



IQTISODIYOT & TARAQQIYOT

Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal

№4



ISSN: 2992-8982

<https://yashil-iqtisodiyot-taraqqiyot.uz/>

2025



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Elektron nashr. 314 sahifa.

E'lon qilishga 2025-yil 7-aprelda ruxsat etildi.

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Muassis: "Ma'rifat-print-media" MChJ

Hamkorlarimiz: Toshkent davlat iqtisodiyot universiteti, O'zR Tabiat resurslari vazirligi, O'zR Bosh prokuraturasi huzuridagi IJQK departamenti.

Jurnalning ilmiyligi:

“Yashil” iqtisodiyot va taraqqiyot” jurnali

O'zbekiston Respublikasi
Oliy ta'lim, fan va innovatsiyalar
vazirligi huzuridagi Oliy
attestatsiya komissiyasi
rayosatining
2023-yil 1-apreldagi 336/3-
sonli qarori bilan ro'yxatdan
o'tkazilgan.



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RESEARCH ON THE EFFECTS OF INTEREST RATE, INFLATION RATE AND GROSS DOMESTIC PRODUCT (GDP) ON THE LEVEL OF FOREIGN DIRECT INVESTMENT (FDI) INFLOWS (EVIDENCE FROM UZBEKISTAN)



Azimov Shakhzod

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Independent researcher

Abstract: This study investigates the macroeconomic determinants of foreign direct investment (FDI), focusing on the effects of interest rates, inflation, and gross domestic product (GDP) on FDI inflows. Using a log-linear Ordinary Least Squares (OLS) regression model and a dataset comprising 33 annual observations, we examine the relationship between the natural logarithms of FDI, interest rates, inflation, and GDP. The results indicate that inflation has a statistically significant and negative impact on FDI, suggesting that rising inflation discourages investment inflows. Interest rates exhibit a positive and marginally significant effect on FDI, while GDP does not show a statistically meaningful relationship. Variance Inflation Factor (VIF) and Belsley-Kuh-Welsch diagnostics suggest moderate multicollinearity, particularly involving GDP, but not at a level requiring model revision. These findings highlight the sensitivity of FDI to macroeconomic stability, especially inflation, and underscore the importance of maintaining a favorable investment climate.

Key words: Variance Inflation Factor (VIF), Belsley-Kuh-Welsch diagnostics, A log-linear Ordinary Least Squares (OLS), Inflation, FDI, GDP, Uzbekistan, Interest rate.

Annotatsiya: Ushbu tadqiqotda xorijiy to'g'ridan-to'g'ri investitsiyalarning (XTI) makroiqtisodiy omillarini, xususan, foiz stavkalari, inflyatsiya va yalpi ichki mahsulot (YAIM)ning XTI oqimlariga ta'sirini o'rganilgan. Tadqiqotda log-chiziqli Oddiy Eng Kichik Kvadratlar (OEKQ) regressiya modeli hamda 33 yillik yillik kuzatuvdan iborat ma'lumotlar to'plami qo'llanilgan. FDI, foiz stavkalari, inflyatsiya va YAIM ko'rsatkichlarining tabiiy logarifmlariga asoslangan bog'liqlik tahlil qilingan. Natijalar inflyatsiyaning XTIGA statistik jihatdan sezilarli va salbiy ta'sir ko'rsatishini, ya'ni inflyatsiya darajasining ortishi investitsiya oqimlarini kamaytirishini ko'rsatdi. Foiz stavkalari XTIGA ijobiy, biroq chegaraviy darajada ahamiyatli ta'sir ko'rsatgan. YAIM esa statistik jihatdan ahamiyatli bog'liqlik namoyon qilmagan. Varians inflyatsiya koeffitsiyenti (VIF) va Belsley-Kuh-Welsch diagnostikasi natijalari o'rta darajadagi kollinearlikni, ayniqsa YAIM bilan bog'liq holat mavjudligini ko'rsatgan, biroq bu modelni qayta ko'rib chiqishni talab qiladigan darajada emas. Ushbu natijalar XTining makroiqtisodiy barqarorlikka, ayniqsa inflyatsiyaga nisbatan sezgiriligini ta'kidlaydi hamda investitsiyalar uchun qulay muhitni ta'minlash zarurligini ko'rsatadi.

Kalit so'zlar: varians inflyatsiya koeffitsiyenti (VIF), Belsley-Kuh-Welsch diagnostikasi, log-chiziqli Oddiy Eng Kichik Kvadratlar (OEKQ), inflyatsiya, XTI, YAIM, O'zbekiston, foiz stavkasi.

Аннотация: Данное исследование анализирует макроэкономические детерминанты прямых иностранных инвестиций (ПИИ), сосредотачивая внимание на влиянии процентных ставок, инфляции и валового внутреннего продукта (ВВП) на приток инвестиций. С использованием лог-линейной модели обыкновенных наименьших квадратов (ОНК) и набора данных из 33 годовых наблюдений изучается взаимосвязь между натуральными логарифмами ПИИ, процентных ставок, инфляции и ВВП. Результаты показывают, что инфляция оказывает статистически значимое и отрицательное влияние на ПИИ, что свидетельствует о снижении инвестиционной привлекательности при росте инфляции. Процентные ставки демонстрируют положительное, но статистически незначительное влияние, тогда как ВВП не показывает значимой зависимости. Диагностика VIF и Belsley-Kuh-Welsch указывает на умеренную мультиколлинеарность, особенно с участием ВВП, но не на уровне, требующем пересмотра модели. Эти результаты подчеркивают чувствительность ПИИ к макроэкономической стабильности, особенно к инфляции, и важность поддержания благоприятного инвестиционного климата.

Ключевые слова: коэффициент инфляции дисперсии (VIF), диагностика Belsley-Kuh-Welsch, лог-линейная модель ОНК, инфляция, ПИИ, ВВП, Узбекистан, процентная ставка.

INTRODUCTION

Foreign direct investment (FDI) plays a vital role in the economic development of transition economies, and Uzbekistan is no exception. Since gaining independence in 1991, Uzbekistan has embarked on a gradual process of economic reform aimed at liberalizing markets, modernizing its industrial base, and integrating more fully into the global economy. In recent years, the government has intensified its efforts to attract foreign investors by improving the business environment, reforming regulatory frameworks, and offering a range of investment incentives. However, the effectiveness of these measures is also shaped by broader macroeconomic conditions.

Understanding the macroeconomic factors that influence FDI inflows is crucial for Uzbekistan as it seeks to position itself as a regional investment hub in Central Asia. Among the key variables affecting investor decisions are interest rates, inflation, and gross domestic product (GDP) each serving as a signal of economic stability, potential returns, and market size. While theoretical models typically suggest that low inflation, favorable interest rates, and strong economic growth attract more investment, empirical findings vary significantly across countries and contexts.

This study examines the impact of interest rates, inflation, and GDP on FDI inflows in Uzbekistan using a log-linear Ordinary Least Squares (OLS) regression model. The analysis is based on 33 annual observations of macroeconomic data, with all variables log-transformed to improve linearity and interpretability. The regression results indicate that inflation has a statistically significant and negative impact on FDI, suggesting that price instability serves as a deterrent to foreign investors. Interest rates show a positive but only marginally significant relationship with FDI, potentially reflecting investor expectations of higher returns in a high-interest-rate environment. GDP, meanwhile, does not exhibit a statistically significant effect on FDI inflows in this model.

These findings underscore the importance of maintaining macroeconomic stability particularly in terms of inflation control as Uzbekistan continues to pursue an open and investment-friendly economic agenda. While GDP growth remains a cornerstone of long-term development, this analysis suggests that reducing inflationary pressures may yield more immediate and measurable improvements in attracting foreign capital. As such, the study offers valuable insights for policymakers aiming to enhance Uzbekistan's investment climate in an increasingly competitive global landscape (Figure 1).

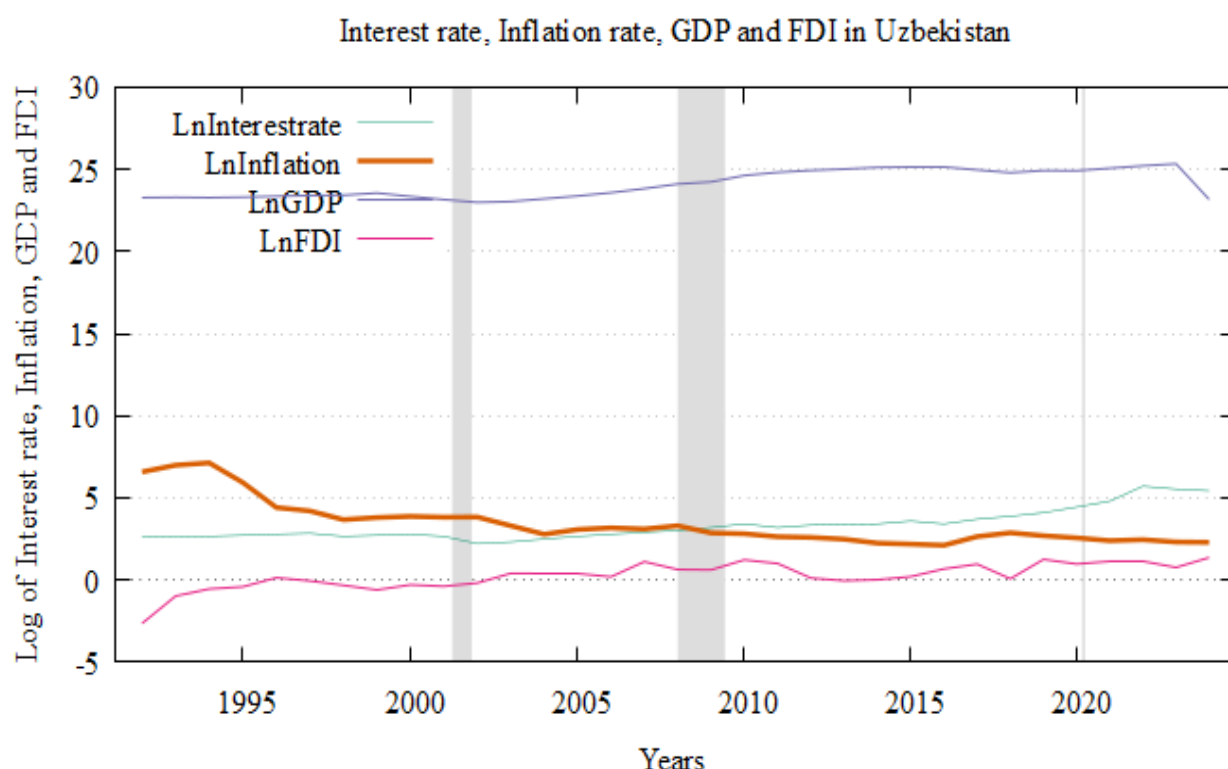


Figure 1. Overall trends for the log of GDP, Interest rate, Inflation rate and FDI in Uzbekistan. This line graph is created by the author (on Gretl) based on data from World Bank Open Data. <https://databank.worldbank.org/>



The time-series graph (Figure 1) displays the logged values of interest rate (LnInterstrate), inflation rate (LnInflation), GDP (LnGDP), and foreign direct investment (LnFDI) in Uzbekistan from 1992 to 2023. Over this period, LnGDP (in blue) remains the highest among the four indicators, showing a steady upward trend from the early 2000s, suggesting consistent economic growth. However, there is a noticeable drop around 2022–2023, which may indicate a recent economic shock or downturn. LnInflation (green line) stays relatively stable with a slight upward trend post-2016, potentially reflecting economic reforms or shifts in monetary policy.

LnInterstrate (orange line) starts high in the early 1990s, then declines sharply during the late 1990s and early 2000s, stabilizing afterward. This likely reflects the government's efforts to transition from high inflationary policies to more stable macroeconomic management. LnFDI (magenta line), while generally lower than the other variables, shows a gradual increase over the years, with some fluctuations. This upward trend suggests improving investor confidence or liberalization policies, although volatility remains a factor. The shaded bands in the graph (early 2000s and around 2008–2010) may represent economic crises or significant transitions, during which the indicators show varying levels of instability or adjustment.

REVIEW OF LITERATURE ON THE SUBJECT

Numerous empirical studies have analyzed the relationship between interest rates and FDI inflows, with varying results depending on the country, the structure of the economy, and the type of FDI being considered.

For example, Asiedu (2002) analyzed the impact of macroeconomic variables on FDI in African countries, finding that higher interest rates tend to deter FDI, as they increase the cost of financing investments. This result is consistent with the cost of capital theory, which suggests that higher interest rates make it more expensive for foreign investors to finance projects, particularly in economies with limited access to capital markets.

Chakrabarti (2001), in his analysis of 30 developing countries, also found that interest rates were negatively associated with FDI, with a stronger impact in countries where the financial sector is underdeveloped. In contrast, Ghosh and Ghosh (2009) found a positive relationship between interest rates and FDI in India, where the relationship was influenced by the monetary policy regime and the size of the market.

A study by Froot and Stein (1991) examined the relationship between interest rates and FDI inflows to developed economies, concluding that low interest rates often attract FDI due to the cheaper cost of financing, especially for industries requiring large capital investment.

Inflation has long been considered a critical variable for determining FDI, with most studies suggesting a negative relationship between inflation and foreign investment. Asiedu (2002) and Onyeiwu and Shrestha (2004) argue that high inflation increases uncertainty about future returns and erodes the value of profits, making FDI less attractive. The volatility of inflation is often cited as a key factor that discourages investors from committing to long-term projects in high-inflation economies.

Agarwal (2000) in a study of 75 developing countries, found that inflation has a significant negative effect on FDI, particularly in countries with unstable inflation rates, as it creates economic uncertainty and risks. Empirical evidence from Latin America by Sosa (2005) found a similar pattern. The study concluded that countries with low and stable inflation rates tend to attract higher FDI, while periods of inflationary pressure led to an outflow of capital, as foreign investors seek safer, more predictable environments. De Mello (1999) found that inflation control is crucial for countries looking to increase FDI inflows, with inflation volatility being a key deterrent for investors. This is particularly important for economies in transition, like Uzbekistan, where inflationary pressures can destabilize the investment climate.

GDP is one of the most commonly used proxies for market size and economic potential, with many studies finding a strong positive relationship between GDP growth and FDI inflows. Dunning (1981) first argued that market-seeking FDI is positively related to the size of the host country's economy. Larger economies typically offer more opportunities for profit and provide the infrastructure, labor, and consumer markets that multinational firms seek.

A study by Kinoshita and Campos (2003) on FDI in transition economies, including former Soviet states, found that GDP growth is a significant determinant of FDI, as it signals a larger, growing market with increased consumer demand. Similarly, Kaufmann (2005) found that strong GDP growth attracts FDI inflows, particularly in Central and Eastern European countries transitioning to market economies. Lipsey (2001), in a comprehensive survey of FDI trends across multiple countries, concluded that GDP growth correlates positively with FDI inflows in both developed and developing economies, as it reflects a booming economy where returns on investment are likely to be high.

In Uzbekistan, studies by Kuchkarov (2017) and Jumanioyozov (2020) suggest that GDP growth has a positive influence on FDI inflows. These studies found that economic growth, coupled with market reforms, has been crucial in attracting foreign investment, especially in sectors like mining, energy, and infrastructure. Tashkent State University (2020) conducted a study specifically focused on Uzbekistan, showing that stable



inflation, moderate interest rates, and strong GDP growth were key determinants for foreign investors in sectors such as manufacturing, agriculture, and energy. Rakhimov (2021) analyzed how the macroeconomic environment, including interest rates and inflation, affected FDI flows into Uzbekistan, concluding that stable inflation and lower interest rates were critical for attracting FDI. The study also highlighted the importance of economic diversification, which is linked to GDP growth, as a key factor in attracting foreign investment.

RESEARCH METHODOLOGY

The method of this study is to disentangle and capture the impact of inflation, interest rate and GDP on FDI through ordinary least squares (OLS). The data obtained from the World Bank Database is used for doing the analysis from 1992 to 2023. The independent variables of the model are inflation, interest rate and GDP. The dependent variable is FDI. To take account of the economic significance of the model, the natural logarithm of the variable data is considered.

The model used is going to verify whether inflation, interest rate and GDP have an impact on FDI and also estimate and measure the scale of the impact. According to the theoretical basis, the functional forms of the models related to inflation and FDI, GDP and FDI as well as interest rate and FDI used in this study are specified as follows. The regression model of the impact of inflation, interest rate and GDP on FDI in Uzbekistan:

$$\ln(FDI)_{ij} = \beta_0 + \beta_1 \ln(InterestRate)_{ij} + \beta_2 \ln(Inflation)_{ij} + \beta_3 \ln(GDP)_{ij} + e_{ij}$$

In the formula, i represents a certain country and j represents a certain year of observation. For the double logarithmic model, the economic significance of the variable coefficients is very clear. α is intercept term. β represents the elasticity coefficients of inflation, interest rate and GDP relative to FDI. And e is random disturbance term.

ANALYSIS AND RESULTS

Ordinary least squares (OLS) method of regression was used to evaluate the slope of the coefficients of the autoregressive model. The use of OLS relies on the stochastic process being stationary. In the case where the stochastic process is not stationary, the use of OLS can result in invalid estimates. These estimates are called 'spurious regression' results thus high adjusted values and high t-ratios yielding results with no economic meaning. Gretl is used for estimation, and the statistical significance level of 5% is uniformly set in the model. A total of 33 observations are included from 1992 to 2023 and the model above is estimated to capture the impact of inflation, interest rate and GDP on FDI of Uzbekistan.

Estimation of the Model:

The estimation of the model being inflation, interest rate and GDP on FDI is expressed in the functional form below as:

Model:

Dependent variable: $\ln(FDI)_{ij} \rightarrow$ Log of FDI for country i in year j

Independent variables: $\ln(Inflation)_{ij}$, $\ln(InterestRate)_{ij}$ and $\ln(GDP)_{ij} \rightarrow$ Log of Inflation, Interest rate and GDP for country i in year j

Intercept (α_0) $\rightarrow$ Represents the baseline level of FDI when Inflation, Interest rate and GDP is at 1 (in log scale)

Coefficient (β_1) $\rightarrow$ Measures the elasticity of FDI with respect to interest rate (i.e., the % change in FDI for a 1% change in interest rate)

Coefficient (β_2) $\rightarrow$ Measures the elasticity of FDI with respect to inflation (i.e., the % change in FDI for a 1% change in inflation)

Coefficient (β_3) $\rightarrow$ Measures the elasticity of FDI with respect to GDP (i.e., the % change in FDI for a 1% GDP)

Error term (e) $\rightarrow$ Captures unobserved factors that influence FDI.



Table 1. OLS Estimation of inflation, interest rate and GDP on FDI in Uzbekistan from 1992 to 2023

OLS, using observations 1-33

Dependent variable: LnFDI

	Coefficient	Std. Error	t-ratio	p-value	
LnInterestrate	0.217937	0.125302	1.739	0.0922	*
LnInflation	-0.352460	0.0740135	-4.762	<0.0001	***
LnGDP	0.0296374	0.0245450	1.207	0.2367	
Mean dependent var	0.236061		S.D. dependent var	0.810135	
Sum squared resid	8.315970		S.E. of regression	0.526497	
Uncentered R-squared	0.635921		Centered R-squared	0.604043	
F(3, 30)	17.46655		P-value(F)	9.51e-07	
Log-likelihood	-24.08253		Akaike criterion	54.16506	
Schwarz criterion	58.65458		Hannan-Quinn	55.67565	

Interpretation of the outcome

Variable	Coefficient	Std. Error	t-ratio	p-value	Interpretation
LnInterestRate	0.218	0.125	1.739	0.0922	A 1% increase in interest rates is associated with a 0.22% increase in FDI , significant at the 10% level .
LnInflation	-0.352	0.074	-4.762	<0.0001	A 1% increase in inflation is associated with a 0.35% decrease in FDI , highly statistically significant (p < 0.001).
LnGDP	0.030	0.025	1.207	0.2367	A 1% increase in GDP is associated with a 0.03% increase in FDI , but not statistically significant (p = 0.2367).
R-squared	0.604	-	-	-	This means that 60.4% of the variation in FDI is explained by the model. It's a good fit, but not perfect — leaving some room for other factors that are not included in the model.

If GDP is highly correlated with other independent variables in the model (inflation or interest rates), it might “lose” its individual statistical significance. This is a common econometric issue—the effect is still there but not clearly distinguishable. Thus, Variance Inflation Factors (VIFs) and the Belsley-Kuh-Welsch (BKW) collinearity diagnostics are carried out to verify multicollinearity problem (table 2, 3).

Table 2. Variance Inflation Factors (VIFs) and Belsley-Kuh-Welsch (BKW) collinearity diagnostics.

Variance Inflation Factors

Minimum possible value = 1.0

Values > 10.0 may indicate a collinearity problem

LnInterestrate 1.791

LnInflation 1.724

LnGDP 2.184

VIF(j) = $1/(1 - R(j)^2)$, where R(j) is the multiple correlation coefficient between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:



lambda	cond	LnIntere ~	LnInflat ~	LnGDP
2.826	1.000	0.005	0.013	0.003
0.159	4.217	0.105	0.434	0.004
0.015	13.657	0.890	0.553	0.994

lambda = eigenvalues of inverse covariance matrix (smallest is 0.0151508)

cond = condition index

note: variance proportions columns sum to 1.0

According to BKW, cond ≥ 30 indicates «strong» near linear dependence, and cond between 10 and 30 «moderately strong». Parameter estimates whose variance is mostly associated with problematic cond values may themselves be considered problematic.

Count of condition indices ≥ 30 : 0

Count of condition indices ≥ 10 : 1

Variance proportions ≥ 0.5 associated with cond ≥ 10 :

LnIntere~	LnInflat~	LnGDP
0.890	0.553	0.994

Table 3. Variance Inflation Factors (VIFs).

Variable	VIF	Interpretation
LnInterestRate	1.791	Low collinearity
LnInflation	1.724	Low collinearity
LnGDP	2.184	Low/moderate collinearity

VIF Interpretation:

VIF values < 10 generally suggest **no major collinearity issue**. Here, all VIF values are below 3, which indicates **low collinearity** among the independent variables (table 4).

Table 4. Belsley-Kuh-Welsch (BKW) Collinearity Diagnostics.

Lambda	Condition Index (cond)	LnInterestRate	LnInflation	LnGDP
2.826	1.000	0.013	0.003	0.003
0.159	4.217	0.434	0.004	0.004
0.015	13.657	0.890	0.553	0.994

Condition Index (cond): Highest condition index = 13.657, which falls between 10 and 30, indicating moderate collinearity.

- According to the BKW diagnostic rules, if cond > 10 and < 30 , it suggests moderate collinearity.

- The very high condition index here signals that there is some linear dependence among the predictors, but not extremely problematic. If this value were ≥ 30 , it would suggest a more severe multicollinearity problem.

Variance Proportions:

- For the highest condition index (13.657), the variance proportions are:

- LnInterestRate: 0.890

- LnInflation: 0.553

- LnGDP: 0.994

This tells us how much of the variance in the regression coefficients is associated with multicollinearity due to the condition index. Specifically:

- LnGDP has an extremely high proportion of variance (0.994) linked to the condition index of 13.657, indicating that LnGDP is highly correlated with the other predictors, especially with LnInflation.

- LnInterestRate also has a high proportion (0.890), but it is less extreme.



• LnInflation has a moderate correlation with the condition index (0.553), indicating that it is moderately related to other variables in the model.

Conclusion from VIFs: The maximum VIF value of 2.184 is acceptable, meaning there is no immediate concern. There is no significant multicollinearity based on the VIFs in the model. All the values are well below 10, which means each predictor (InterestRate, Inflation, and GDP) is reasonably independent from the others.

CONCLUSION AND SUGGESTIONS

The findings of this study reveal that inflation has a significant and negative impact on foreign direct investment (FDI) inflows in Uzbekistan, indicating that rising inflation undermines macroeconomic stability and discourages foreign investors. Interest rates show a positive but only marginally significant relationship with FDI, suggesting that a stable and predictable monetary policy plays a supportive yet limited role in attracting investment. Gross Domestic Product (GDP), meanwhile, does not exhibit a statistically meaningful effect, implying that while economic growth is important, it may not serve as a standalone determinant for investment inflows. Although multicollinearity diagnostics indicate some level of linear dependency involving GDP, it is not severe enough to compromise the model's validity.

To foster greater FDI inflows, it is essential to maintain low and stable inflation through effective institutional reforms and consistent monetary discipline. Enhancing the transparency of the Central Bank's policy actions and ensuring predictability in financial markets can build investor confidence. Interest rate stability over the medium term can also create a favorable investment environment. Furthermore, streamlining regulatory procedures, ensuring legal protection for investors, and reinforcing macro-financial stability are critical for establishing a trustworthy and competitive investment climate. Sustained economic growth, underpinned by long-term strategic planning and aligned with macroeconomic stability, will play a decisive role in ensuring the continuous attraction of foreign direct investment.

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IQTISODIYOT & TARAQQIYOT

Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal

Ingliz tili muharriri: Feruz Hakimov

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Sahifalovchi va dizayner: Oloviddin Sobir o'g'li

2025. № 4

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Litsenziya raqami: №046523. PNFL: 30407832680027

Manzilimiz: Toshkent shahar, Mirzo Ulug'bek tumani
Kumushkon ko'chasi, 26-uy.



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