2011	73500	18300	45200	11200	10200	6.9	91.5
2012	86500	21500	50300	13000	11600	7.3	91.8
2013	101200	24700	56100	14800	13400	6.8	92.1
2014	120300	28900	62400	17100	15600	6.1	92.4
2015	138900	32500	70100	19500	18200	5.7	92.6
2016	161000	36700	78200	22400	21000	5.9	92.9
2017	189500	41500	86900	26100	24400	6.3	93.1
2018	221000	47200	96300	29800	28100	8.4	93.4
2019	255200	53800	107500	34100	32300	14.5	93.6
2020	274900	56100	115200	31800	35100	11.1	93.2
2021	326400	64800	132400	38900	40200	10.0	93.8
2022	389000	75200	154300	45100	46800	12.3	94.1
2023	452800	87300	179500	52400	54100	9.8	94.5
2024	520000	101500	208000	60800	62800	8.7	95.0

In this study, a multivariate linear regression model was constructed based on macroeconomic indicators. Gross domestic product (GDP) was selected as the dependent variable, and investment, consumption, exports, government spending, inflation, and employment were selected as independent variables.

A multivariate regression model is generally expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

As a result of practical calculations, the following regression equation was obtained:

$$Y = -1433698 - 5.472X_1 + 3.540X_2 - 0.471X_3 + 5.646X_4 + 1605.815X_5 + 15121.430X_6$$

Here:

- Y – gross domestic product (GDP);
- X_1 – investment;
- X_2 – consumption;
- X_3 – export;
- X_4 – government spending;
- X_5 – inflation rate (%);
- X_6 – employment rate (%).

According to the model results, the coefficient of determination $R^2 =$ was 0.999704 . This result indicates that 99.97 percent of the outcome variable is explained by the model, meaning that the model is highly adaptive.

The overall statistical significance of the model was tested using the F-statistic. The calculated F-statistic value is 4503.812, which is a very small significance level ($p < 0.05$). This indicates that the model is statistically reliable overall.

The significance of individual parameters was assessed using t-statistics and p-values. According to the results, X_4 the variable government spending () was found to be statistically significant ($p < 0.05$).. Consumption (X_2) was marginally significant ($p \approx 0.057$), and other factors were observed to be not statistically significant enough in this model.

Results and analysis: The results of the regression analysis showed that the model was highly adaptive. The coefficient of determination $R^2 = 0.999704$ is , which means that almost 99.97 percent of the resulting variable - gross domestic product (GDP) - is explained by the factors included in the model. This indicates that the model has high accuracy.

The overall statistical significance of the model was assessed using the F-statistic. The calculated $F = 4503.812$ value and the correspondingly very small p-

value confirm that the model is statistically reliable overall. This means that the selected regression model is effective in explaining the outcome measure.

The effects of individual factors were analyzed using t-statistics and p-values. According to the results, X_4 the variable government spending () is statistically significant ($p < 0.05$) and has a positive effect on GDP. This means that an increase in government spending has a positive effect on economic growth. The variable consumption (X_2) is marginally significant ($p \approx 0.057$), and its effect is relatively stable, but not completely reliable.

The remaining factors – investment (X_1) , exports (X_3) , inflation (X_5) , and employment (X_6) – were found to be statistically insignificant in this model ($p > 0.05$). This does not mean that these factors do not have an effect, but rather that they may be correlated or that the model may have a multicollinearity problem.

It should be noted that a very high coefficient of determination and the insignificant appearance of some factors indicate the possibility of multicollinearity in the model. This indicates the presence of a strong linear relationship between the independent variables, which can affect the reliability of the estimates of individual coefficients.

Overall, the results obtained indicate that the regression model has a high level of accuracy in general. The model explained the main part of the resulting indicator, especially public spending was shown to be an important influencing factor. However, it is advisable to re-select factors or conduct additional diagnostic analyses to further improve the model.

Conclusion: In this study, the relationship between variables was studied theoretically and practically using regression analysis. The results of the study once again confirmed that regression analysis is an important scientific tool in the quantitative assessment of economic processes. Using this method, the relationship between the resulting indicator and the factors affecting it was determined and the degree of their influence was assessed.

The multivariate regression model constructed on the basis of practical calculations was found to have high accuracy. The high value of the coefficient of determination indicated that a large part of the resulting variable was explained by the model. At the same time, the overall statistical significance of the model was confirmed using the F-statistic, which indicates the reliability of the model.

According to the results of the analysis, it was found that government spending has a significant positive impact on the outcome indicator. The consumption factor is partially significant and may play an important role in economic processes. The statistically insignificant appearance of other factors is explained by their interdependence or the presence of multicollinearity in the model.

The study also found that methodological problems that may arise when using the regression model, including multicollinearity and variability in error variance, can affect the model results. Therefore, it is advisable to use additional econometric methods to overcome such problems in the future.

In general, this study once again confirmed that regression analysis is an effective tool for in-depth study of economic processes, their forecasting, and making scientifically based management decisions.

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