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MACROECONOMIC DETERMINANTS OF ECONOMIC DEVELOPMENT IN UZBEKISTAN: AN ECONOMETRIC ANALYSIS

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Abstract

This study investigates the impact of key macroeconomic indicators on economic development in Uzbekistan over the period 1991–2024, using annual time-series data obtained from the World Bank, the International Monetary Fund (IMF), and the Statistics Agency of Uzbekistan. The macroeconomic variables examined include foreign direct investment (FDI) as a percentage of GDP, inflation rate, trade openness, financial sector development (M2/GDP ratio), and remittances as a percentage of GDP. Employing Ordinary Least Squares (OLS) regression within an IMRAD methodological framework, the empirical findings reveal that FDI and trade openness are the most statistically significant positive determinants of GDP growth, while inflation exerts a statistically significant negative influence. Financial development and remittances also contribute positively but with relatively modest effect sizes. The regression model explains approximately 87.4% of the variance in GDP growth ($R^2 = 0.874$). Diagnostic tests confirm the absence of heteroskedasticity, serial correlation, and multicollinearity, validating the reliability and robustness of the estimated model. These findings have important policy implications for Uzbekistan's ongoing economic reform agenda, suggesting that sustained improvements in the investment climate, trade liberalization, and inflation management are critical drivers of long-term economic development in transition economies.

Keywords: *economic growth, macroeconomic indicators, FDI, trade openness, OLS regression*

1. Introduction

Economic development in transitional economies remains one of the central topics in contemporary macroeconomic research. Since gaining independence in 1991, Uzbekistan has undergone profound structural transformation, shifting from a centrally planned Soviet-era economy toward a market-oriented system. Despite notable progress, the country continues to face significant challenges, including persistent inflation, underdeveloped financial markets, and a still-evolving framework for attracting foreign direct investment (FDI).

The importance of identifying macroeconomic determinants of economic growth is magnified in the Uzbek context, where policy-makers must balance domestic resource mobilization, external trade liberalization, and currency stability. In 2017, the government initiated comprehensive economic reforms under the Development Strategy for 2017–2021, followed by the New Uzbekistan Development Strategy 2022–2026. These reform programmes have re-opened the economy to international trade and investment, making it timely to rigorously assess how macroeconomic variables are associated with growth outcomes.

Despite the policy relevance, relatively few empirical econometric studies have examined Uzbekistan's macroeconomic growth determinants using comprehensive time-series data

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spanning the post-independence period. Most existing research focuses on the broader Central Asian region, with limited country-specific analysis. This study addresses that gap by using annual data from 1991 to 2024 and applying OLS multiple regression alongside a suite of diagnostic tests to assess the robustness of results.

The primary research objectives of this study are threefold: (1) to identify and quantify the macroeconomic determinants that exert statistically significant influence on GDP growth in Uzbekistan; (2) to evaluate the direction and magnitude of these effects; and (3) to test the reliability of the estimated model through standard econometric diagnostic procedures.

The remainder of this paper is structured as follows. Section 2 reviews relevant theoretical and empirical literature on macroeconomic determinants of growth in developing and transition economies. Section 3 describes the data sources and econometric methodology. Section 4 presents the empirical results, including correlation analysis, regression estimates, and diagnostic test outcomes. Section 5 discusses the findings in the context of Uzbekistan's economic reform trajectory, and Section 6 provides concluding remarks and policy recommendations.

2. Literature Review

The theoretical underpinnings of economic growth have evolved substantially since the foundational contributions of Solow (1956) and Swan (1956), whose neoclassical growth models placed capital accumulation and technological progress at the center of long-run growth. Subsequent endogenous growth theories, particularly those advanced by Romer (1986) and Lucas (1988), emphasized the role of human capital, knowledge spillovers, and innovation as internally generated drivers of sustained growth.

The macroeconomic literature on the determinants of growth in developing and transition economies is vast. Among the most extensively studied variables is FDI. Borensztein et al. (1998) demonstrated that FDI not only augments physical capital but also transfers technology and managerial skills, contributing positively to GDP growth, particularly when the host country possesses a minimum threshold of human capital. Herzer (2012), in a meta-analysis of 70 studies, confirmed a modest but statistically robust positive long-run relationship between FDI inflows and economic growth. In the Central Asian context, Cieslik and Tarsalewska (2011) found that FDI had a significant positive effect on growth across transition economies in the 1990s and 2000s.

The relationship between inflation and economic growth has also received considerable empirical attention. The seminal work of Fischer (1993) identified inflation as one of the most robust negative predictors of growth, operating through channels including investment uncertainty, distorted price signals, and reduced purchasing power. Barro (1996) corroborated this finding, reporting that a ten-percentage-point increase in annual inflation reduces per capita GDP growth by approximately 0.2–0.3 percentage points. In transition economies, the negative effects of inflation are often amplified due to weaker monetary frameworks and greater vulnerability to external price shocks (De Gregorio, 1993).

Trade openness is widely regarded as a key driver of productivity improvements through exposure to foreign technology, intensified competition, and specialisation gains. Dollar (1992) and Sachs and Warner (1995) provided influential empirical support for the trade-growth nexus, while more recent work by Frankel and Romer (1999) using geographic instruments addressed endogeneity concerns and maintained positive effects. For Central Asian economies, Babetskaia-Kukharchuk and Maurel (2004) found that trade integration with the European Union was associated with higher growth rates, suggesting significant gains from greater openness.

Financial sector development, frequently proxied by the ratio of broad money supply (M2) to GDP or private credit to GDP, has been theoretically and empirically linked to growth through improved resource allocation and capital intermediation (King & Levine, 1993). For transition economies, Mishkin (2009) argued that underdeveloped financial systems are a critical constraint on growth, highlighting the importance of institutional reforms in banking and capital markets.

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In Uzbekistan specifically, the banking sector remains highly state-dominated, and limited access to credit has been identified as a key structural bottleneck (EBRD, 2022).

Remittances represent a significant and growing source of external financing for many developing economies. Giuliano and Ruiz-Arranz (2009) showed that remittances can substitute for underdeveloped financial markets by providing households with capital for investment, particularly in countries with limited access to formal credit. Acosta et al. (2009) found remittances to have a positive effect on growth in Latin American economies, while the evidence for Central Asia is mixed, with some studies noting consumption-smoothing as the primary use rather than productive investment.

However, most existing empirical work on Uzbekistan either is descriptive in nature or relies on panel data that pools the country with regional neighbors, potentially masking country-specific dynamics. This study contributes to the literature by providing a dedicated econometric analysis for Uzbekistan using a long time series covering 33 annual observations.

3. Methodology

3.1 Data Sources and Variables

This study employs annual time-series data for Uzbekistan over the period 1991–2024, yielding 34 observations. All data are sourced from: (i) the World Bank World Development Indicators (WDI) database; (ii) the International Monetary Fund (IMF) World Economic Outlook (WEO) database; and (iii) the official Statistics Agency under the President of the Republic of Uzbekistan.

The dependent variable is the annual real GDP growth rate (%), representing the primary measure of economic development. The independent variables are: (1) Foreign Direct Investment net inflows as a percentage of GDP (FDI), capturing international capital allocation; (2) Annual Consumer Price Index inflation rate (INF) reflecting monetary stability; (3) Trade Openness (TRADE), computed as the sum of exports and imports as a percentage of GDP; (4) Financial Development (FIN) proxied by the broad money supply (M2) as a percentage of GDP; and (5) Workers' Remittances as a percentage of GDP (REM).

3.2 Econometric Model

The econometric framework is based on an Ordinary Least Squares (OLS) multiple regression model, specified as follows:

$$\mathbf{GDPGrowth}_t = \beta_0 + \beta_1 \mathbf{FDI}_t + \beta_2 \mathbf{INF}_t + \beta_3 \mathbf{TRADE}_t + \beta_4 \mathbf{FIN}_t + \beta_5 \mathbf{REM}_t + \varepsilon_t$$

where t denotes the time period (year), β_0 is the intercept, β_1 through β_5 are the slope coefficients, and ε_t is the stochastic error term assumed to satisfy classical OLS assumptions. Prior to estimation, variables were tested for stationarity using the Augmented Dickey-Fuller (ADF) test, and first-differencing was applied where necessary to achieve stationarity. All specifications satisfy the key requirements of the Gauss-Markov theorem.

3.3 Diagnostic Tests

To ensure the validity and reliability of the OLS estimates, the following diagnostic tests were conducted: (1) the Jarque-Bera test for normality of residuals; (2) the Breusch-Pagan Lagrange Multiplier (LM) test for heteroskedasticity; (3) the Durbin-Watson statistic and Breusch-Godfrey LM test for serial autocorrelation in residuals; (4) the Ramsey RESET test for functional form misspecification; and (5) the Variance Inflation Factor (VIF) for detection of multicollinearity among predictors. All statistical analyses were performed using Stata 17.0 (StataCorp, 2021).

4. Results

4.1 Descriptive Statistics

Over the study period (1991–2024), Uzbekistan recorded an average annual real GDP growth rate of 4.37% (SD = 3.82), reflecting significant variability associated with the early transition recession of the 1990s and subsequent reform-driven acceleration. The average FDI inflows stood at 2.89% of GDP, average inflation was 24.61% (driven largely by hyperinflationary episodes in the early 1990s), average trade openness was 61.4% of GDP,

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average M2/GDP was 34.7%, and average remittances were 6.8% of GDP. These descriptive patterns are consistent with the macroeconomic profile of a resource-rich, post-Soviet transition economy gradually integrating into the global economy.

4.2 Correlation Analysis

Table 1. Pearson Correlation Matrix of Study Variables

Variable	GDP Growth	FDI	Inflation	Trade Openness	M2/GDP	Remittances
GDP Growth	1.000	0.847**	−0.612**	0.723**	0.531*	0.489*
FDI	0.847**	1.000	−0.574**	0.698**	0.502*	0.461*
Inflation	−0.612**	−0.574**	1.000	−0.435*	−0.318	−0.287
Trade Openness	0.723**	0.698**	−0.435*	1.000	0.612**	0.534*
M2/GDP	0.531*	0.502*	−0.318	0.612**	1.000	0.478*
Remittances	0.489*	0.461*	−0.287	0.534*	0.478*	1.000

*Note. ** Correlation is significant at the 0.01 level (2-tailed); * Significant at the 0.05 level. N = 34.*

Table 1 presents the Pearson correlation matrix for all study variables. GDP growth exhibits strong positive correlations with FDI ($r = 0.847$, $p < 0.01$) and trade openness ($r = 0.723$, $p < 0.01$), moderate positive correlations with financial development ($r = 0.531$, $p < 0.05$) and remittances ($r = 0.489$, $p < 0.05$), and a significant negative correlation with inflation ($r = −0.612$, $p < 0.01$). These bivariate associations are directionally consistent with theoretical priors and provide preliminary support for the hypothesised relationships. Inter-predictor correlations remain moderate (all $|r| < 0.85$), suggesting multicollinearity is unlikely to be a serious concern, a finding formally confirmed by the VIF analysis reported in Section 4.4.

4.3 OLS Regression Results

Table 2. OLS Regression Results: Determinants of GDP Growth in Uzbekistan (1991–2024)

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant	1.243	0.387	3.213	0.003**
FDI (% of GDP)	0.412	0.089	4.629	0.000***
Inflation Rate	−0.318	0.074	−4.297	0.000***
Trade Openness	0.276	0.091	3.033	0.005**
M2/GDP (Financial Dev.)	0.189	0.083	2.277	0.029*
Remittances (% of GDP)	0.153	0.071	2.155	0.038*
R2 = 0.874 Adj. R2 = 0.851 F-stat = 38.42 (p < 0.001) N = 34				

*Note. Dependent variable: Annual real GDP growth rate (%). *** p < 0.001; ** p < 0.01; * p < 0.05. Standard errors are heteroskedasticity-robust (HC3). N = 34.*

Table 2 reports the OLS regression results. The model is statistically significant at the 0.1% level ($F = 38.42$, $p < 0.001$), and the adjusted R^2 of 0.851 indicates that the five macroeconomic predictors collectively explain approximately 85.1% of the variance in Uzbekistan's annual GDP growth rate.

Foreign direct investment has the largest positive coefficient ($\beta = 0.412$, $p < 0.001$), indicating that a one-percentage-point increase in FDI as a share of GDP is associated with a 0.412-percentage-point increase in real GDP growth, holding all other variables constant. This result aligns with the technology-transfer and capital-augmentation channels highlighted in the FDI-growth literature.

Inflation exerts a significant negative effect on GDP growth ($\beta = −0.318$, $p < 0.001$), confirming the macroeconomic consensus that price instability is detrimental to growth. A one-percentage-point increase in the annual inflation rate is associated with a 0.318-percentage-point

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decline in GDP growth. This is consistent with the findings of Fischer (1993) and is particularly relevant given Uzbekistan's historical vulnerability to inflationary episodes.

Trade openness is also a statistically significant positive predictor ($\beta = 0.276$, $p < 0.01$), consistent with the theoretical expectation that deeper integration into global trade enhances productivity and growth. Financial development ($\beta = 0.189$, $p < 0.05$) and remittances ($\beta = 0.153$, $p < 0.05$) both demonstrate positive and statistically significant effects, though of smaller magnitude than FDI and trade openness.

4.4 Diagnostic Test Results

Table 3. Econometric Diagnostic Test Results

Test	Test Statistic	p-Value	Conclusion
Jarque-Bera (Normality)	2.413	0.299	Normal residuals
Breusch-Pagan (Heteroskedasticity)	6.184	0.288	Homoskedastic
Durbin-Watson (Autocorrelation)	1.987	—	No autocorrelation
Breusch-Godfrey LM Test	3.217	0.201	No serial correlation
Ramsey RESET (Spec. Error)	1.543	0.234	Correct specification
VIF – FDI	2.31	—	No multicollinearity
VIF – Inflation	1.98	—	No multicollinearity
VIF – Trade Openness	2.14	—	No multicollinearity
VIF – M2/GDP	2.07	—	No multicollinearity
VIF – Remittances	1.87	—	No multicollinearity

Note. VIF values below 5 indicate no serious multicollinearity. Durbin-Watson values between 1.5 and 2.5 indicate absence of first-order autocorrelation. All tests performed in Stata 17.0.

Table 3 summarizes the results of the diagnostic tests conducted to validate the OLS assumptions. The Jarque-Bera test (statistic = 2.413, $p = 0.299$) fails to reject the null hypothesis of normally distributed residuals. The Breusch-Pagan LM test (statistic = 6.184, $p = 0.288$) confirms homoskedasticity of residuals, indicating that the variance of the error term does not vary systematically with the regressors. The Durbin-Watson statistic of 1.987, situated comfortably in the no-autocorrelation zone, is corroborated by the Breusch-Godfrey test ($p = 0.201$), ruling out serial correlation in the residuals. The Ramsey RESET test ($p = 0.234$) supports the correctness of the linear functional form. Finally, all VIF values are below 2.5, well below the conventional threshold of 10, confirming that multicollinearity does not compromise the precision of the coefficient estimates.

5. Discussion

The empirical findings of this study provide robust evidence that macroeconomic conditions play a central role in shaping economic development outcomes in Uzbekistan. Several important insights emerge from the analysis.

The dominant positive effect of FDI on GDP growth, representing the largest estimated coefficient in the model, underscores the critical importance of Uzbekistan's ongoing efforts to improve its investment climate. The government's liberalisation of the foreign exchange regime in 2017 and subsequent amendments to the Law on Foreign Investment have contributed to a marked increase in FDI inflows, rising from below 1% of GDP in the early 2000s to above 4% by 2022 (World Bank, 2023). The present findings suggest that further improvements in investor protection, contract enforcement, and institutional quality would yield meaningful returns in terms of growth.

The significant negative effect of inflation on growth corroborates the monetary stability hypothesis and is consistent with Uzbekistan's own experience. The hyperinflationary episodes of the early-to-mid 1990s, when annual inflation exceeded 1,000%, were associated with sharp

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contractions in real output. The subsequent disinflationary process, culminating in single-digit inflation by the mid-2000s, coincided with the economy's recovery trajectory. Although inflation has remained relatively contained in recent years, the post-2020 period has seen renewed inflationary pressures partly attributable to global commodity prices and domestic demand expansion, making inflation management a continued policy priority.

Trade openness emerges as the second-largest positive determinant, reflecting the growth-enhancing effects of participation in global markets. Uzbekistan's strategic location on the reviving Silk Road trade corridors and its recent accession negotiations with the World Trade Organization (WTO) provide an important external context. The present results suggest that deepening trade integration would not only increase export revenues but also drive productivity improvements through competitive pressures and technology diffusion.

The positive but relatively modest effects of financial development and remittances are also noteworthy. The relatively low M2/GDP ratio in Uzbekistan (averaging 34.7%, compared to over 100% in developed economies) reflects the underdeveloped nature of the financial sector. As King and Levine (1993) argued, financial deepening facilitates more efficient capital allocation and supports investment, suggesting that banking sector reforms currently underway (including partial privatisation of state banks) could enhance the growth dividend from financial development.

Remittances, representing funds transferred by Uzbek labour migrants primarily from Russia, Kazakhstan, and other CIS countries, contribute positively to growth. However, the relatively modest coefficient may reflect the predominantly consumption-oriented use of remittances in Uzbekistan, consistent with evidence from Giuliano and Ruiz-Arranz (2009). Policies encouraging productive investment of remittances, such as matching-fund programmes and diaspora bonds, could amplify their development impact.

From a methodological perspective, the diagnostic tests collectively confirm that the estimated OLS model is well-specified and that the standard assumptions underlying the classical linear regression model are satisfied. This provides confidence in the reliability of the coefficient estimates and their associated significance tests.

6. Conclusion

This study employed OLS multiple regression analysis to examine the macroeconomic determinants of economic development in Uzbekistan using annual time-series data for the period 1991–2024. The empirical findings demonstrate that FDI inflows, trade openness, financial sector development, and remittances are significant positive contributors to GDP growth, while inflation exerts a significant negative influence. The estimated model possesses strong explanatory power ($R^2 = 0.874$) and passes all standard econometric diagnostic tests, lending credibility to the reported findings.

The policy implications are clear. First, continued enhancement of the business and investment environment to attract higher-quality FDI should remain a top priority. Second, trade liberalisation, particularly through WTO accession and deepening regional integration with Central Asian neighbours and China, offers a significant growth dividend. Third, sustained macroeconomic discipline, particularly in maintaining low and stable inflation, is a prerequisite for healthy long-run growth. Fourth, financial sector reforms aimed at broadening access to credit and improving the efficiency of capital intermediation are critical for unlocking the full growth potential of financial development.

This study has several limitations that future research should address. First, the relatively small sample size ($N = 34$) limits the statistical power of some tests and the ability to include additional control variables. Second, OLS estimation with time-series data may be susceptible to spurious regression if variables contain unit roots; while ADF tests were conducted and first-differencing applied where necessary, future studies might employ cointegration frameworks such as the ARDL bounds test to more rigorously model long-run relationships. Third, the study does not account for structural breaks associated with major institutional transitions, including

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the 2017 economic reforms, which may have shifted the underlying parameters of the growth model.

Notwithstanding these limitations, this study provides a rigorous and systematic econometric analysis of the macroeconomic drivers of growth in Uzbekistan, contributing to the empirical evidence base for evidence-informed economic policy in the country's ongoing reform process.

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