From plan to market price: inflation drivers in New Uzbekistan

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ABSTRACT: This study analyzes the drivers of inflation in new phase of economic development after 2017 liberalization. Applying the Autoregressive Distributed Lag (ARDL) approach, the research examines the relationships among monetary, non-monetary and external factors of inflation between October 2017 and May 2025. The findings revealed that money and producer price index (PPI) had significant impact on inflation in the long run. Short-run results showed strong inflation inertia and PPI had a statistical significant effect on CPI in the short run. The study also identified unidirectional causality from broad money to consumer price index (CPI) and from PPI to CPI with Toda and Yamamoto causality test. These insights are crucial for policymakers aiming to address inflationary pressures and promote long-term economic stability in Uzbekistan. Central Bank of Uzbekistan (CBU) should maintain monetary tightening to control monetary drivers of inflation during the liberalization. Limiting role of state and eliminating trade tariffs foster greater competition, thereby helping to control cost-push inflation.
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Introduction

Uzbekistan's economy has undergone significant changes since the liberalization in 2017. New reforms include the liberalization of the foreign exchange market, which led to the equalization of the official and black-market exchange rates. Uzbekistan announced transition to inflation targeting regime in 2020, shifting focus from exchange rate control to price stability. The introduction of a new regime and associated reforms aims to stabilize the Uzbek economy and reduce inflation in the long term (Al Rasasi & Cabezon, 2022). This transition aims to ensure stable prices and exchange rates (Ismailov, 2023). Initially, the Central Bank of Uzbekistan

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(CBU) targeted 5% inflation by 2023, but due to various disturbances, this target was postponed to the second half of 2025. As of June 2025, yearly inflation rate was 8.7 %, still above the CBU's target. Thus, studying drivers of inflation remains a crucial topic not only for policymakers but also the existing literature.

Inflation refers to rising overall prices of goods and services. The term negative tax is used because it decreases purchasing power, hence lowering the ability to buy goods and services (Karki & Risal, 2020). Stable inflation is essential due to the substantial economic costs associated with high, excessively low, or volatile inflation. High inflation erodes the purchasing power of households, particularly affecting those on fixed incomes, and consequently reduces their standard of living. For businesses, high inflation introduces significant challenges, including supply chain disruptions and increased uncertainty, which can hinder decision-making and long-term planning. Thus, stable inflation is critical for fostering economic well-being and reducing financial vulnerabilities for both households and businesses.

Considerable literature studied drivers of inflation. Nevertheless, the results vary, both among different countries and within individual countries across various time periods. Inflation factors are notably distinct in rich countries compared to transition and emerging economies. Supply-side factors of inflation became major concern in industrial economies especially after COVID-19 shock and Russia and Ukraine conflict. Empirical study by Diaz et al. (2024) revealed that global supply chain disruptions and commodity prices shocks became dominant factors of inflation in Germany, Japan and USA. Moreover, a recent study using principal component analysis identified that supply-side disruptions are dominant source of CPI and gross domestic product (GDP) deflator inflation (Abu Asab, 2025). In turn, supply disruptions play a predominant role in shaping inflation in emerging market economies (EMEs). Alam and Alam (2016), using the Bounds test approach, found that short-term inflation is influenced by supply-side disruptions in production and distribution in India. Similarly, supply-side disruptions are more relevant to transitional economies due to high import dependence on intermediate and capital goods. Supply-side factors appear to be the primary drivers of headline inflation in Kazakhstan, with significant contributions from exchange rate pass-through effects on imported goods (Ybrayev et al., 2024). Central Bank of Uzbekistan (CBU) has highlighted persistent supply chain disruptions as key factors contributing to high inflation in recent years (CBU, 2024).

In addition to supply-side drivers, research studies identified demand-side forces operating through various macroeconomic channels. Corbo and Di Casola (2022) found that global demand shock is main determinant of consumer price inflation in Swedon and Canada. While traditional demand-side factors are influential, their impact is relatively limited in emerging economies (Mohanty & Klau, 2001). Baranov and Somova (2015) found that monetary factors, particularly money supply, were statistically significant in influencing inflation. Theoretically, expansionary fiscal policy rises aggregate demand, making pressure on prices. Lim and Papi (1997) demonstrated that in Turkey, the government budget deficit was the primary driver of inflation. Complementing these findings, Catao and Terrones (2005) established

that fiscal deficits exert significant inflationary effects in most nations, particularly in developing economies. Similarly, large government deficit financed through monetary expansion was a primary cause of inflation in Uzbekistan (Akimov 2001). The study stresses CBU independence as essential for price stability.

Our study aims to identify primary drivers of inflation in Uzbekistan, an emerging post-Soviet economy undergoing structural transformations. Despite considerable growth potential, Uzbekistan continues to face significant challenges, including market inefficiencies, the dominant role of the state in key sectors, and exposure to external shocks. The primary objective is to assess the impact of demand (monetary policy and fiscal policy), supply, and external factors of inflation during Uzbekistan's recent phase of structural transformation. In particular, the analysis focuses on the effects of interest rates, money growth, exchange rates, producer prices, import growth, and global commodity prices on inflation dynamics. The empirical section employs the Autoregressive Distributed Lag (ARDL) model to capture both short- and long-run relationships among the variables.

The structure of the paper is as follows. Next section outlines structure of Uzbekistan economy and inflation dynamics. The third section includes theoretical framework and literature review. The methodology and data are presented in section four. The fifth section presents the results of the study while the last section concludes.

Economic structure and inflation dynamics in Uzbekistan

The economy of Uzbekistan is not big, countries GDP with 90.9 billion US dollars in 2023. This is around 2.500 USD per capita income (World Bank World Development Indicators 2023). The table 1 shows the sectoral development of Uzbek economy in different time periods. The structure of the economy has not seen drastic change since 2006. While industry's share has increased, added value of agriculture has been declining in GDP share.

Table 1. Percentage breakdown of Uzbekistan GDP by sectors (in %)

	Industry	Agriculture, forestry, and fishing	Construction	Services
2006	22.1	24	5	48
2012	24.0	17.5	5.9	52.6
2018	26.3	32.4	5.7	35.6
2023	26.1	24.3	6.2	43.4

Source: Author's work based on data of Statistical Committee of Uzbekistan

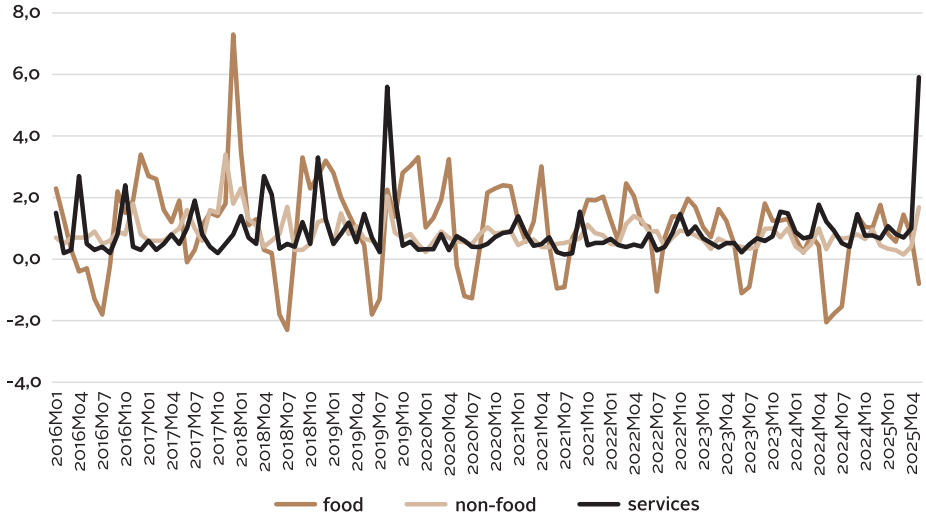
Maintaining stable inflation is difficult in Uzbekistan due to several structural issues. The Uzbek economy is predominantly state-owned, resulting in various issues that contribute to inefficient monetary policy and consequently high inflation.

Following the liberalization measures in 2017, the Uzbekistan government continued to pursue its supportive industrial policies. They involved granting tax incentives, providing energy subsidies, and taking steps to safeguard domestic industries from imports. Despite such incentives, price levels in those industries are strikingly high. Another challenge is the dominance of state ownership over the largest enterprises and banks. As of 2021, state owned banks make up 12 out of 33 commercial banks, holding 80% of all bank assets and credits (Babasyan et al, 2023). It is challenging to influence the behavior of those state enterprises and banks with market-based instruments. Therefore, a strategic privatization approach is necessary. One of the crucial factors impeding inflation dynamics in Uzbekistan is the energy market. The government of Uzbekistan subsidizes the energy sector through the state budget. Recently, this subsidizing policy placed a significant strain on the budget. For instance, allocated subsidies from Uzbekistan's state budget increased fivefold in just two years, rising from 5.63 trillion sums to 29.25 trillion sums (equivalent to 2.5 billion dollars). Of this amount, 18 trillion sums were used to cover the difference between the cost of purchasing and selling gas, while 1.02 trillion sums were spent on geological exploration[3]. Recently, government of Uzbekistan announced a new decree regarding to move market mechanisms for determining energy pricing by cancelling subsidizing from government budget step by step. A social norm was set up for households and businesses, such as 200 kWh of electricity for households. Consumers receive subsidies up to this limit, with any usage beyond it being charged at the market rate for energy. This is highlighted as a key factor for future high growth according to International Monetary Fund (IMF) forecasts (IMF 2024). Overall, the factors mentioned above hinder efficient monetary and fiscal policy that are the main instrument to control price level.

Statistical Committee of Uzbekistan as a responsible institution measure CPI as a proxy variable for price level. CPI of Uzbekistan includes 510 food products, non-food products and service. The following figure shows monthly CPI between 2016-2025.

3 The data was collected from telegram channel of Ministry of Economy and Finance of Uzbekistan. https://t.me/minecofinuz/9021

Figure 1. CPI components (compared to previous month)



Source: Author's construction based on Statistics committee data

Figure 1 illustrates CPI measured on a monthly basis, reflecting changes in prices relative to the previous month. The data highlights a clear seasonal pattern across CPI components. At the beginning of the year, all components typically exhibit an upward trend. This increase is primarily driven by rising prices of vegetables and other daily agricultural products during the winter months, when supply is limited. Conversely, in the summer period, the CPI tends to decline due to the harvest season, which significantly increases the supply of agricultural products and vegetables, thereby exerting downward pressure on inflation. Additionally, the fluctuations observed in non-food and service components can be attributed to price liberalization in the energy sector, which impacts these categories. It is challenging to draw definitive conclusions from this graph, as it reflects changes relative to the previous month rather than absolute trends. It is important to note that service component was 5.91% on May 2025 and it is largely associated with the increase in tariffs in the utilities sector.

Figure 2. Year-on-Year Growth in CPI Components

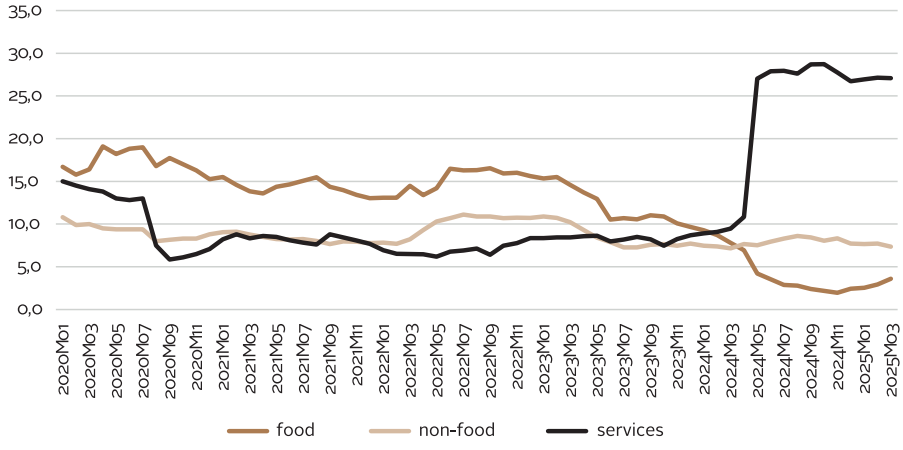


Figure 2 presents annual changes in CPI components compared to the same period of the previous year. This is more informative than figure one since it removes seasonal effects and captures structural inflation trends. For example, service component had a drastic upward trend on May 2024. In May 2024, revised tiered tariffs for household electricity and gas consumption were introduced. These tariffs were structured based on the share of each consumer category and aligned with international practices. In accordance with the same regulatory framework, the price of compressed natural gas was increased to 1,600 Uzbek sum (UZS) per kilogram starting from May 2024.

CBU conducts regular surveys to assess inflation expectations and perceived inflation among households and firms. CBU survey, conducted in December 2024, revealed that household inflation expectations were largely driven by anticipated increases in energy prices (57%), utility bills (56%), and currency depreciation (55%). In December 2024, overall perceived inflation rose to 14.7%, marking the highest level since February 2023 and reflecting a 0.6% increase compared to November. The impact of inflation was particularly pronounced in Tashkent, where residents reported a perceived inflation rate of 18.3%[4]. The sustained rise in energy prices throughout 2024 had a cascading effect on the broader economy, contributing to significant increases in the prices of various goods and services. The December survey further highlighted socioeconomic disparities in the perception of inflation, with lower-income households bearing a disproportionately higher burden.

4 https://cbu.uz/upload/iblock/697/e6hontixgoz9832hrgz04rlozo675f74/Inflyatsion-kutilmalar-Dekabr-2024-yil.pdf

Empirical literature

Empirical literature was selected based on objective of the study and geographical focus. Research on inflation dynamics is markedly limited in Uzbekistan, so we incorporated studies on post-communist or similar transition economies. Since post-communist economies are small open economies, high dollarization and strict exchange rate regulation. Exchange rate shock creates substantial pressure on prices. For example, Lissovolik (2003) examined the dynamics of inflation in Ukraine by employing a markup model and a money market model. The study concluded that wages and exchange rates are significant long-term determinants of inflation, whereas monetary factors play a more immediate, short-term role. Similarly, Siliverstovs and Bilan (2005) confirmed that inflation in Ukraine is primarily driven by devaluation expectations among economic agents. Focusing on Central Asian economies, Isakova (2007) analyzed inflation dynamics in Kyrgyzstan through cointegration analysis and error correction models. The study revealed that internal factors such as inflation inertia, exchange rate fluctuations had a significant influence on current inflation. Ybrayev et al. (2024) studied inflation factors by comparing supply and demand drivers in Kazakhstan. Inflation is largely driven by supply-side forces in Kazakhstan, notably the exchange rate pass-through to prices of goods with substantial import content. According to Junior (2007), the impact of exchange rates on inflation has weakened, especially in developing countries, due to the adoption of inflation targeting. However, empirical findings of Nasir and Vo (2020) indicated that the implementation of the IT framework has led to a stronger transmission of exchange rate fluctuations to inflation.

Another influential driver of inflation is monetary expansion. In many post-communist countries, central banks lack full de facto independence, increasing the risk of monetary expansion unlinked to output, which in turn exerts upward pressure on prices. This argument is supported by empirical studies that document a positive association between monetary expansion and inflationary pressures in post-communist economies. For example, inflation in Russia is primarily a monetary phenomenon (Koen & Marrese, 1995; Hoggarth, 1996; Korhonen, 1998). A study by Nikolic (2000) investigated the relationship between monetary aggregates (M0, monetary base, M2, and broad money) and inflation and identified the growth rate of broad money as a key determinant of inflation in Russia. Budina et al. (2006) suggested that inflation was primarily driven by monetary expansion. Majidov (1999) investigated the relationship between central bank independence and inflation in post-Soviet countries, uncovering a strong positive correlation between the two. Despite the extensive body of research on inflation dynamics in various post-Soviet economies, there is a notable lack of empirical studies focused specifically on Uzbekistan. This gap in the literature highlights the need for further assessment of driving factors of inflation in Uzbekistan. This study aims to fill the gap.

Exchange rate, money growth and inflation relationship are also widely studied in developing and emerging economies. Loungani and Swagel (2001) investigated the impact of exchange rate regimes on inflation in developing countries. The study

findings indicated that in nations with floating exchange rate systems, inflation is more significantly affected by changes in money supply and exchange rates compared to countries operating under fixed exchange rate regimes. Similarly, Deka and Dube (2021) explored the causal relationship between exchange rates and inflation in Mexico, revealing the existence of bidirectional causality over time. Their findings indicate that exchange rate depreciation directly contributes to inflationary pressures. Osorio and Unsal (2013) analyzed inflation dynamics in Asia and observed that the influence of monetary and supply shocks on inflation had diminished over time. Instead, they emphasized that during the 2000s, inflation was predominantly driven by domestic demand. Similarly, Bui and Kiss (2021), using a VAR model, found that money supply remains a significant determinant of inflation in emerging economies. In low-income African economies, monetary factors also appear to play a central role in driving inflation. For instance, Moriyama (2008) studied inflation dynamics in Sudan and found that fluctuations in the growth of money supply and nominal exchange rates were key determinants of inflation, with a time lag of 18 to 24 months. Furthermore, Kuma and Gata (2023) analyzed food price inflation in Ethiopia using the ARDL model. Their results confirmed that monetary factors, including interest rates and money supply, were the primary drivers of inflation and exhibited a positive and statistically significant relationship with food price changes. Valogo et al. (2023) investigates the threshold impact of exchange rate pass-through on inflation in Ghana. The outcomes of the threshold model indicated that when the currency rate depreciates by more than 0.70% (threshold level) per month, it has a significant positive impact on inflation. These studies collectively underscore the significant role of monetary factors in shaping inflation across developing and low-income economies, while also highlighting the importance of domestic demand and exchange rate dynamics in specific contexts.

Methodology and data

Theoretical model

This study aims to determine factors that influence inflation dynamics in Uzbekistan. To explore inflationary factors from a broader perspective, monetary, non-monetary and external factors were taken into consideration. The following theoretical equation is constructed.

$$\pi_t = \beta_0 + \beta_1 m_t + + \beta_2 reer_t + \beta_3 ppi_t + \beta_4 imp_t + \beta_5 wcp_t + \varepsilon_t \quad (1)$$

π_t – consumer price index (proxy inflation).
m_t – broad money supply
$reer_t$ – real effective exchange rate
ppi_t – producer price index
imp_t – import volume
wcp_t – world commodity price index
ε_t – error term

In literature, chosen factors are widely used to test inflation dynamics. The variables in equation one is discussed in detail based on current literature. Despite the apparent decline in the predictive capability of money growth for price stability, money aggregate may still have notable impact on inflation dynamics (Amisano & Fagan 2013, Ringwald & Zörner 2023). Equation (1) also includes exchange rate as a key determinant of inflation because of Uzbekistan's high dollarization and import dependence feature. To approximate supply side shocks, the study used producer price index as a proxy variable for marginal costs in domestic economy and world commodity price index as a global supply chain disruption. Import volume is incorporated to capture imported factors of production and goods and services.

Bounds testing approach

Engle and Granger (1987) and Johansen (1988) cointegration tests are not applicable when dealing with series that have different integration orders. However, Pesaran, Shin, and Smith (2001) introduced the bounds testing approach as an alternative method for testing cointegration relationships in cases when the series exhibit different levels of stationarity. In the bounds testing framework, the dependent variable is expected to be integrated of order one and the independent variables can be either integrated of order zero or one; however, it is not allowed to be integrated of order two or higher. This is because the bounds testing approach is specifically designed for cointegration analysis in the presence of mixed-integration time series.

Following Pesaran, Shin, and Smith (2001), ARDL bounds test equation is constructed as follows.

$$\Delta\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2 r_{t-1} + \beta_3 m_{2\,t-1} + \beta_4 reer_{t-1} + \beta_5 ppi_{t-1} + \beta_6 imp_{t-1} + \beta_7 wcp_{t-1} + \sum_{i=1}^{p} \alpha_1 \Delta\pi_{t-i} + \sum_{i=0}^{p} \alpha_2 \Delta r_{t-i} + \sum_{i=0}^{p} \alpha_3 \Delta m_{2\,t-i} + \sum_{i=0}^{p} \alpha_4 \Delta reer + \sum_{i=0}^{p} \alpha_5 \Delta ppi_{t-i} + \sum_{i=0}^{p} \alpha_6 \Delta imp_{t-i} + \sum_{i=0}^{p} \alpha_7 \Delta wcp_{t-i} + dummy + \varepsilon_t \quad (4)$$

Equation (4) includes both short run and long run terms of ARDL model. Dependent variable is difference of CPI, coefficients from to captures long run part of the model, indicating how lagged values of both CPI and other independent variables influence current changes of inflation. The second part, which is summation of lagged differences of both dependent and independent variables represents short-run dynamics of the model. Short-run term has its own coefficients from to and p is the number of lags. Dummy variable is incorporated to reflect exchange rate liberalization on September 2017.

Once cointegration relationship is determined with bounds test, it is essential to employ ARDL approach for short-run and long-run analysis, as both methods operate on similar methodological principles.

The ECM representation of the ARDL model is as follows.

$$\Delta\pi_t = \beta_0 + \sum_{i=1}^{q1} \alpha\, \Delta\pi_{t-i} + \sum_{i=0}^{p1} \delta_1\, \Delta r_{t-i} + \sum_{i=0}^{p2} \delta_2\, \Delta m_{2\,t-i} + \sum_{i=0}^{p3} \delta_3\, \Delta reer_{t-i} + \sum_{i=0}^{p4} \delta_4 \Delta ppi_{t-i} + \sum_{i=0}^{p5} \delta_5\, \Delta imp_{t-i} + \sum_{i=0}^{p6} \delta_6\, \Delta wcp_{t-i} + \gamma ECT_{t-1} + dummy + \varepsilon_t$$

ECT is error correction term that capture speed of adjustment or deviation from long-run relationship with coefficient γ If the coefficient of ECT is negative ($\gamma<0$) and statistically significant, it indicates that short-term deviations among the variables diminish over time, and the series eventually revert to their long-run equilibrium. This confirms that the model's error correction mechanism is functioning effectively, providing further evidence of the reliability of the long-run analysis. A proportion γ% of the deviations is corrected in each period, and all deviations are expected to disappear by the end of 1/ γ periods.

The long-run analysis focuses on the level values of the variables, and the corresponding equation is as follows:

$$\pi_t = \beta_0 + \sum_{i=1}^{q1} \alpha\, \pi_{t-i} + \sum_{i=0}^{p1} \varphi_1\, r_{t-i} + \sum_{i=0}^{p2} \varphi_2\, m_{2\,t-i} + \sum_{i=0}^{p3} \varphi_3\, reer_{t-i} + \sum_{i=0}^{p4} \varphi_4 ppi_{t-i} + \sum_{i=0}^{p5} \varphi_5\, imp_{t-i} + \sum_{i=0}^{p6} \varphi_6\, wcp_{t-i} + \varepsilon_t \qquad (5)$$

$$\varphi_1 = \frac{\sum_0^{p1} \varphi_1}{1-\sum_1^{p1} \alpha} \qquad (6) \qquad\qquad \varphi_2 = \frac{\sum_0^{p2} \varphi_2}{1-\sum_1^{p1} \alpha} \qquad (7)$$

Equation (6) and (7) is mathematical calculation of long-run coefficients. Similar methodology is used to obtain other coefficients of long-run estimates of ARDL model.

Following the current literature Alper et al. (2022) and Sankaran et al. (2019), this study proposes to use Toda and Yamamoto (1995) causality test by considering mixture of stationary and non-stationary variables. The Toda-Yamamoto (1995) causality test serves as a robust framework for analyzing long-term causal relationships, even when time series display heterogeneous integration orders. In contrast to the conventional Granger causality test, which may yield unreliable results with non-stationary series, this method employs the level values of the variables, thus offering deeper insights into causal dynamics. Importantly, the test does not necessitate uniform integration orders among variables or the existence of a co-integration relationship, underscoring its flexibility across diverse data configurations. Furthermore, Toda and Yamamoto established that the test adheres to an asymptotic χ^2 distribution, irrespective of whether the series are stationary, trend-stationary, or cointegrated thereby ensuring its robustness across varied time series properties. To use Toda and Yamamoto (1995), three distinct steps need to be taken. First, vector autoregression

(VAR) model is constructed to determine optimal lag length (p). Second, the VAR model is estimated by incorporating the highest degree of integration of the series (d_{max}) into the lag order (p) resulting in a model with ($p+d_{max}$) lags. Third, Restrictions are applied to the coefficients associated with (d_{max}) and the significance of these restrictions is evaluated using the modified Wald test.

Data collection

To analyze the dynamics of inflation, it is crucially important to consider factors that drive inflation in a transitional economy Uzbekistan. In this regard, equation one includes variables that approximate the demand, supply and international factors of inflation. Monthly data from January 2017 September 2024 were collected from Statistics Agency of Uzbekistan, Central Bank of Uzbekistan, Economy and Financial Ministry, Enhanced General Data Dissemination System of IMF and Bruegel database. October 2017 was chosen as starting date due to liberalization of exchange rate market on September 4, 2017. It was a historical reform that opened a door for structural changes. We aim to conduct empirical study in a smoother and more stable economic environment.

In this study, the CPI is employed as a proxy for the inflation rate. Since the statistical committee of Uzbekistan publishes monthly CPI changes relative to the previous month, we constructed a CPI index using 2016 as the base year (2016 = 100). To account for the monetary determinants of inflation, the study incorporates the broad money supply (M_2). Also, REER was included to capture how the exchange rate shock impact on inflation. Furthermore, as Uzbekistan is a small, open, and import-dependent economy, the total import volume is included to capture the impact of imports on domestic prices. Producer price index serves as a proxy marginal costs or supply side factor while world commodity price index is as proxy variable to capture global supply side disruptions.

The study started checking normality of dataset to assess the distribution and statistical properties of each variable. The descriptive statistics result is presented in Appendix 1. Next, it is essential to verify that the variables need to be integrated into the order of zero or one but not to be two or more. Thus, it is crucially important to check stationarity of variables in ARDL bounds testing approach. Appendix 2 summarizes unit root and stationarity test results. In recent years, Uzbekistan has implemented significant structural reforms, which have impacted key economic variables such as exchange rate and import volume. To account for these changes, the study utilized a breakpoint unit root test to analyze the stationarity of these variables, incorporating the potential effects of structural shifts caused by the reforms.

Results and discussion

As a framework of the study, we checked stationarity of the variables and found mixture of integrated order one and zero of all variables but not more than one. Thus, the next step is to conduct cointegration analysis with the Bounds test

approach. Before starting interpretation of results, we checked stability of ARDL model for serial correlation of residuals, heteroscedasticity and Ramey RESET test. The stability test results are satisfactory and are presented in Appendices 3, 4 and 5 for reference. Table five below summarizes cointegration test results.

Table 2. ARDL Cointegration results

Null hypothesis: No levels relationship **Number of cointegrating variables: 5** **Trend type: Unrest. constant (Case 3)** **Sample size: 92**						
Test Statistic			Value			
F-statistic			5.84477			
t-statistic			-4.475925			
	10%		**5%**		**1%**	
Sample	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F-statistic						
Asymptotic	2.260	3.350	2.620	3.790	3.410	4.680
t-statistic						
Asymptotic	-2.570	-3.860	-2.860	-4.190	-3.430	-4.790

*I(0) and I(1) are respectively the stationary and non-stationary bounds

The bounds test results consist of two main parts. The first part presents the F-statistic and t-statistic values, which are central to the test. Specifically, the F-statistic is 5.84, and t-statistic is -4.47. The second part of the table provides the critical values for the bounds test, which are used for comparison with the test statistics to draw conclusions. The null hypothesis is no cointegration among the variables. To evaluate this hypothesis, the calculated test statistics are compared to the critical values. As shown in the table, the upper critical value for the F-statistic is 3.79 at the 5% significance level, which is lower than the calculated F-statistic of 5.84. Therefore, the null hypothesis is rejected, indicating the presence of cointegration among the variables. Similarly, the t-statistic results provide additional evidence. The critical t-statistic value is compared with the absolute value of the calculated t-statistic. In this case, the absolute value of the calculated t-statistic is 4.47, which exceeds absolute value of critical value of 4.19. Thus, the null hypothesis is also rejected based on the t-statistic, further confirming the existence of cointegration among the variables. This result confirms the theoretical framework of Pesaran, Shin, and Smith (2001) that is used to check cointegration between variables in the case of level stationery and non-stationary variables. Since there are long run relationships between variables, the next step is to run short and long run estimation of regression with ARDL.

Table 3. Cointegrating coefficients

Variables	Coefficients	Std. Errors	t-Statistics	Probability values
M(-1)	0.001818	0.000232	7.835031	0
IMP(-1)	0.000817	0.000338	-2.416565	0.0178
REER	-0.002534	0.001131	-2.240172	0.0276
WCP(-1)	0.000471	0.000146	3.236396	0.0017
PPI (-1)	0.005303	0.000434	12.20849	0.000

Note: *Coefficients derived from the CEC regression.

In table 3, the cointegration analysis, conducted under an unrestricted constant specification (Case 3), identifies persistent long-term interactions among these variables. The first determinant of inflation is broad monetary aggregate, revealing that one percent rise of broad money in previous month rises in inflation by 0.2 percent in the long run, as indicated by its positive coefficient and statistically significant probability value. This is consistent with theoretical expectation that money growth has a long-term positive effect on prices. The study by Friedman and Schwartz (1963) found strong empirical evidence that money growth and prices are highly correlated, especially over long-term horizon. This gave rise to the monetarist maxim that inflation is always and everywhere a monetary phenomenon. Next, imports had a negligible impact on inflation in the long-term with 0.0008 coefficient and it is significant. Consistent with recent empirical findings of Yılmaz and Bulut (2025) who found transmission of imports to inflation in Turkey. Moreover, a one percent increase in REER (appreciation) is associated with a 0.2 percent fall in inflation. This aligns with current theories, as currency appreciation typically reduces inflation by making imports cheaper and reducing imported inflationary pressures, and it is statistically significant at 5 percent level. Current literature found similar results with both linear and non-linear models (Kayamo, 2021; Aisen et al.,2021).

Although Uzbekistan was previously a gas exporter, since around 2020 it transitioned into a net importer. The energy sector is highly reliant on imported machinery and intermediate inputs (e.g., 61 percent of basic chemicals, 72 percent of compressors) (UNDP, 2023). Importantly, Uzbekistan has opened borders to the world in new era, and the economy has been tight connections with global economy. Thus, world commodity prices are expected to have impact on domestic prices. Our empirical model showed that world commodity prices had a small effect on inflation. Specifically, one percentage increase of world commodity prices in previous month led to rise inflation by 0.04 percent in the long run. The last regressor is producer price index, representing symmetric impact on prices. One percentage change in the price of producers in previous month increases in inflation by 0.5 percent. The magnitude is bigger than other predictors and it is statistically significant. Overall, these findings highlight the importance of chosen variables in explaining long-run inflationary trends.

Table 4: Short-Run Results of the ARDL Error Correction Model

Dependent Variable: D(CPI) **Method: ARDL** **Sample: 2017M10 2025M05** **Included observations: 92** **Dependent lags: 3** **Automatic-lag linear regressors (3 max. lags): M IMP REER WCP PPI** **Deterministics: Unrestricted constant and no trend (Case 3)** **Model selection method: Akaike info criterion (AIC)** **Number of models evaluated: 3072** **Selected model: ARDL(3,2,1,0,1,3)**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.148973	0.024368	-6.113577	0
D(CPI(-1))	0.401394	0.085974	4.668766	0.0000
D(CPI(-2))	-0.279606	0.081236	-3.441908	0.0009
D(M)	-0.000196	0.000113	-1.741128	0.0855
D(M(-1))	-0.000465	0.000118	-3.958099	0.0002
D(IMP)	8.55E-05	9.93E-05	0.860883	0.3918
D(WCP)	-6.82E-05	7.17E-05	-0.951841	0.3440
D(PPI)	0.001845	0.000338	5.453866	0.000
D(PPI(-1))	-0.001224	0.000385	-3.178507	0.0021
D(PPI(-2))	0.000780	0.000354	2.200340	0.0306
C	0.246166	0.039748	6.193115	0.0000
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood F-statistic Prob(F-statistic)	0.687322 0.648720 0.003311 0.000888 400.6829 17.80526 0.0000	Mean dependent var S.D. dependent var Akaike info criterion Schwarz criterion Hannan-Quinn criter. Durbin-Watson stat	0.006083 0.005586 -8.471367 -8.169849 -8.349671 2.104607	

*p-values are incompatible with t-Bounds distribution.

The short-run dynamics of the ARDL model in table 4 presented several statistically significant determinants of monthly CPI inflation in Uzbekistan for the period 2017M10–2025M05. The error correction term (COINTEQ*) has a significant negative coefficient of -0.1489 (p = 0.0000), indicating a speed of adjustment of 14.08 percent per period toward the long-run equilibrium. This suggests that deviations from the long-run relationship are corrected relatively slowly in the subsequent

periods, which is consistent with theoretical expectations of partial adjustments in economic models. The coefficient on the first lag of inflation is large (0.4) and highly significant, indicating strong inflation inertia. Broad monetary aggregate had a negative impact on inflation in the short run, potentially due to lagged transmission mechanisms in monetary policy. However, it is not statistically significant. Notably, import volume and world commodity prices did not have a statistically significant effect on inflation in short run. By contrast, producer price index had statistically significant coefficients. For example, a one percent increase in producer prices in the current period leads to a 0.1 percent rise in CPI inflation. Overall, the short-run inflation process is primarily influenced by past CPI dynamics and producer prices, while monetary and external cost factors operate with lags or limited significance. This suggests the importance of domestic production costs and price-setting behavior in shaping near-term inflation outcomes in post-liberalization Uzbekistan.

Table 5: Toda and Yamamoto causality test result

VAR Granger Causality/Block Exogeneity Wald Tests Sample: 2017M10 2025M05 Included observations: 92			
Dependent variable: CPI			
Excluded	Chi-sq	df	Prob
M	21.04107	3	0.0001
IMP	3.812964	3	0.2824
REER	5.968052	3	0.1132
WCP	4.695225	3	0.1955
PPI	8.406173	3	0.0383
All	36.04678	15	0.0017

Table 5 reports causality test results with Toda and Yamamoto approach. Initially, a VAR system was constructed with six variables and found lag two with lag length criteria. Since we have the highest order of integration is one, would be three. Then, all endogenous variables are entered as exogenous with lag number three then VAR Granger Causality/Block Exogeneity Wald Tests was applied. The table only reports one case where CPI is dependent variable, other cases where all variables are dependent variables in turn can be found in software program file. In the case of CPI as a dependent variable, money ($p = 0.0001$) and producer price index ($p = 0.0383$) significantly Granger-cause CPI at the 5% significance level. This indicates that past values of these variables contribute to forecasting CPI. This result confirmed ARDL regression model outcomes with short and long run analysis. However, the remaining variables (REER, IMP, and WCP) do not significantly Granger-cause CPI within the tested model, as their p-values exceed the 5% threshold level. The joint test for all excluded variables results in a χ^2 value of 36.04678 with 15 degrees of

freedom and a p-value of 0.0017. This suggests that the combined lagged effects of all variables significantly influence CPI. When money and producer price index were dependent variables in separate cases, CPI does not Grager cause on both M and PPI which means that there is unidirectional causality relationship between CPI and Money and CPI and Producer price index between 2017 and 2025.

Conclusion

Uzbekistan as a transitional economy has made significant structural changes in recent years. Although recent structural reforms have been gradually implemented in the economy, high inflation and currency depreciation continue to pose significant challenges to both the financial and economic sectors. This study aims to identify the primary factors of inflation using the ARDL bounds testing approach after the liberalization in Uzbekistan. Collecting extended historical data is challenging and limited so this study used monthly data from January 2017 to May 2025. Our empirical study has three parts. Firstly, bounds test was used to check cointegration relationship among variables since chosen variables had mixed integration orders. Next, once cointegration relationship has been identified, short-run and long run ARDL regression analysis applied. Lastly, Toda and Yamamoto causality test employed to test causality among variables.

The study has the following findings. First, real effect exchange rate has been found to be key driver of inflation in the long run. This can be justified with import reliance and high dollarization of the economy. Lagged value of money, import, world commodity prices and producer price index had a statistically significant effect on CPI in the long run. Second, short-run results showed that the error correction term (ECM) had a significant negative coefficient of -0.1489 with a speed of adjustment of 15% per period toward the long-run equilibrium. Lagged CPI has a statistically significant effect on current CPI with coefficient 0.4. Additionally, current value of producer prices and two lags of this variable were found to have significant effects on CPI inflation in the short run. Money and import world commodity prices did not have significant influence on prices as drivers of inflation in short run. Third, unidirectional causality relationships were found among inflation, money and producer price index with Toda Yamamoto causality test.

The policy implications of the study are as follows. As the empirical studies showed that monetary policy variable and producer prices had strong short and long run effects on proxy inflation variable and supported by Toda Yamamoto causality test, CBU should maintain restrictive monetary policy especially tightening proactively during administered price liberalization period. Furthermore, reducing state dominance and trade barriers in the economy improves competition in key sectors and this support controlling cost push inflation as proxied by producer prices in our model. Lastly, structural reforms in the economy, particularly in the energy and external sectors, will be essential for managing inflation.

Our study has several limitations that future researchers may address. First, this study does not include certain variables, such as output and fiscal expenditures,

as these are published on a quarterly basis, whereas our analysis is conducted on a monthly scale. Future research could incorporate these variables using quarterly time series data for a more comprehensive analysis. Second, incorporation of market distorting variables could further strengthen the model's results. ■

References

1. Abu Asab, N., (2025). Are supply shocks a key driver of global inflation? Evidence from CPI and GDP deflator analysis. *Research in Globalization, 10*, 100279.
2. Aisen, A., Manguinhane, E., & Simione, F. F. (2021). *An empirical assessment of the exchange rate pass-through in Mozambique*. International Monetary Fund.
3. Akimov, A. (2001). Reforming the Financial System; The Case of Uzbekistan. *CASE Network Studies and Analyses*, (234).
4. Al Rasasi, M., Cabezon, E. (2022). Uzbekistan's Transition to Inflation Targeting. *IMF Working Papers, 229*, pp. 1-24.
5. Alam, M.Q. and Alam, M.S. (2016). The determinants of inflation in India: The bounds test analysis. *International Journal of Economics and Financial Issues*, *6*(2), pp.544-550.
6. Alper, A. E., Alper, F. O., Ozayturk, G., & Mike, F. (2022). Testing the long-run impact of economic growth, energy consumption, and globalization on ecological footprint: new evidence from Fourier bootstrap ARDL and Fourier bootstrap Toda–Yamamoto test results. *Environmental Science and Pollution Research*, 1-16.
7. Amisano, G. and Fagan, G. (2013). Money growth and inflation: A regime switching approach. *Journal of International Money and Finance*, *33*, pp.118-145.
8. Babasyan, D., Gu, Y., & Melecky, M. (2023). Late banking transitions: Comparing Uzbekistan to earlier reformers. *World Development Perspectives*, *30*, 100493.
9. Baranov, A. O., & Somova, I. A. (2015). Analysis of main factors of inflation dynamics in post-Soviet Russia. *Studies on Russian Economic Development*, *26*, 110-123.
10. Budina, N., Maliszewski, W., De Menil, G., & Turlea, G. (2006). Money, inflation and output in Romania, 1992–2000. *Journal of International Money and Finance*, *25*(2), 330-347.
11. Bui, T. T., & Kiss, D. G. (2021). Measuring monetary policy by money supply and interest rate: evidence from emerging economies. *Review of Economic Perspectives*, *21*(3), 347-367.
12. Catao, L.A. and Terrones, M.E., 2005. Fiscal deficits and inflation. *Journal of Monetary Economics*, *52*(3), pp.529-554.
13. Corbo, V. and Di Casola, P. (2022). Drivers of consumer prices and exchange rates in small open economies. *Journal of International Money and Finance*, *122*, p.102553.
14. Deka, A. and Dube, S. (2021). Analyzing the causal relationship between exchange rate, renewable energy and inflation of Mexico (1990–2019) with ARDL bounds test approach. *Renewable Energy Focus*, *37*, pp.78-83.
15. Diaz, E. M., Cunado, J., & de Gracia, F. P. (2024). Global drivers of inflation: The role of supply chain disruptions and commodity price shocks. *Economic Modelling*, *140*, 106860.

16. Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.
17. Friedman, M., & Schwartz, A. J. (1963). *A monetary history of the United States, 1867–1960*. Princeton University Press.
18. Hoggarth, G. (1996). Monetary policy in Russia. *Russia's Financial Markets and the Banking Sector in Transition', Bank of Finland Studies A*, *95*, pp.53-82.
19. International Monetary Fund. (2024). Republic of Uzbekistan: 2024 Article IV Consultation-Press Release; and Staff Report.
20. Isakova, A. (2007). Modeling and forecasting inflation in developing countries: The case of economies in central Asia. *Center for Economic Research and Graduate Education, Discussion Paper*, (2007-174).
21. Ismailov, A. (2023). Urgent issues of regulation of money supply in the conditions of transition to the inflation targeting regime in Uzbekistan. *Economics & Education, 24(2)*, pp. 53-57.
22. Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, *12*(2-3), 231-254.
23. Karki, D. and Risal, H.G. (2020). Asymmetric impact of oil price on inflation: Evidence from Nepal. *NRB Economic Review*, *31*(1), pp.21-46.
24. Kayamo, S. E. (2021). Asymmetric impact of real exchange rate on inflation in Ethiopia: a non-linear ARDL approach. *Cogent economics & finance*, *9*(1), 1986931.
25. Koen, V, and M Marrese. (1995). Stabilization and Structural Change in Russia, 1992-1994. IMF Working Paper, WP 95/13. International Monetary Fund.
26. Korhonen, I. (1998). An error-correction model for prices. *Money, Output and interest rate in Russia, Bank of Finland, Review of Economies in transition*, *5*, pp.33-44.
27. Kuma, B. and Gata, G. (2023). Factors affecting food price inflation in Ethiopia: An autoregressive distributed lag approach. *Journal of Agriculture and Food Research*, *12*, p.100548.
28. Lim, M.G. and Papi, M.L. (1997). *An econometric analysis of the determinants of inflation in Turkey*. International Monetary Fund.
29. Lissovolik, M.B. (2003). Determinants of inflation in a transition economy: The case of Ukraine. IMF Working Paper, WP 03/126. International Monetary Fund.
30. Loungani, P. and Swagel, P. (2001). Sources of inflation in developing countries. IMF working paper series N-01/198
31. Majidov T. (1999) "Central Banking in Transition Countries", Dissertation in partial fulfilment of Msc in Banking and Finance, Department of Economics, University of Stirling, Stirling.
32. Mohanty, M.S. and Klau, M. (2001). What determines inflation in emerging market economies? *BIS Papers*, *8*, pp.1-38.
33. Moriyama, M. K. (2008). *Investigating inflation dynamics in Sudan*. International Monetary Fund.
34. Nasir, M. A., Huynh, T. L. D., & Vo, X. V. (2020). Exchange rate pass-through & management of inflation expectations in a small open inflation targeting economy. *International Review of Economics & Finance*, *69*, 178-188.

35. Nikolić, M. (2000). Money growth–inflation relationship in post-communist Russia. *Journal of Comparative Economics*, *28*(1), 108-133.
36. Nogueira Junior, R. P. (2007). Inflation targeting and exchange rate pass-through. *Economia Aplicada*, *11*, 189-208.
37. Osorio, C. and Unsal, D.F. (2013). Inflation dynamics in Asia: Causes, changes, and spillovers from China. *Journal of Asian Economics*, *24*, pp.26-40.
38. Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.
39. Ringwald, L. and Zörner, T.O. (2023). The money-inflation nexus revisited. *Journal of Empirical Finance*, *73*, pp.293-333.
40. Sankaran, A., Kumar, S., Arjun, K., & Das, M. (2019). Estimating the causal relationship between electricity consumption and industrial output: ARDL bounds and Toda-Yamamoto approaches for ten late industrialized countries. *Heliyon*, *5*(6).
41. Siliverstovs, B., & Bilan, O. (2005). Modeling inflation dynamics in transition economies: The case of Ukraine. *Eastern European Economics*, *43*(6), 66-81.
42. Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of econometrics*, *66*(1-2), 225-250.
43. Valogo, M.K., Duodu, E., Yusif, H. and Baidoo, S.T. (2023). Effect of exchange rate on inflation in the inflation targeting framework: Is the threshold level relevant? *Research in Globalization*, *6*, p.100119.
44. Ybrayev, Z., Shamar, B., & Mamatova, K. (2024). Domestic inflation decomposition in a small open economy: Evidence from import price dynamics in Kazakhstan. *Central Bank Review*, *24*(4), 100179.
45. Yılmaz, E., & Bulut, N. (2025). *Inflation dynamics: Profits, wages and import prices*. *Economic Systems*.

Appendix 1: Descriptive Statistics and Normality Test Results

	CPI	M	IMP	REER	WCP	PPI
Mean	169,3978	144411,7	14438,35	39,16464	151,0433	212,3978
Median	169,8000	122271,9	12964,81	39,01271	157,5215	213,3000
Maximum	208,6000	292023,6	21034,82	43,54173	241,9187	269,4000
Minimum	120,4000	72736,60	7377,648	32,34435	85,04903	134,4000
Std. Dev.	24,4206	62730,62	4295,271	2,497236	35,87315	36,19470
Skewness	-0,206206	0,698303	0,223138	-0,861891	0,554884	-0,508444
Kurtosis	1,899687	2,312617	1,600483	3,745855	2,838509	2,390390
Jarque-Bera	5,292959	9,288179	8,271600	13,52295	4,821046	5,388464
Probability	0,070900	0,009618	0,015990	0,001158	0,089768	0,067594
Sum	15584,60	13285881	1328328	3603,147	13895,98	19540,60
Sum Sq. Dev.	54269,28	3,58E+11	1,68E+09	567,4933	117106,4	119215,1
Observations	92	92	92	92	92	92

Appendix 2: Unit root and stationarity test results

		ADF test		PP test		Integration result
Variables	Integration level	Intercept	Trend and intercept	Intercept	Trend and intercept	
CPI	Level	0,2740	0,0232	0,1687	0,0678	I(0)
M	Level	1,0000	0,9931	1,0000	0,9988	I(1)
	The first difference	0,0000	0,0000	0,0000	0,000	
WCP	Level	0,1992	0,2443	0,5704	0,8538	I(1)
	The first difference	0,0000	0	0,0000	0	
PPI	Level	0,5109	0,2826	0,1022	0,3017	I(1)
	The first difference	0,000	0	0,000	0,000	
Breakpoint unit root test						
IMP		Break date		Probability value		I(0)
	Level	2020m05		0,018		
REER	Level	2022m06		0,2037		I(1)
	The first difference	2022m06		<0,01		I(0)

Appendix 3: Serial correlation test of residuals

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 3 lags			
F-statistic	0,514893	Prob. F(2,85)	0
Obs*R-squared	1,906379	Prob. Chi-Square(2)	0,5921

Appendix 4: Heteroskedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	0,985150	Prob. F(15,87)	0,4790
Obs*R-squared	14,97630	Prob. Chi-Square(15)	0,4531
Scaled explained SS	21,55268	Prob. Chi-Square(15)	0,1201

Appendix 5: Summary of Ramsey RESET Test

Test	Statistic	p-value	Conclusion
t-statistic	0,421775	0,6744	Fail to reject H_0
F-statistic	0,177894	0,6744	Fail to reject H_0
Likelihood Ratio	0,217959	0,6406	Fail to reject H_0

Appendix 6: CUSUM test result