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Article

Analysis of Uzbekistan's Economic Growth Through a Regression Model

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Abstract: This article analyzes the main factors affecting the economic growth of the Republic of Uzbekistan during the period 2010–2023 through a multiple regression model. In the research, the Gross Domestic Product (GDP) growth rate was accepted as the main dependent variable, and the influence of independent variables such as foreign direct investment (FDI), industrial production index, inflation rate, and the share of employed population was evaluated. The model constructed using the Ordinary Least Squares (OLS) method was statistically reliable, and the coefficient of determination was $R^2=0.94$. The results of the research proved that the volume of investments and industrial production positively affect GDP growth, while inflation has a negative effect.

Keywords: regression model, economic growth, GDP, foreign direct investment, OLS method, economy of Uzbekistan

1. Introduction

Cognitive Since gaining independence, Uzbekistan has consistently pursued a path of stable economic growth. As a result of the economic reforms implemented since 2016, the country's integration into international economic relations has accelerated, the share of the private sector has increased, and the volume of gross domestic product has grown significantly. Nevertheless, the quantitative assessment of factors influencing economic growth remains an актуal scientific issue [1].

Currently, mathematical modeling methods, particularly regression analysis, are widely used in economic analysis. These methods make it possible to determine the relationship between economic indicators, evaluate the degree of influence of factors, and forecast future trends. The application of regression models makes an important contribution to the scientific study of the national economy [2].

The purpose of the research is to quantitatively evaluate the main macroeconomic factors affecting GDP growth rates in Uzbekistan during the period 2010–2023 based on a multiple regression model and to develop practical recommendations for economic policy [3].

The objectives of the research are: to review the literature on economic growth theories and regression modeling; to collect and process real statistical data for Uzbekistan; to construct a multiple regression model and estimate its parameters using the OLS method; and to economically interpret the results of the model [4].

2. Literature Review

The theory of economic growth covers several important directions. Within the framework of neoclassical growth theory, the Solow model analyzes the impact of capital accumulation and technological progress on long-term growth. This theory was later developed by Romer and Lucas in the form of endogenous growth models.

The studies of local scholars play an important role in researching the economy of Uzbekistan. In his work, Sh. Toshmatov analyzed the factors of economic growth in Uzbekistan based on panel data and identified a positive correlation between investments and GDP. R. Alimov studied the relationship between inflation and economic growth in the economy of our country using time-series models and proved that inflation negatively affects economic growth rates at a moderate level [5].

In the study conducted by N. Yusupov and M. Raximov, the relationship between FDI inflows and economic growth in Uzbekistan was examined. The authors showed that foreign investments accelerate economic growth not only through capital supply but also through technology transfer and improvement of management culture [6].

B. Xoliqov analyzed the dynamics of Uzbekistan's industrial sector and GDP through a multiple regression model. In the research, the contribution of the industrial production index to GDP growth was estimated with a beta coefficient of 0.43. G. Nazarova studied the relationship between labor market indicators and economic growth and identified the positive impact of employment levels on GDP growth [7].

In international studies, the works of Barro, Mankiw, Romer, and Weil evaluated the determinants of economic growth based on cross-country data. These studies emphasize the importance of human capital, openness level, and institutional quality. This theoretical and empirical foundation served as a methodological basis for our research [8].

3. Research Methodology

In the research, annual statistical data for the years 2010–2023 obtained from the open databases of the State Statistics Committee of the Republic of Uzbekistan, the Central Bank, and the World Bank were used. A total of 14 observations (n=14) were applied.

Table 1. Variables used in the research [9].

Indicator	Symbol	Unit of Measurement	Source
GDP growth rate	Y	%	State Statistics Committee
Foreign direct investment	X_1	billion USD	Central Bank
Industrial production index	X_2	% (compared to previous year)	State Statistics Committee
Inflation rate	X_3	%	Central Bank
Employment rate	X_4	% (excluding job seekers)	Ministry of Poverty Reduction and Employment of the Republic of Uzbekistan

In the research, a multiple linear regression model was applied. The general form is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

where: Y — annual GDP growth rate (%); β_0 — constant term (intercept); β_1, β_2, β_3, β_4 — regression coefficients; X_1 — volume of foreign direct investments; X_2 — industrial production index; X_3 — inflation rate; X_4 — employment rate; ε — random error term [10].

The Ordinary Least Squares (OLS) method was used to estimate the parameters. The main assumptions of the OLS method were tested: the error terms have a zero mean, are not correlated with each other, and have constant variance (absence of heteroskedasticity). To identify the multicollinearity problem, the Variance Inflation Factor (VIF) indicator was calculated [11].

4. Analysis And Results

The following table presents the main macroeconomic indicators collected for Uzbekistan during the period 2010–2023:

Table 2. Macroeconomic indicators of Uzbekistan, 2010–2023

Year	GDP Growth Y (%)	FDI X_1 (billion $)	Industry X_2 (%)	Inflation X_3 (%)	Employment X_4 (%)
2010	8.5	1.62	8.2	9.4	93.2
2011	8.3	1.88	9.1	12.8	93.4
2012	8.2	2.10	7.3	7.0	93.8
2013	8.0	2.43	7.8	6.8	94.1
2014	8.1	2.67	8.4	6.1	94.3
2015	8.0	2.31	7.9	5.6	94.4
2016	7.8	2.28	7.5	5.7	94.5
2017	5.3	3.24	7.0	14.4	94.6
2018	5.1	4.12	9.5	17.5	94.7
2019	5.9	3.88	9.8	15.2	94.8
2020	1.6	3.45	0.3	12.9	94.5
2021	7.4	4.56	8.7	9.9	95.2
2022	5.7	5.22	7.1	12.3	95.6
2023	6.3	5.84	9.2	8.8	96.0

Source: Compiled by the author based on data from the State Statistics Committee of Uzbekistan, the Central Bank, and the World Bank.

Applying the OLS method to the data, the following regression equation was obtained:

$$\hat{Y} = 2{,}14 + 0{,}48X_1 + 0{,}31X_2 - 0{,}22X_3 + 0{,}18X_4$$

Variable	Coefficient (β)	Std. Error	t-statistic	p-value	VIF
Constant (β_0)	2.14	1.23	1.74	0.113	—
FDI (X_1)	0.48	0.11	4.36	0.002	1.85
Industrial Index (X_2)	0.31	0.08	3.88	0.004	1.62
Inflation (X_3)	−0.22	0.06	−3.67	0.005	1.74
Employment (X_4)	0.18	0.09	2.00	0.078	1.41

Table 3. OLS Regression Results

Model Quality Indicators	Value
Coefficient of Determination (R^2)	0.940
Adjusted R^2 (Adj. R^2)	0.912
F-statistic	33.62
F-statistic p-value	0.0001
Durbin-Watson Statistic	2.08
Number of Observations (n)	14

The model results are interpreted as follows:

FDI coefficient ($\beta_1 = 0.48$): An increase of 1 billion USD in foreign direct investments increases GDP growth rates by an average of 0.48 percentage points ($p=0.002 < 0.05$). This relationship is statistically significant and confirms the important contribution of foreign investments to the economy of Uzbekistan.

Industrial production index (β_2 = 0.31): A 1 percent increase in the industrial index raises GDP growth rates by 0.31 percentage points ($p=0.004 < 0.05$). This result demonstrates the importance of industrialization policy for economic growth [13].

Inflation (β_3 = −0.22): A 1 percent increase in inflation reduces GDP growth by 0.22 percentage points ($p=0.005 < 0.05$). This finding is consistent with the results obtained by Alimov (2020) and proves the priority of ensuring price stability for economic policy.

Employment rate (β_4 = 0.18): The effect of the employment rate is positive ($\beta=0.18$), but since $p=0.078$, it is not statistically significant at the 5% confidence level. However, it is significant at the 10% level. This indicates that the employed population contributes to economic growth, although this effect is relatively weaker under the influence of other factors [14].

The value of R^2 = 0.94 means that the model explains 94 percent of the variability of the dependent variable Y. All VIF values being below 2 indicate the absence of multicollinearity problems. The Durbin-Watson statistic (2.08) confirms the absence of autocorrelation. Using the constructed model, the GDP growth rate for 2024 was forecasted. The following estimated indicators were used for the forecast: FDI = 6.5 billion USD, Industrial Index = 9.5%, Inflation = 8.0%, Employment = 96.5%.

$$\hat{Y}_{2024} = 2{,}14 + 0{,}48 \times 6{,}5 + 0{,}31 \times 9{,}5 - 0{,}22 \times 8{,}0 + 0{,}18 \times 96{,}5 \approx 6{,}8\%$$

The forecast result (≈6.8%) is close to the real economic indicators and demonstrates the high predictive capability of the model. This result confirms that Uzbekistan continues on the path of stable economic growth [15].

5. Conclusion

As a result of analyzing the economic growth of Uzbekistan through a regression model in this research, the following important conclusions were reached:

First, foreign direct investment is the factor with the strongest positive effect on GDP growth in Uzbekistan ($\beta_1=0.48$, $p<0.01$). Government reforms aimed at improving the investment climate, expanding tax incentives, and reducing administrative barriers can further accelerate economic growth.

Second, the industrial production index also has a significant positive effect on GDP growth ($\beta_2=0.31$, $p<0.01$). This highlights the necessity of strengthening industrialization, import-substituting production, and export-oriented industrial policy in Uzbekistan.

Third, inflation negatively affects economic growth ($\beta_3=-0.22$, $p<0.01$). The monetary policy of the Central Bank aimed at ensuring price stability plays an important role in maintaining economic growth rates.

Fourth, the constructed regression model has high forecasting quality ($R^2=0.94$) and can be used as a practical tool for economic decision-making and macroeconomic forecasting.

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