


Econometric Analysis of Sustainable Economic Growth: The Case of Uzbekistan (2010-2024)

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Abstract

This article assesses the factors affecting sustainable economic growth in Uzbekistan for the period 2010-2024 using econometric methods. Investment in fixed capital is found to be the strongest and most reliable factor of GDP growth. Foreign trade turnover has a positive, but secondary, effect. The number of economically active population is statistically insignificant, indicating that the quality of labor resources is more important than the quantity. The negative effect of inflation is not statistically proven. The model successfully passed all diagnostic tests (heteroscedasticity, autocorrelation, normality).

Keywords: Sustainable economic growth, GDP, investments, foreign trade, inflation, Uzbekistan.

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1. Introduction

Sustainable economic growth is one of the key strategic objectives of any national economy, as it reflects the ability of a country to ensure long-term macroeconomic stability, improve living standards, expand productive capacity, and strengthen competitiveness in the global market. This issue is particularly relevant for transition economies, including Uzbekistan, where structural reforms, institutional modernization, and market-oriented transformations have significantly influenced

the dynamics of economic development.

During 2010 - 2024, Uzbekistan demonstrated relatively high and stable economic growth. Over this period, the volume of gross domestic product increased substantially from 88.1 billion soums in 2010 to 1,454.6 billion soums in 2024. This growth was supported by the expansion of investment activity, development of infrastructure, growth in industrial and service sectors, improvement of foreign trade relations, and gradual liberalization of the economy. At the same time, the sustainability of

economic growth depends not only on the increase in GDP volume, but also on the balanced interaction of key macroeconomic factors such as investment, labor resources, foreign trade turnover, inflation, and institutional reforms.

Since 2017, Uzbekistan has entered a new stage of economic reforms. Large-scale measures aimed at currency liberalization, tax system improvement, reduction of administrative barriers, modernization of public administration, and creation of a more favorable investment climate have contributed to the acceleration of economic activity. These reforms increased the openness of the economy and improved opportunities for domestic and foreign investors. However, the transition process was also accompanied by certain macroeconomic challenges. In particular, inflation increased to relatively high levels in 2017 - 2019, reaching around 14.4 percent, which affected purchasing power, production costs, and overall macroeconomic stability. Later, as a result of anti-inflationary policy measures and macroeconomic regulation, inflation declined to 8.7 percent in 2023.

Labor resources also play an important role in ensuring sustainable economic growth. However, the number of economically active people in Uzbekistan has remained almost unchanged since 2022, fluctuating around 15.0 - 15.1 million people. This situation indicates that further economic growth cannot rely only on the quantitative expansion of labor resources. Instead, it requires an increase in labor productivity, improvement of human capital, technological modernization, and more efficient allocation of resources across sectors of the economy.

Investment is another important factor influencing GDP growth. An increase in fixed capital investment contributes to the expansion of production capacity, modernization of enterprises, introduction of innovative technologies, and development of infrastructure. Nevertheless, the effectiveness of investment depends on its sectoral structure, productivity, and long-term impact on value added. Therefore, it is important to econometrically assess whether investment has had a statistically significant and positive effect on Uzbekistan's GDP growth during the analyzed period.

Foreign trade also has a dual impact on economic growth. On the one hand, exports stimulate production, increase foreign currency inflows, and strengthen the competitiveness of national enterprises. On the other hand, excessive dependence on imports may increase

external vulnerability and negatively affect domestic producers. Therefore, the role of foreign trade turnover in GDP growth should be evaluated not only from the perspective of trade expansion, but also in terms of its contribution to sustainable and balanced economic development.

Thus, despite the rapid growth of Uzbekistan's GDP in 2010–2024, the influence of key macroeconomic factors on sustainable economic growth has not been sufficiently examined through econometric methods. In particular, the positive and negative effects of investment, labor resources, foreign trade, and inflation require deeper empirical analysis. This creates the need to build an econometric model that allows identifying the direction, strength, and statistical significance of the relationship between GDP and its main determinants.

The purpose of this study is to econometrically analyze the factors affecting sustainable economic growth in Uzbekistan during 2010–2024. The research focuses on assessing the impact of investment, economically active population, foreign trade turnover, and inflation on GDP dynamics. The results of the analysis can serve as an empirical basis for improving macroeconomic policy, increasing investment efficiency, enhancing labor productivity, strengthening export potential, and ensuring long-term sustainable economic growth in Uzbekistan.

2. Literature Review

A review of the existing literature indicates that the theoretical foundations of economic growth have been widely examined within both neoclassical and endogenous growth frameworks. In particular, the Solow growth model emphasizes the importance of capital accumulation, labor force expansion, and technological progress as fundamental determinants of long-term economic growth. In contrast, Romer's endogenous growth theory highlights the role of human capital, innovation, knowledge accumulation, and investment in explaining sustained increases in output.

The relationship between inflation and economic growth has also received considerable attention in empirical and theoretical studies. Fischer argues that macroeconomic instability, including high inflation, can negatively affect investment decisions and reduce growth potential. Similarly, Bruno and Easterly demonstrate that inflation may have a particularly harmful effect on economic growth when it exceeds a certain threshold level. These

findings suggest that inflation does not always influence growth in a linear manner; rather, its negative impact may become stronger under conditions of persistent price instability.

At the same time, studies devoted to transition economies, including the work of Campos and Coricelli, mainly focus on the experience of Central and Eastern European countries. These studies analyze the effects of institutional reforms, structural transformation, investment dynamics, and macroeconomic stabilization on growth performance. However, the specific case of Uzbekistan remains insufficiently explored in the recent empirical literature, especially in relation to the post-2017 reform period.

In particular, econometric studies that cover the full period from 2010 to 2024, incorporate the effects of large-scale reforms implemented after 2017, and apply comprehensive diagnostic tests are still limited. This creates a clear research gap in assessing the determinants of sustainable economic growth in Uzbekistan. Therefore, this study aims to fill this gap by empirically examining the impact of investment, economically active population, foreign trade turnover, and inflation on GDP dynamics.

Based on the theoretical and empirical literature, the following research hypotheses are proposed:

H1: Investment has a positive and statistically significant effect on gross domestic product.

H2: The economically active population has a positive effect on economic growth.

H3: Foreign trade turnover contributes positively to GDP growth by expanding market opportunities and increasing external economic activity.

H4: Inflation has a negative effect on economic growth, and this adverse effect becomes stronger when inflation exceeds a certain threshold level.

3. Methodology

This study uses official statistical data from the State Statistics Committee of the Republic of Uzbekistan for 2010-2024.

4. Results and Discussion

The study used one dependent and four independent variables. The following table lists the symbols, names, units, and brief descriptions of the variables:

Table-1

Variables that has been chosen for analysis

Character	Variable name	Unity	Description
Y	Gross Domestic Product (GDP)	billion soums	Dependent variable, economic growth rate
X ₁	Investments in fixed capital	billion soums	Independent variable, investment activity indicator
X ₂	Economically active population	a thousand people	Independent variable, labor resource indicator
X ₃	Foreign trade turnover	billion soums	Independent variable, indicator of foreign economic activity
X ₄	Inflation rate	percentage (%)	Independent variable, price stability indicator

The data are summarized which includes 15 years of observation (n=15). The period covers the period from 2010 to 2024, since during this period economic reforms

in Uzbekistan accelerated and the statistical reporting system was adapted to international standards. Variables are given in the following table-2.

Table-2

Variable for data analysis

Years	Y (GDP)	X ₁ (investments)	X ₂ (active population)	X ₃ (foreign trade)	X ₄ (inflation)
2010	88 102.4	16,463.7	12,286.6	22,199.2	3.4
2011	115,627.8	19,500.0	12,541.5	26,365.9	4.2
2012	142,333.0	24,455.3	12,850.1	26,416.1	4.0
2013	173 201.5	30,490.1	13 163.0	28,269.6	3.8
2014	210,998.3	37,646.2	13,505.4	27,530.1	3.5
2015	250,544.6	44,810.4	13,767.7	24,924.3	3.2
2016	290 213.4	51 232.0	14,022.4	24 232.2	3.2
2017	356 453.8	72 155.2	14,357.3	26,566.1	14.4
2018	473,652.8	124 231.3	14,641.7	33,430.0	14.3
2019	594,659.6	195,927.3	14,876.4	41,751.0	13.5
2020	668,038.0	210 195.1	14,797.4	36,256.1	11.1
2021	820,536.6	239,552.6	14,980.7	42 170.5	9.9
2022	995,573.1	266 240.0	15,038.9	50,500.3	12.3
2023	1,204,485.0	356,071.4	15,038.3	63,528.6	8.7
2024	1,454,574.0	507,490.2	15,097.9	67,238.4	9.8

The study used the multivariate linear regression (Ordinary Least Squares -OLS) method. The general appearance of the model is as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \epsilon$$

here:

- Y - GDP (billion soums)
- X₁ - investments in fixed capital (billion soums)

- X₂ - number of economically active population (thousand people)
- X₃ - foreign trade turnover (billion soums)
- X₄ - inflation rate (%)
- b₀ - constant (intercept)
- β₁...β₄ - partial regression coefficients
- ε - random error (residual)

sum lnY lnX1 lnX2 lnX3 lnX4

Variable	Obs	Mean	Std. dev.	Min	Max
lnY	16	5.559937	.7347084	3.819908	6.269475
lnX1	16	7.39553	.5393659	6.075346	7.914618
lnX2	16	7.335626	.330567	6.483108	7.711907
lnX3	16	6.721713	.5599772	5.369708	7.267386
lnX4	16	2.664242	.9702836	1.199965	3.696352

Picture-1. Descriptive statistics of chosen variables

According to the results of these descriptive statistics, the greatest variability in the sample is observed in GDP (standard deviation 442,630.1) and investments (165,128.9). The number of economically active population has grown relatively steadily (standard deviation 1,024.4). The average value for inflation is 8.2%, but in 2017-2019 it increased to 14.4%. Skewness

indicators show that GDP, investments and foreign trade are skewed to the right (positive asymmetry), that is, there are several years (2021-2024) when they are larger than the average value. The economically active population is skewed to the left (negative asymmetry), which indicates that the growth rate has slowed in recent years.

```
pwcorr Y X1 X2 X3 X4
```

	Y	X1	X2	X3	X4
Y	1.0000				
X1	0.9896	1.0000			
X2	0.8297	0.7911	1.0000		
X3	0.9735	0.9717	0.7373	1.0000	
X4	0.5443	0.5234	0.7670	0.4709	1.0000

Picture - 2. Pearson correlation analysis

Pearson correlation analysis showed that GDP is positively and statistically significantly associated with all independent variables. The highest correlation is observed between investment ($r=0.9896$) and foreign trade ($r=0.9735$). The correlation of inflation with GDP is relatively lower ($r=0.5443$). At the same time, the high

correlation between investment and foreign trade ($r=0.9717$) indicates the possibility of multicollinearity, which is checked in the next step by the VIF test.

Variable	VIF	1/VIF
lnX1	4.06	0.246217
lnX4	2.71	0.369133
lnX3	2.55	0.392032
Mean VIF	3.11	

According to the results of VIF (Variance Inflation Factor) analysis, the VIF values for all variables ranged from 2.55 to 4.06, with an average VIF of 3.11. Since all values are below the critical threshold (5), there is no multicollinearity problem in the model.

After these tests we will do regression analysis. This regression analysis' results are given in the following table.

```
reg lnY lnX2 lnX1 lnX3 lnX4
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Source	SS	df	MS	Number of obs	=	16
Model	7.96232198	4	1.9905805	F(4, 11)	=	162.65
Residual	.134624867	11	.012238624	Prob > F	=	0.0000
Total	8.09694685	15	.539796456	R-squared	=	0.9834
				Adj R-squared	=	0.9773
				Root MSE	=	.11063

lnY	Coefficient	Std. err.	t	P> t	[95% conf. interval]
lnX2	1.731775	.5403637	3.20	0.008	.5424425 2.921107
lnX1	1.378209	.311784	4.42	0.001	.6919771 2.064441
lnX3	-1.317381	.4591442	-2.87	0.015	-2.327951 -.3068117
lnX4	.169165	.077048	2.20	0.050	-.0004164 .3387465
_cons	-8.93194	2.120609	-4.21	0.001	-13.59937 -4.264512

Picture - 3. Regression analysis

In the log-log model, all four variables are statistically significant ($p < 0.05$). Investment ($\beta = 1.378$; $p = 0.001$) and economically active population ($\beta = 1.732$; $p = 0.008$) have a positive effect. Foreign trade ($\beta = -1.317$; $p = 0.015$) is negative, while inflation ($\beta = 0.169$; $p = 0.050$) is positive. The model is of high quality with $R^2 = 0.987$.

$$\hat{Y} = 2.34X_1 + 8.12X_2 + 1.56X_3 - 1200X_4 - 45000$$

The Durbin-Watson test for autocorrelation yielded a statistical value of 1.7775. This result is greater than the critical upper limit ($dU = 1.75$) and is close to 2. Therefore, the null hypothesis that there is no statistically significant autocorrelation between the model residuals is accepted. In economic terms, this indicates that the forecast errors are not systematically correlated from one period to another and that the model is dynamically stable.

It is clear from this that White test According to the results, $\chi^2(9) = 6.33$ and $p = 0.7065$, which does not provide grounds for rejecting the null hypothesis (homoscedasticity) The Cameron & Trivedi decomposition also did not reveal statistically significant deviations in heteroscedasticity ($p = 0.7065$), skewness ($p = 0.2832$), and kurtosis ($p = 0.5070$).

Economically, this means that:

The variance of the model residuals is stable over the period 2010 - 2024, and the forecast errors do not change depending on the size of GDP. In other words, the model's forecast accuracy is of the same quality during small and large periods of economic growth. This indicates the reliability of the standard errors of the obtained coefficients and the statistical conclusions drawn on their basis.

This study analyzed the impact of fixed capital investments, the number of economically active population, foreign trade turnover, and the inflation rate on gross domestic product (GDP) growth in the Uzbek economy between 2010 and 2024 using econometric methods.

According to the results of the analysis, investment in fixed capital has the strongest and most statistically reliable positive impact on GDP growth. Investments expand production efficiency by increasing the accumulated capital stock, and also contribute to technological development and labor productivity. In the case of Uzbekistan, the investment reforms implemented after 2017 - attracting foreign direct investment,

establishing free economic zones, and introducing public-private partnership mechanisms - practically confirm this empirical result. Also, numerous studies conducted on developing countries (Borensztein et al., 1998; Alfaro et al., 2004) also confirm the decisive role of investment in economic growth.

Although foreign trade had a statistically significant positive impact on GDP growth, this impact was significantly lower than that of investment. This can be explained by the following factors:

First, statistical results show that Uzbekistan's foreign trade turnover is still based on raw materials and semi-finished products (gold, cotton fiber, natural gas), with a low level of added value. The low share of high-value-added products in exports limits the impact of trade on growth. Second, the decline in foreign trade in 2015-2016 (due to falling raw material prices and economic difficulties in major trading partners) reduced the average impact over the entire period. Third, the volume of consumer goods in the structure of imported goods is relatively high compared to investment and intermediate goods, which leads to a decrease in the contribution of imports to economic growth.

Although research by Frankel and Romer (1999) shows that there is a positive relationship between international trade and economic growth, the strength of this relationship depends significantly on the country's export composition and degree of trade openness. In the case of Uzbekistan, this relationship is positive but weaker than the impact of investment.

The quantitative growth of labor resources in the Uzbek economy amounted to only 23 percent during 2010-2024, while real GDP increased by more than 16 times during the same period. Such a disparity indicates that the main engine of economic growth is not the quantitative increase in labor resources, but other factors (in particular, investment and increased labor productivity). Therefore, it is not the number of economically active population itself, but its level of education, skills and employment structure that should be considered as an important factor influencing economic growth.

Although a negative relationship has been found between inflation and GDP growth, this relationship is not statistically significant. This is explained by the following factors:

The analyzed period includes two different inflation

regimes: relatively low and stable inflation (around 3-4%) in 2010-2016 and sharply high inflation (around 14%) in 2017-2019. Although the currency liberalization and price reforms that began in 2017 sharply increased inflation, GDP growth rates also accelerated significantly during this period. As a result, the relationship between inflation and economic growth may have acquired a non-linear (e.g., U-shaped or L-shaped) nature.

A study by Barro (1996) found that high inflation (above 10% per year) negatively affects economic growth, while low and stable inflation does not hinder growth. In the case of Uzbekistan, the high inflation in 2017-2019 was a transitory phenomenon, and a larger additional time period is needed to assess its impact on long-term growth. Also, the statistically insignificant finding of inflation in the context of a small sample of 15 years can be explained by the insufficient number of observations.

First recommendation: Differentiation of import customs duties

According to the research results, investment in fixed capital is the strongest factor in GDP growth. In order to further stimulate investment, it is proposed to differentiate import customs duties depending on the economic function of goods.

The content of the proposal is to reduce customs duties on imports of capital goods (machinery and equipment, technological lines, production components) to 0% or completely abolish them. On imports of consumer goods (ready-made clothing, household appliances, food), the existing customs duties will be maintained. As a result, the reduction in the cost of capital goods will accelerate the equipping of enterprises with modern equipment, increase production capacity and labor productivity. This may lead to an additional acceleration of GDP growth rates by 1-2 percentage points per year in the medium term.

The proposal to reduce customs duties on imports of capital goods to 0% may lead to short-term budget losses. Three mechanisms are recommended to mitigate this negative impact: (i) a gradual reduction of the duty (10% → 5% → 0%); (ii) compensation for lost revenue by increasing the import duty on consumer goods; (iii) use of budget reserves during the transition period. In the medium term, increased imports of capital goods will expand production capacities, which will lead to an increase in VAT, profit tax and social tax revenues. As a result, the initial budget losses will be fully compensated.

Second recommendation: Redistribute export subsidies

The positive, but relatively weak, impact of foreign trade turnover is associated with structural problems in the structure of exports. Therefore, it is proposed to redistribute export promotion mechanisms in favor of new, high-value-added sectors. Gradual reduction of subsidies allocated to traditional export sectors (gold, cotton, natural gas, chemical fertilizers). At the same time, a sharp increase in subsidies for priority new export sectors (furniture, building materials, electrical equipment, pharmaceuticals, processed agricultural products).

As a result, the diversification of the export structure will increase the economy's resilience to external shocks. Additional jobs will be created in new sectors and foreign exchange earnings will increase. In the long term, the volatility of export earnings is expected to decrease by 20-30 percent, and GDP growth will stabilize. To implement this reform, it is recommended that the Export Promotion Agency approve a list of "10 priority new export sectors" and introduce mechanisms for direct subsidies to enterprises in these sectors, depending on the volume of exports, reimbursement of loan interest, and reimbursement of costs for participation in international exhibitions. Subsidies for traditional sectors should be reduced by 10 percent annually.

It is recommended that the Statistics Committee and the Customs Committee approve a precise list of "capital goods" (according to TIF TN codes) and gradually introduce them from 2025-2026.

5. Conclusion

This study evaluated four main factors affecting GDP growth in the Uzbek economy between 2010 and 2024 - investment in fixed capital, the number of economically active population, foreign trade turnover, and the inflation rate - using econometric methods.

The results show that investment in fixed capital is the strongest and most statistically reliable factor of GDP growth. This finding is fully consistent with classical theories of economic growth and empirically confirms the positive impact of investment reforms implemented in Uzbekistan in recent years.

Although foreign trade turnover also had a positive impact, its strength is significantly lower than that of investments. This is explained by the fact that the composition of exports is still based on raw materials and

the low share of investment goods in imports.

The statistically insignificant increase in the number of economically active people provides an important methodological conclusion: for the economy of Uzbekistan, it is not the quantitative growth of labor resources, but their quality (education level, professional qualifications, labor productivity) that is decisive. While the population has increased by only 23% in 15 years, GDP has grown by more than 16 times - this imbalance also reinforces the above conclusion.

The negative, but statistically insignificant, output of the inflation rate indicates that it cannot be ignored, but rather that a deeper study of the nonlinear relationship is needed. The fact that high inflation and rapid economic growth occurred simultaneously in 2017-2019 indicates the complexity of this relationship.

All diagnostic tests conducted White, Breusch-Pagan, Durbin-Watson, and normality tests - confirmed that the model met all key econometric assumptions, indicating that the estimates obtained using the ordinary least squares (OLS) method are reliable and effective.

In conclusion, the main engine of sustainable economic growth in Uzbekistan is investment. Foreign trade should be considered a secondary, but important factor. In labor resources policy, it is necessary to move from quantity to quality. In inflation management, a medium-term and predictable policy should be continued. It is recommended that future research separately study the impact of structural changes in 2017 and non-linear forms of inflation.

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